



Briefing Paper

Property Rights and
Development:

Water Rights and Rural Household Welfare

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Executive summary

This Briefing Paper presents the debate on the impact of formalised water rights on rural household welfare. Drawing on this debate, it identifies key research questions and weighs up the evidence to answer these questions, discussing the nature of the evidence available and highlighting gaps in current evidence that need to be tackled through further research. Specifically, this Briefing Paper considers the evidence for the impact of formalised water rights on food security, food production/ productivity, and household incomes and nutrition as subcomponents of rural household welfare. The paper also considers the interplay between land and water rights, and the implications of large-scale land acquisitions for water rights.

Overall, the evidence on the impact of formalised water rights on rural household welfare is limited, heterogeneous in its focus and of mixed quality.

While the literature discussing water in relation to rights is vast, that portion focussing on water property rights, as opposed to contractual rights established between clients and service providers, or the human right to water, is smaller (Newborne 2004). Very few of the papers identified seek to answer directly the research questions as framed for this review, and most provide anecdotal evidence on the particular household welfare outcomes of concern here. While an attempt has been made to distinguish between theoretical/ conceptual and empirical literature, most papers are inductive and exploratory, evolving theory using case-study evidence, rather than deductively testing a pre-existing theory or hypothesis. Identified papers which employ quantitative methods do so to simulate impacts or assess preferences. No formal impact evaluations of the formalisation of water property rights on the considered components of household welfare were identified in the course of the review.

There are clear theoretical and conceptual arguments for the formalisation of water rights, which allocate shares between different users on the basis of objective and transparent administrative criteria, separate from land-rights regimes and regulated by competent public institutions. But, evidence that reforms have been able to achieve these objectives is thin, at best. Indeed, the available evidence suggests that emphasis should be on ensuring attempts at formalisation do not override, but rather learn from, the positive and durable aspects of customary water rights regimes. Moreover, the evidence indicates that any reforms require substantial accompanying investment in infrastructure and institutional capacity for assigning, monitoring and enforcing water rights.

Reviewing literature on *tradable* formal water rights, little evidence was found from middle-income countries, and none from low-income countries, that tradability in formal water rights enhances household welfare outcomes. Additional assessment of the evidence on the links between land and water rights indicates that, while there are strong theoretical arguments for separating the respective rights regimes, they should not be designed in isolation from each other. A review of the emerging evidence on the implications of large-scale land acquisitions for water rights suggests that such phenomena intensify existing challenges, rather than posing totally new ones – due to the increased volumes of natural and financial resources, and the greater power asymmetries, which may be involved.

The following research needs are particularly identified:

- It is not clear how far the concept of ‘pluralism’ – a multiplicity of coexisting rights regimes; uses; users; bases and strengths of claim; and safeguarding and mediating institutions – is being taken account of in policy and programming decisions. In the face of dynamic and complex contexts, there is a need for simple principles for designing water rights, to provide co-benefits of increased security of water allocations and access for low-income

households, alongside other desirable outcomes such as broad economic development.

- The inadequacies of riparian rights regimes, whereby water rights are vested in land ownership or tenure, do not mean that the links between land and water should be disregarded. This is an area in which rigorous political economy analysis can assist actors to better understand the incentives and constraints conditioning their own actions, and those of other sectors.
- Emerging research has begun to show that the water-related impacts of large-scale land acquisitions are significant. While this area is still new, the next step should be to attempt to characterise the end-impact on livelihoods and welfare, taking account of changes in the distribution of water allocation and access, as well as in the end benefits derived from resource use, both positive and negative.

1 Background and objectives

This Briefing Paper forms part of a wider study commissioned by DfID to contribute to debates on the link between property rights and development in two principal arenas:

- The Golden Thread narrative of the UK government, which emphasises secure property rights as a key element of promoting economic growth and development: “A genuine golden thread would tie together economic, social and political progress in countries the world over... Only then will people escape the fear of seeing their homes bulldozed just because they don't have property rights.” Such rights would be underpinned by mapping and formal cadastre systems “...using satellite photos to map plots of land that will facilitate the creation of property rights” (Cameron 2012).
- DfID country programmes on property rights, which have ranged from support to land administration systems to funding individual and community titling in different countries.

Underpinning this is a broad agreement that secure property rights are necessary for development, expressed in terms of equitable growth, household welfare, and social and political engagement. Implicit in such discussions is the view that private, individual tenure is the most appropriate form for guaranteeing security of property rights. However, others argue for promoting tenure security under different mechanisms rather than private land ownership. This is particularly the case in sub-Saharan Africa where forms of customary tenure emphasise membership of communities as the basis for access to land and therefore prioritise territorial control by collective units over private conceptions of property rights.

In parallel, there is a discussion on how the link between property rights and development is influenced by a range of other factors that may be equally, or more, important than property rights *per se*.

This study aims to look at the state of evidence on the link between secure property rights and development, with an emphasis on recent evidence in African countries, and identify where there are significant gaps that need to be plugged by further research. In line with DfID's definition of a Literature Review, this is designed to be a “review of main literature in the field including all major research studies”.¹

¹ Summary table of evidence products (DfID 2012)

2 Approach and methodology

A team of five researchers carried out the overall literature review, with the support of a research assistant. A senior review team, comprising mainly external academics specialising in the themes covered in this study, provided input into the conceptualisation of the research questions and search strategy, suggested additional literature and reviewed the draft and final reports.

The overall study looks at the role of property rights in promoting development in five areas agreed between DfID and ODI:

- Property rights and economic growth at a macro level
- Land property rights and rural household welfare
- Water rights and rural household welfare
- Property rights and urban household welfare
- Property rights and social, political and economic empowerment

The evidence assessed by the review team is presented for each theme in the form of a Briefing Paper, comprising:

- Discussion of the conceptual framework, context and theory of change;
- Assessment of evidence for each research question; and
- Identification of research gaps.

For each theme, a theory of change was constructed using DfID's theory of change framework (Vogel 2012) to set out the hypothetical causal pathways between property rights and the development outcomes of concern. Research questions were then identified to query the extent and quality of the evidence in support of the main causal linkages assumed in the theory of change. In the case of the review on water rights, household welfare was the overall development outcome of concern, to be measured mainly in terms of food security and/ or household income,

Important points of orientation for the study were DfID's Rapid Review on the "Golden Thread of International Development", (DfID undated b) which explores the evidence on different pathways to the triple objectives of growth, poverty reduction and civil liberties, and DfID's rapid review of the literature on property rights (Selvetti 2012).

2.1 Search strategy

The literature review combined three tracks of literature searches:

1. Bibliographic database search of academic databases and journals, using consistent search strings that were tested beforehand and a set of inclusion criteria, with forward and backward searches on key references. Two main databases were used for the search in the case of water: Scopus and Google Scholar. These were complemented by searches of the Water Alternatives journal website.
2. Snowball technique of contacting experts in the field (see Annex 1) to ask them recommendations for important studies on the research question as well as insights into the key propositions.
3. Hand-searching specific websites for relevant studies using similar search terms as for the bibliographic databases.

The strategy focused on literature on Africa produced from 2000, using literature produced between 1990 and 2000 where recommended by the senior review team or where such references were frequently cited in the more recent literature. In the case of water rights, literature from other (predominantly middle-income) countries outside Africa was included where deemed especially relevant. The extensive literature from high-income countries, notably Australia and the United States, was excluded due to the very different institutional context. The search strategy focused on literature published mainly in peer review journals and principally in the English language, partly because of the way that the databases operate and partly due to the criteria in DfID's draft guidelines for assessing evidence quality.

Table 1 presents an example of the results of the search conducted through Scopus for the five themes covered. To these were added other references picked up in the search process. The review team then screened all references to identify the most relevant material. In the case of the water property rights theme, a total of 105 abstracts from different sources were screened.

Table 1: Studies downloaded from Scopus

Searches	Rural	Growth	Urban	Water	Social and Political Empowerment
Number of variations searched	16	12	5	12	8
Abstracts downloaded	86	50*	19	39	44
Titles forward/backwards searched	9	7	2	4	0
Full titles downloaded from Scopus	47	43	21	40	39

2.2 Derivation of the evidence base

In this section, we discuss the potential impact of the general search strategy and evidence quality assessment criteria in deriving the evidence base that underpins the key finding of the Briefing Papers.

Issues raised by the search strategy

Although the strategy was designed to do a wide-ranging search and include as many relevant studies as possible, the results of the search process highlighted some potential bias towards particular types of studies and evidence, namely:

Literature published in journals. Whilst efforts were made to include other types of papers, including working papers, conference papers and other reports, most of the papers selected and analysed were journal articles or working papers intended for publication. For the water theme some books (including edited volumes and monographs) were reviewed on the basis of expert recommendation. This is due mainly to the greater visibility and accessibility of journal articles through database searches as they generally include full metadata which is picked up by search engines. Such articles are also more likely to be cited and referenced in other studies.

Explicitly empirical and economic-based papers. The explicit focus on 'evidence' in the review process is likely to have led to bias towards papers which emphasise their methodology or use of data. On the whole, papers from the economics discipline were

more likely to include more details on their use of 'data' and 'evidence', although a loose application of search terms (i.e. relaxing use of 'data' or 'evidence' was consciously used in order to include other terms. As a result, perspectives from some disciplines are not fully represented, notably history, politics, cultural studies and sociology.

Impact of the methodology to assess quality of evidence

The exclusion of particular types of evidence by the search strategy is compounded by the criteria for assessing the quality of the evidence that could be considered, provided in DfID's draft Guidelines (*Assessing the Quality of Social Science Research Evidence: Summary*).² This emphasises measurement aspects of evidence, in the principles of validity and reliability, implying a preference for quantitative studies over qualitative studies using inductive methods.

Focus on particular types of evidence

In the context of research on property rights, the implicit preference for quantitative studies runs the risk of excluding a significant body of work relevant to the issue and providing only for a partial review of the evidence. The different standards of emphasis on, and transparency of, research design and methods in different disciplines may also mean that research produced by those disciplines that bring design and methodology to the fore are likely to be given higher quality scores.

An additional concern is that the inclusion of the number of studies as a factor in assessing the strength of the evidence may mean that the numbers can be influenced by concentrated research efforts in particular places run by particular research groups (for example, in the land case, highland Ethiopia by the World Bank/IFPRI). The contextual factors of the location and the wider issues of knowledge building that are associated with particular research efforts (which may have disciplinary or policy biases) are, as a result, downplayed.

Resource implications

The criteria provided in the summary guidelines could be seen as a first hurdle for most peer-reviewed articles to be accepted into a journal without distinguishing further between the quality of different articles. Publication in a peer-reviewed journal would normally be taken as a minimum threshold for quality assurance and has been used as such in this study.

If the peer review process is not seen to be adequate and further verification is deemed necessary, this implies that a much greater volume of resources would be needed as it can take a lot of time to delve deeply into the methodology of individual studies to assess how well they fulfil the different assessment criteria. For example, in the literature looking at the link between secure property rights and economic growth, there are articles published (and used in the literature review) that discuss in great depth a single parameter used in one model compared to another (e.g., the instrumental variable), an exercise that could not be reproduced with the scope of work and budget provided for the literature review. Indeed, a thorough assessment would imply verifying primary data, which is not always available, and again, would be extremely resource intensive for a wide-ranging literature review which uses broad inclusion criteria.

The guidelines appear to privilege experimental design but it can be difficult to work out, for example, whether a study was really quasi-experimental or whether it was intended to be an experimental design but was not done strictly according to criteria for this. There may also be academic disputes about whether conditions in the area of study created a natural experiment or not. Requiring the reviewer to make a judgement on the debates is time-consuming, and the reviewer may not be equipped to do this in the context of a broad literature review. This means that a very brief summary of the state of evidence is risky to apply; even classifying studies according to whether they are

² The review team were provided with draft guidelines by DfID, which are similar but not entirely equal to the recent guidelines published on DfID's webpage.

really experimental or quasi-experimental is challenging — without going back into the primary data, it is not really possible to make a robust assessment.

Issues of aggregation

Not all the principles of quality laid out in the guidelines establish an equal threshold for assessment (e.g., the criterion of acknowledging the existing body of research is much less rigorous and easier to meet than, for example, that of demonstrating measurement validity). This makes it difficult to aggregate all the principles into a single arrow or indicator of strength and quality of evidence.

The challenges of property rights as a research focus

In the case of property rights,³ the different dimensions and interpretations of property rights in the literature and the greater complexity relative to specific interventions, such as cash transfers, have made it difficult to tease out causality from statistical econometric analysis. Forms of property rights influence but do not necessarily determine real or perceived security of property, which may affect investment and innovation through different paths. However, they may equally engender all manner of other linkages within systems, some of which we may not appreciate, and which depend heavily on context (and it can be hard to define what elements of context matter most). Cross-country regression cannot deal fully with this, even if it can produce some indicative results. Qualitative analysis can provide additional understanding of the contexts that create the variegated patterns.

As such, it can be difficult to come to a firm conclusion about the overall strength of the evidence although we do make some comments on this during our analysis of the evidence. In the Briefing Papers, we have strived to make this as transparent as possible, highlighting and discussing the nature of the evidence, and trying to provide an informed sense of the broader pattern.

³ As made clear in the sections dealing more specifically with water rights, 'property rights' to water must be understood somewhat differently to land rights and rights to other fixed assets.

3 Water rights and rural household welfare - theoretical and conceptual issues

3.1 Special characteristics of water and water rights

The patchy nature of the evidence base and its predominantly inductive, exploratory nature in part reflect the particular characteristics of water, which make it harder to establish a system of rights in the first place. Water is 'mobile, fluid and fugitive' (Meinzen-Dick 2000). To be secure, water rights regimes must take account of the variable distribution of water resources in time and space (likely to be exacerbated with climate change), and the fact that impacts of a water resource intervention (use, diversion or pollution) can occur at some distance downstream (Hodgson 2006). This contrasts with property rights to land and other fixed physical assets, where security of the right is framed primarily in terms of protection from expropriation by other actors (Besley and Ghatak 2010). Groundwater resources present particular challenges to designing appropriate rights regimes: like surface water resources groundwater possesses stock and flow characteristics simultaneously (accumulating for a time in aquifers, but interacting with neighbouring rock, other aquifers and surface water) but it is inevitably harder to define, and thus assign shares or rights, to a subterranean resource.

3.2 Typologies of water rights

Formalisation of water rights often involves vesting ownership of the resource in public hands as a first step. Therefore, formal water rights are generally not private property rights and may convey rights of use but not private ownership of the resource. Several authors distinguish three basic models for determining rights to use and otherwise exploit water resources: riparian rights, whereby use of water is permissible for people owning adjacent land; prior appropriation, whereby rights to use water are determined by historic or customary use; and public allocation of water rights on the basis of administrative criteria (Ward 2010; Zheng et al 2012). The latter category, meanwhile, is equivalent to formal water rights, and while this model takes centre stage in the research questions, they necessarily require consideration of, and comparison with, other models.

Box 1: A working definition for formalised water rights

The evidence reviewed implies a need to question binary distinctions such as formal vs. informal/customary. Nonetheless, a working definition is adopted as short-hand, to facilitate discussion: formalised water rights are explicit water rights that specify a certain volume or share of the available water resources, which have the backing of the dominant legal regime, and for which allocation, registration, monitoring and enforcement is entrusted to an official bureaucracy. Formalised water rights are generally 'not intrinsically tied to specific land plots and in an increasing number of jurisdictions they are transferable and thus may be traded on a temporary or permanent basis. Long term, clearly defined and secure, they amount to a form of property right over the use of water' (Hodgson 2006).⁴

⁴ The working definition is adapted from Hodgson 2006. Hodgson uses 'modern water rights'; the term formalised is preferred for this paper, however, in that it does not convey a prejudgement that this form of water right is the end-point of institutional evolution.

3.3 Why formalise water rights?

According to theory, there are various means whereby formalised systems can provide a modicum of certainty and security in the face of hydrological variability (as well as longer-term changes in climate, land-use or patterns of demand). Firstly, rights will often specify a proportional share of available flow, in addition to, or in place of, a fixed volume. Second, rights may be specified as being of fixed, rather than indefinite duration, so reallocation is possible in case of changing future needs.⁵ Other conditions may be attached to water rights, not only to help cope with variability and change, but to incentivise conservation, raise revenue, help manage dispute and generally assist with the proper functioning of the rights systems. Such conditions include a requirement to pay a fee, to make use of the right within a certain time-period, to measure the water abstracted and/ or used and to treat any wastewater prior to discharge (Hodgson 2004).

The logic for formalisation of water rights is especially apparent where competition for water resources increases, and the state views it as necessary to redistribute the public good associated with water with the objective of increasing efficiency and or equity, rather than leaving it to the 'historical accident' of riparian or prior-appropriation rights.

3.4 Concerns over formalising water rights

Is formalisation viable in developing countries?

In practice, water rights formalisation requires a sophisticated architecture – both in institutional and infrastructure terms – if they are to be effective (i.e., to ensure the right confers access; and that distribution matches allocation). Total flow volume and the volume used, over time, by each rights-holder, must be established; a means of recourse in the event of disputes must be provided. The fact that this sophisticated architecture is rarely in place in developing countries gives rise to concerns about the viability of formalised water rights regimes. Such concerns are only partially answered by an empirical literature which tends to focus on middle income countries including Chile, South Africa and India.

This is not to say that customary or riparian systems are necessarily more effective at dealing with variability and downstream impacts. But the logic of formalisation lies partly in the assumed inability of customary or riparian systems to cope with increasing competition for water. Consequently the onus is on proponents of formalisation to demonstrate that formalised rights are more secure in all instances, including in the face of hydrological variability and change.

Taking account of the plurality of rights

Moreover, formalisation is rarely a straightforward process. Debates on water property rights are emotive due to the fact that water's status as public or private good is contested. A challenge for formalising water rights (and for some authors the reason formalisation so often fails) is to adequately comprehend the complexity of water uses, users, bases for claiming rights, relative strength of rights, and enforcing institutions and mechanisms (Meinzen-Dick and Bakker 2001). This complexity is sometimes referred to as 'pluralism', which 'begins from a recognition that multiple legal and normative frameworks coexist' (Meinzen-Dick and Bakker 2001: 131).

The notion of 'bundles of rights' has also been applied to water, implying that rights cannot be expressed simply in terms of ownership, but may convey rights to access, or enter, a physically defined property (e.g. rights for recreational or in-stream water uses of water); rights to withdraw (to obtain a benefit by withdrawing a portion); rights to exclude (to determine who else has access); rights to manage (to regulate patterns of

⁵ There is a trade-off here with ensuring sufficient duration to incentivise investment, as the value of priced or market tradable fixed duration water rights is likely to decrease as time passes.

use and potentially alter the flow and thus distribution of benefits); and rights to alienate (i.e. to sell, bequest or lease portions of the water resource). (Schlager and Ostrom 1992). Accordingly, each individual may have access to different rights within the overall 'bundle of rights' (permitting use and/ or control) at a given time, and any attempt to codify rights needs to take account of the full bundle if it is to be an effective instrument for demand and competition management.⁶ For some authors, formal water rights which function according to narrow administrative criteria, and even the simple labels 'formal' vs. 'informal', risk exacerbating, rather than mitigating, conflict over the resource, because they privilege singular aspects of people's identities (and so draw attention to difference) rather than acknowledging multiplicity and overlap (Benjaminsen and Lund 2002).

The distinction within a 'bundle of rights' between control and use also implies that allocation, the process of assigning rights to different users, needs to be distinguished from distribution, 'the actual delivery of water from the source among users at certain places, in certain amounts, and at certain times' (Zwarteveen 1997). Extending this distinction still further, it may be necessary to separate those water rights that confer an expectation that water will be delivered through fixed infrastructure, such as irrigation canals, from those rights which confer permission to withdraw the resource from a (largely) natural water body. Accordingly, the former kinds of rights are contractual – between the user and the provider of the service, for example the management body of the irrigation scheme (even if there are also underlying rights to a certain share of the resource itself). Frequently, however, this is a distinction not made in the literature, despite the fact that water property and contractual rights may require very different legal forms and give rise to different administration challenges (Hodgson 2006).

Formalised water rights and protection of poor and excluded groups

There are also concerns that even where the required supporting architecture is in place, formalised water rights regimes may not meet the needs of poor and marginalised users, either because they ignore these users and uses, or because they open up avenues for more politically and economically powerful interests to manipulate the regime to their advantage. This can "formally dispossess customary title holders, many of whom are poor, from their prior claims" (Namara et al 2010). It should, however, be acknowledged that informal or customary water rights are not immune to manipulation. For example, where traditional forms of water rights are attached to land rights or ownership, and the distribution of land is skewed in favour of the wealthy, low-income and excluded groups can lose out (Namara et al 2010).

Among the discussion of marginalised social groups, there is a small but forceful body of literature which focuses on the gender dimensions of water rights. Gender inequity persists in many attempts to formalise rights regimes, which might be expected to challenge patriarchal structures which previously exclude women. This has, paradoxically, been attributed to the success in securing recognition of women's role and needs in relation to water in the 'domestic' sphere. In contrast, less critique has been applied to assumptions that water for irrigation and related 'productive' purposes (for which rights are more often required) is a male concern (Zwarteveen 1997; Van Koppen 1998; Zwarteveen and Meinzen-Dick 2001).

3.5 Water rights and land rights

As part of this study, we were asked to look at the relationship between land and water rights, particularly in the context of large-scale land acquisitions in developing countries. Theoretical linkages between land and water rights have already been touched on –

⁶ Vesting most rights of control (notably rights of exclusion and management in the above typology) in the state, or at least in 'public' hands, is often a first step in a process of formalisation – see Hodgson 2006.

most obviously the potential for water rights to be derived on a 'riparian' basis (see for example, Hodgson 2004).

There are, nonetheless, pragmatic arguments for a clear separation between land and water rights. Water rights must be time and place-specific to be effective, in a way that land rights must not; survey and registration techniques differ (e.g. a cadastral approach is of limited utility for assigning water rights); and tradability of land rights is the norm, but remains the exception in the case of water rights.

This does not mean that the implications of land rights and land use can be ignored in the design of water rights. Land use choices, and restricting who can access land, will impact how far water rights can be realised, and vice versa. The prevalence of riparian systems of water rights is difficult to assess (particularly given 'informal' or customary water rights may be established on the basis of land ownership or rights of use) but such systems are likely widespread. Rights to groundwater are particularly likely to be conferred on the land owner – the resource is difficult to characterise, one rights holder's use can impact on another in hidden ways, and in many cases regimes for groundwater management and dispute resolution are comparatively less evolved than those for surface water (Hodgson 2004).

Consequently, despite the theoretical logic for separating land and water rights, the interaction between the two, and how this may affect household welfare outcomes, remains a live question.

3.6 Water rights and large-scale land acquisitions

The literature on large-scale land acquisitions with relevance to water rights, use and access is growing fast although the issue has only gained prominence recently. As such, contributions are predominantly inductive, building rather than testing theory.

Some researchers argue that lack of sufficiently clear and protected water rights among existing users of land and water resources, and reliance on vaguer, customary forms, makes it easier for economically and politically powerful interests to expropriate the resource (Smaller and Mann 2009). However, as the empirical literature reviewed below makes clear, this does not mean that the challenge of making formalised systems work in practice disappears. If anything, it intensifies, as those more economically and powerful external actors are better able to manipulate formal systems to their advantage.

Viewing the broad trends across the continent, various challenges have been proposed for understanding, and mitigating, the water-related impacts of large-scale land acquisitions. Again, these echo the issues discussed above for water rights, generally:

- Quantifying water requirements, at an aggregate level and especially at a more refined spatial and temporal scale (i.e. in specific catchments, accounting for variation in water availability and crop water demand).
- Recognising the complex interplay (and value) of existing land and water use, including customary land management practices such as flood recession planting, which do not fall into a conventional, binary typology of irrigated vs. rainfed agriculture.
- Recognising the multiplicity of existing users who are more or less mobile and differentiated in terms of land rights, wealth and water access (Woodhouse 2012; Woodhouse 2011).

The need to comprehend these multiple elements is reinforced by the likely permanence of agreements once they are signed. The international legal regimes and treaties which

ultimately sanction lease agreements can, according to one argument, give grounds for the investor to claim compensation where terms are broken. This is particularly the case in processes that will tend to underline advantages for large investors over those seeking to protect the rights of small landholders (investment treaties, for example, commonly provide for claims to be heard before international arbitral tribunals, rather than national courts from which there is little or no right of appeal). Where availability changes, this may mean investors' rights must be protected over those of other users and uses (Smaller and Mann 2009).

3.7 Theory of change and research questions

A theory of change for how water rights formalisation might enhance rural household welfare

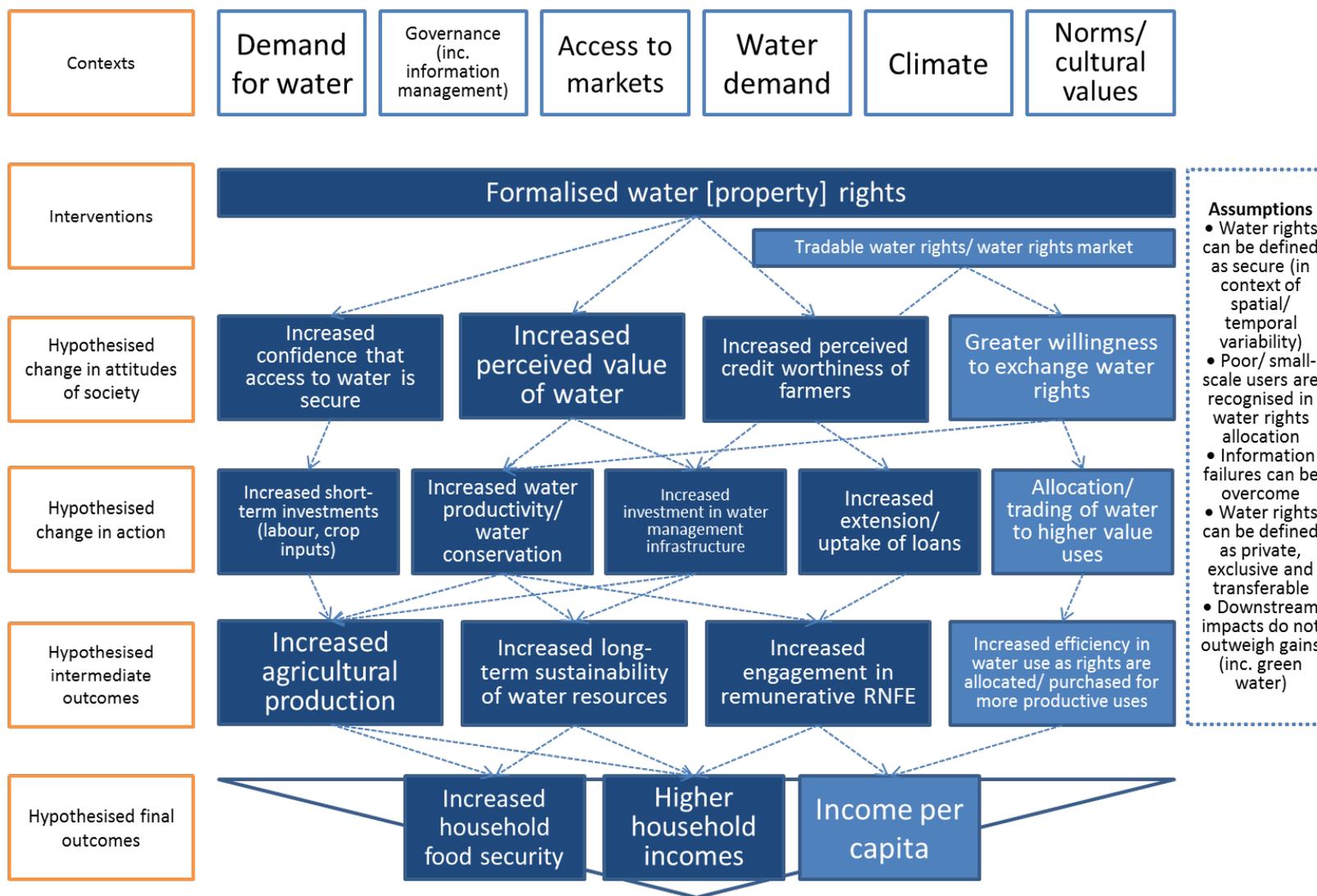
As stated, the literature is primarily inductive and few impact evaluations of water rights formalisation have been carried out. As a result, few papers set out clearly defined hypotheses for the assumed causal pathway between a given water rights regime and different outcomes. A degree of supposition is therefore required to elaborate a theory of change for how formalising water rights might lead to rural household welfare improvements. Drawing on the literature reviewed (theoretical and conceptual as well as primary and empirical), Figure 1 outlines a theory of change for some supposed links between formalised water rights and development outcomes.

The theory of change is constructed in positive terms, but this does not signify any prior assumptions about the findings of this review. As such, the theory of change offers some hypotheses which are then assessed in the course of the literature review.

The theory of change presented in Figure 1 borrows from the theory of change constructed for the review relating to land rights and rural household welfare, but takes account of the substantially different nature of water as a resource. As noted, this literature review is necessarily delimited, and focuses on household welfare as the **final outcome** of most interest. Insofar as quantitative evidence of this outcome might exist, indicators of food security/productivity and household incomes were assumed to be of greatest interest (as per the land rights components of the review). The theory of change also shows the potential links to the **final outcome** of economic growth, focusing on the indicator of income per capita, though this was not a focus of this review.

In the diagram, the causal pathways that are primarily considered in the literature review are indicated on the left-hand side, in darker colour – i.e. those that might operate via the **intermediate outcomes** of increased agricultural production, increased long-term sustainability of water resources and increased engagement in the remunerative rural non-farm economy.

Figure 1: Theory of change for impacts of formalised/tradable water rights



Key: -----> : assumed causal pathways

The other intermediate outcome hypothesised in the diagram, increased efficiency in water use arising from allocation/ purchasing of water rights for more productive uses, is not the main focus of the literature review, but is shown on the right hand side, in lighter colour. Administrative selection may be used to allocate water rights to uses that are perceived as more productive, but the greater part of the literature focuses on systems of tradable water rights. That water rights are tradable is not, however, an inevitable corollary of formalisation. This is reflected in the diagrammatic theory of change, placing 'Tradable water rights' as a second tier **intervention**, beneath 'Formalised water rights'. The literature on tradable water rights tends to focus on the limited locations where the pre-requisite of a formalised water rights system is well established – with Chile as the most prominent example among low and middle-income countries.⁷ However, markets do occur, often on a 'spot' basis, i.e. with ad-hoc trades made between users, in other locations.⁸ Since tradable water rights and water markets are sometimes advocated for on the basis of household welfare (equity and poverty alleviation), rather than economic efficiency (Box 2), the present paper provides a brief (but by no means extensive) review of the empirical literature on water markets from Chile and other middle/ low-income contexts.

Box 2: Theoretical equity and poverty alleviation arguments for tradable water rights

In addition to the supposed economic efficiency benefits of tradable water rights and water markets, arguments have also been made from a poverty alleviation/equity perspective:

- Administrative allocation of water has tended to favour the wealthy
- Under a tradable system, farmers can use secure water rights as collateral
- Transfer of water to higher value uses will incentivise efficiency savings, increasing net water availability, including for the poor
- Judicious government regulation and intervention in the market may generate revenue (water taxes)

The intermediate outcomes are hypothesised to derive from several changes triggered by strengthened (formal) water rights: namely a number of **attitudinal changes**, in turn leading to **changes in action**:

- First, that formalised water rights give farmers confidence that access to water is secure, increasing their willingness to invest other resources (such as labour) with potential productivity gains.
- Second, that formalised water rights can increase the perceived value of water (because each user knows s/he is limited to a certain amount or share), in turn increasing water conservation practices and investments in water management infrastructure (to better direct the entitled amount to productive use). An associated argument is that water rights are a prerequisite to imposing an administrative limit on aggregate withdrawals, which in turn makes available sufficient water 'headroom' to meet the needs of the environment.
- Third, that secure access to water increases the perceived credit worthiness of farmers, enabling increased extension and uptake of loans – this possible effect is, however, likely to be supplementary to any perceived creditworthiness effect of having secure land title.

⁷ Three full decades have elapsed since the 1981 water code allowing time for the implications of those reforms to be assessed and re-assessed.

⁸ It has been pointed out that tradable water rights require both the rights, and the conditions under which those rights may be exchanged between parties, to be defined; markets for water can meanwhile arise even where rights are not formalised – for example where multiple potential buyers are available to purchase groundwater for irrigation from tubewells. See Perry et al. 1997. However, the two terms are often conflated.

A set of **contextual** or conditioning factors are also identified, which are hypothesised to moderate how water property rights might contribute to development outcomes. These include broad socio-economic and institutional factors such as access to markets and governance. Information management is a particularly important dimension of the latter – just as much of the debate in land rights circulates around the issue of surveying and demarcating titles, the challenge of accurately measuring water availability and withdrawals presents major challenges to effective systems of formalised water rights. Climate change, which is likely to increase hydrological variability and extremes in numerous locations, exacerbates the challenge – and may provide increasing justification for defining water rights not in terms of a fixed volume, but a fixed share of a changing total available amount.

In the face of hydrological variability, ‘secure’ in relation to water rights may have more meaning if viewed in terms of the security/stability of the ‘rules of the game’ by which proportional shares are determined, rather than any supposed certainty of the outcomes of such rules/processes. Cultural norms and practices may also be important contextual factors. Here, too, the link with land may be important, for example where fencing of land (or water resources) is viewed as an affront to customary rights of certain groups to water.

Some contextual factors are highlighted as being particularly important to the logic of the theory of change, and therefore especially deserving of testing, as prior **assumptions** (see box to the right of Figure 1).

Research questions

Based on the discussion of the debates around water rights and household welfare, and water and land rights, and the derived theory of change, this Briefing Paper reviews the evidence in relation to three research questions:

- Does the evidence confirm that formalisation of water rights increases rural household welfare in and of itself, or are other factors essential to provide secure access to water for productive purposes?
- What does the evidence say about the appropriate relationship between land and water rights, in terms of maximising household welfare?
- Does the emerging evidence on the recent phenomenon of large-scale land acquisitions indicate that these pose new challenges to designing and implementing water rights in support of household welfare?

The second and third questions reflect a link to the other chapters in this paper: which focus on land property rights. The fact that this Briefing Paper is a small part of a larger review focusing on land rights means the Briefing Paper cannot claim to be comprehensive. Nonetheless, the methodology outlined in the general introduction has been followed and evidence from a wide geographical spread of countries in Africa, Asia and Latin America is cited.

4 Evidence on each research question

4.1 General characteristics of the evidence

Types of studies

Compared to the evidence on strengthened land rights and rural household welfare, the comparable body of evidence for water rights is weighted more towards sociocultural anthropology than economics.

Focus of studies

While around 60 economics-based studies were identified in the equivalent search for land rights, there are far fewer comparable studies in the case of formalised water rights in developing countries. These are, moreover, confined to middle-income contexts with relatively greater institutional and financial capacity, and they do not directly focus on the main topic of this review: the impact of formalised water rights on household welfare.

Among the economics-based studies, five of those identified are concerned primarily with efficiency gains (and, to a lesser degree, distributive impacts) of initiating or enhancing *tradability* of rights in a number of middle-income countries where formalised water property rights are comparatively better established, and institutional and financial capacity is higher (namely Chile⁹, Tunisia¹⁰, South Africa¹¹ and India¹²). Moreover, two of these are simulations, which estimate impacts of theoretical changes in tradability of rights using hydrologic-economic models (Cai et al 2006; Zekri and Easter 2005).¹³ As such, while these studies make a contribution in their own right, in terms of context-specific findings and methodological development, they tell us relatively little about the impacts of formal (not necessarily tradable) water rights on household welfare, especially in the region of focus, Sub-Saharan Africa.

A further three studies were identified that apply contingent valuation to estimate willingness to pay for various changes in water rights, including increased reliability of delivery of water and tradability – again from middle-income countries with comparatively more embedded formalised systems (South Africa, Tunisia and India).¹⁴ This is of interest from a methodological perspective and may aid in the design of water rights regimes by helping understand farmer preferences. However, the studies do not assess outcomes of changes to water rights ex-post and thus do not help to answer the research questions.

Among the studies reviewed from the larger body of research that approaches water rights formalisation from an anthropological perspective, none are primarily concerned to assess impacts on rural household welfare. Those that do refer to household welfare outcomes employ anecdotal examples, rather than attempting any systematic quantification. However, this reflects the nature of the problem and underlying theoretical frameworks deployed in the anthropological literature, notably the concept of pluralism. Most of the identified anthropological studies are geared towards understanding the complex functioning of different, overlapping rights regimes (of varying degrees of formalisation) in a specific context, and what this entails for multiple users and uses of water. At the very heart of the concept of legal pluralism is a questioning of any binary distinction between formal and non-formal rights regimes. This in turn may make attempts to attribute causality between formalisation and end

⁹ Cai 2006 and Romano and Leporati 2002: 41-58. It should be noted that only a working paper version of this paper could be accessed; moreover, while there are a number of other economics/ econometrics assessments of the impacts of the Chilean rights reform written in the 1990s, this paper was focused on in view of it being comparatively recent and its focussing on distributive impacts.

¹⁰ Zekri and Easter 2005

¹¹ Armitage, Nieuwoudt and Backenberg 1999

¹² Sharma and Sharma 2006

¹³ The models integrate hydrological and socio-economic data to estimate the implications of water rights trading at different scales, including farm, farm groups and basin.

¹⁴ South Africa: Speelman et al 2010; South Africa and Tunisia: Speelman et al 2011; India: Veetil et al 2011.

outcome harder, because in a given pluralistic situation, actors are using different water rights regimes simultaneously.¹⁵

Implications for assessment of the quality of evidence

This characteristic of the anthropological literature makes it hard to apply the framework adopted for evaluating quality of evidence in the present paper, which draws on DFID guidance. For example, because the anthropological literature is predominantly inductive, it rarely sets out to deductively test a pre-defined hypothesis; but inclusion of a hypothesis is one 'principle of quality' according to the evaluation framework. Because case studies in the anthropological literature are often constructed from a number of field investigations conducted over an extended period, methodological details (interview formats and questions, etc.) are often only presented in summary format, if at all. This makes it harder to evaluate such papers according to other predefined principles of quality, including internal validity and measurement reliability (though this is applicable also to some of the economics papers reviewed).

While this broad pattern, and the caveats it entails, should be noted before elaborating on specific findings, it also has relevance for how remaining evidence gaps are presented and approached – considered in section 5 below.

4.2 Evidence for research question 1: water rights and rural household welfare

1. Does the evidence confirm that formalisation of water rights increases rural household welfare in and of itself, or are other factors essential to provide secure access to water for productive purposes?

The heterogeneous evidence identified, both qualitative and quantitative, is insufficient to answer the question conclusively. However, the available evidence suggests that what matters for secure access to water is not so much formalisation of water rights on paper, in national or sub-national legislation, but the broader set of institutional and infrastructural capacities which enable water to be allocated, and delivered, to the intended beneficiary at the right time, in the right quantity. For smaller irrigation schemes with a limited number of users, the evidence suggests that context-specific rights regimes that have evolved over time through collective action may be preferable in terms of equitable distribution ('customary', insofar as they are site-specific, additive and evolving). While increasing demand and competition for water may place strain on the efficacy of these collective action systems, it is not clear that top-down imposition of a formal (i.e. concretised in legislation) water rights blueprint has been any more effective in the cases analysed to date.

Evidence from the anthropological literature

A small body (12 studies) of medium quality,¹⁶ context-specific evidence was identified, predominantly derived from anthropological case-study approaches, referring loosely to household welfare impacts in contexts where water rights have been formalised. None of these papers are focused exclusively on documenting end outcomes for household welfare of the sort hypothesised in the theory of change (i.e. increased household food security or household

¹⁵ Linked to this difficulty in attributing causality within a pluralistic rights context, is that the case study evidence presented in the anthropological literature does not tend to question or refute individual links in the causal chain presented in the Theory of Change (for example the notion that formalisation of water rights increases the perception that water access more secure, in turn increasing short or term investment in inputs, and thence enhancing productivity). Rather, most of the papers are concerned to question whether the logic of the theory of change as a whole is applicable in developing countries. For example, the papers reviewed query whether top-down attempts to formalise water rights are viable, where infrastructure for measuring and controlling water flow is insufficient (e.g. Mehari et al 2009) or where communities can continue to seek recourse to other, pre-existing and in some cases more effective customary rights (e.g. Juma and Maganga 2004).

¹⁶ Assignment of 'medium' quality, based on the pre-defined 'principles of quality', arises mainly from the more limited elaboration of methodological details in this body of literature.

incomes). Some do mention such outcomes based on a few anecdotal examples, but the majority are concerned to explore the interplay of formal and informal/ customary rights in practice, and what this entails for security of access to water for different stakeholders, particularly smallholder farmers.

In Sub-Saharan Africa, the identified papers in this body of evidence focus on Ethiopia,¹⁷ Tanzania¹⁸ and South Africa.¹⁹ Additional studies were identified on India,²⁰ Sri Lanka²¹ and Peru.²² Due to the limited number of papers presenting context-specific evidence, key findings are explored by country below.

Insofar as any general summary can be made, this body of evidence suggests that attempts at formalisation in these particular contexts (notably Tanzania, but also Ethiopia, India and South Africa) have not necessarily led to greater security of access to water for poor rural households, for a number of reasons. For example, formalisation attempts may wrongly assume that an imposed formal system will somehow eradicate all pre-existing rights. Instead, the evidence suggests that people will continue to navigate a plural situation according to expedience, appealing to whichever rights regime best suits their purpose at a given time. Further reasons are that attempts at formalisation have not been accompanied by sufficient infrastructure and institutional capacity to define, monitor and enforce the rights regime; nor have formalised systems necessarily been more resistant against manipulation by more powerful interests.

- In Tanzania, most evidence is from the Pangani and Rufiji river basins where pilot projects have been initiated to implement integrated water resources management under a series of national legislative and policy reforms. This includes establishment of river basin organisations to oversee a formalised system of water rights and water fees, as well as establishing and strengthening water user associations.²³ Case study evidence suggests that the attempts at rights formalisation have in many cases been counterproductive: increasing conflicts between users, costing more to implement than the water fees generated and exacerbating rural poverty (Sokile and van Koppen 2004; van Koppen et al 2004; van Koppen et al 2006). It is not entirely clear to what extent this can be attributed to the formalisation of water rights, per se, versus the levying of fees for water. But the case studies point to a number of structural, contextual factors that limit the ability of the formalised system to operate effectively. These include: insufficient infrastructure and capacity for the formal water 'bureaucracy' of river basin organisations and water user associations to assess and control river flows, and thus enforce rights (Mehari et al 2009); and the continued, understandable, desire, of local people to use the rights regime which best protects their interests (which in some cases is the modern regime, in others pre-existing, 'informal' or customary regime). (Juma and Maganga 2004). A recent case study in the Kikuletwa catchment of the Pangani basin suggests smallholder irrigators have been unable to defend their formalised rights against appropriation by more economically and politically powerful interests, in this instance the cities of Arusha and Moshi (Komakech et al 2012).
- In Ethiopia, the identified case studies depict the evolution of various rights regimes in specific irrigation schemes in the Fogera plains (Amhara region (Eguavoen et al 2012)) and Toke Kutaye (Oromia region (Deribe et al 2008)), underlining the difficulty in discerning any coherent or binary distinction between informal/

¹⁷ Eguavoen et al 2012; Deribe 2008; Zeleke 2007

¹⁸ Komakech et al 2012; Mehari et al 2009; van Koppen et al 2006; Juma and Maganga 2004; van Koppen et al 2004; Sokile and van Koppen 2004

¹⁹ Kemerink, Ahlers and van der Zaag 2011

²⁰ Wagle et al 2012; Warghade and Sathe 2012

²¹ Meinzen-Dick and Bakker 2001

²² Kemerink et al 2011

²³ Relevant legislation includes the 1974 Water Utilization (Control and Regulation) Act, the 1997 and 2002 Amendments Acts, and the 1991 and 2002 National Water Policies. The 2002 Water Act was put into force by a revised Water Act of 2009 (see Komakech et al 2012 and Mehari et al 2009).

customary, and formal. Given the more limited top-down policy prescriptions regarding water rights in Ethiopia compared to, for example, Tanzania, a concern of the identified studies is to demonstrate the potential for collective action for equitable and effective allocation and distribution of water in small, user-managed schemes. A further study, applying mixed econometric and qualitative methods (Deribe 2008)²⁴ to data from schemes in Atsbi Wemberta (Tigray region) and Ada'a (Oromia region), suggests collective action is most effective where an intermediate number of households participate in the scheme, compared to schemes involving a low or very high number. The reduced efficacy of collective action where high numbers of users are involved is attributed to increased competition leading to violation of agreed rules; the policy implication drawn is that assigning of rights and strengthening water user associations is required, given likely increase in demand for natural resources over time. However, other factors identified as contributing to effectiveness of collective action for local water allocation, including access to formal credit and extension programmes, again suggests the need for significant institutional and capacity support, alongside efforts to clarify and strengthen rights.²⁵

- In South Africa, a case study drawing on interviews with smallholder and commercial farmers in an anonymous catchment of the Thekula basin of KwaZulu-Natal depicts a political economy of water rights and water allocation which is dominated more by entrenched economic and power asymmetries (rooted in the apartheid era) than by official policy (the National Water Act of 1998, widely cited as a model piece of legislation). The result is that smallholders have been unable to claim reallocated (formalised) water rights from commercial farmers (Kemerink et al 2011).
- In India, evidence of powerful interests being able to navigate formal water rights regimes to their advantage is also found in a case study in Maharashtra – where authors argue that a coalition of elite interests converging around hydropower have been able appropriate water rights as well as physically diverting water, apparently in contravention of state legislation (Wagle et al 2012).
- In Peru, similarly, case study evidence from Cajamarca suggests that water user associations have been effectively dispossessed of their formally allocated collective water rights by a transnational mining company that has undertaken complex negotiations with farmers and authorities, and invested in hydraulic infrastructure that physically alters water distribution (Sosa and Zwartveen 2012).²⁶
- In Sri Lanka, evidence from a multi-disciplinary study of Kindiya Oya irrigation scheme is presented to illustrate pluralism in water rights, including a multiplicity of different uses of water; users of water; bases for claiming water rights; bundles of rights (extending beyond simply 'ownership', to access, withdrawal, exclusion, management and alienation rights); relative strengths of rights; and institutions that safeguard, or mediate, the realisation of rights (Meinzen-Dick and Bakker 2001).

²⁴ The author combines qualitative and econometric analysis of data from a survey of 169 communities and 22 focus group interviews, with focus group discussions

²⁵ Proxies for effectiveness of collective action include presence of guards to protect site and prevent manipulation of water flow; nomination of an individual in charge of water distribution; contributions to payment of guard and nominated water distributor; occurrence of disputes, and application of any penalty system.

²⁶ Evidence presented on the implications for water availability for smallholders is anecdotal. The authors argue that the mining company acquired de facto control over water allocation with the acquiescence of the nominally responsible water authority.

Box 3: Evidence on gender aspects

A number of papers provide evidence on the need to specifically consider women's needs, roles and capacity in water rights formalisation processes.

Evidence drawn from a number of case studies from Africa, Asia and Latin America highlights some of the ways irrigation infrastructure rehabilitation or development, and accompanying alterations in water rights, can be prejudiced against female and other marginalised users: for example, where water rights are vested by the implementing agency in: a) existing land rights holders (who, in patrilineal societies tend to be men); or b) those who contribute to construction of the scheme (where women are either barred from contributing or their contribution is discounted)(Van Koppen 1997).

At the same time, where a continued contribution to maintenance of rehabilitated irrigation infrastructure is required, the burden may fall more on women due to perceived lower opportunity cost of women's labour, compared to men participating in off-farm employment (Zwarteveen 1995).

Evidence from irrigation schemes in Atsbi Wemberta (Tigray region) and Ada'a (Oromia region) in Ethiopia nonetheless suggests that a higher proportion of female-headed households correlates with lower occurrence of violations of collective water allocation systems – revealing the need to integrate female water users into water management reform, including implementation of water rights (Deribe 2008).

Evidence from the economics literature

As noted, the identified economics papers focus mainly on the implications of enhancing tradability of water rights. As presented in the hypothetical theory of change, formalisation is viewed as a prerequisite to tradability (insofar as it provides greater perceived assurance that the right is secure and will therefore hold its value). The literature which discusses tradability therefore tends to focus on countries where a formalisation process has been underway for some time, and where institutional and infrastructural capacity is sufficient for formal rights to be realised. It does not, therefore, directly contribute to answering whether formalisation, in and of itself, contributes to household welfare. These papers do provide methodological insights and innovation, and may provide lessons for some, predominantly middle-income countries – as such the identified papers are briefly discussed below. As the evidence identified is heterogeneous in method and findings, this makes it difficult to refer to it as a 'body of evidence', or to evaluate it as such.

Three studies were identified that analysed, *ex-post*, the impact of water rights trading. One study examining the official water market in Limarí Province, Chile, found that the distribution of water rights became more inequitable²⁷ as trading progressed in the case-study area and that peasant households tended to rely more on their original/ customary rights rather than participation in the market. The authors identify a correlation between increasing inequity of water rights distribution and income distribution, but do not attribute causality to this relationship (Romano and Leporati 2002).²⁸ The second study from South Africa, comparing two catchments (one in the Orange Valley, another in the Nkwaleni Valley), looks primarily at efficiency gains, i.e. whether water accrues to higher value uses. It finds that water had accrued to higher value uses²⁹ in the Orange Valley, while a market had not emerged at all in the Nkwaleni Valley. Explanatory factors include the strong administrative role played by the Department of Water Affairs in the former catchment, and the larger number of willing sellers.

²⁷ i.e. peasant households held a lower share of water rights on a per capita and aggregate basis.

²⁸ The more extensive literature on efficiency gains from trading under the Chilean regime dating from the 90s was not a focus of this review due to time constraints and limited transferability of lessons from Chile's extreme version of formalised/ private water rights. Romano and Leporati's study provides a useful summary of this literature. Recent, more qualitative assessments have reinforced the need to question the equity outcomes of formalisation and trading of water rights in Chile. See for example Bauer 2004; and Budds 2010

²⁹ Table grapes, rather than wine or raisin grapes. Discourses which frame efficiency and use-value purely in monetary terms within the formal economy have, however, been problematized by some authors as ignoring the value of smallholder uses besides irrigation, which may not be linked into the formal economy – for example fishing, domestic uses including consumption, livestock watering and vegetable gardens. See for example Komakech et al 2012.

The study did not seek to interrogate the equity implications of water trading, or its ultimate impact on household welfare (Armitage et al 1999). A case study in Rajasthan, India, shows how spot trading of water (in this case groundwater) can emerge in contravention of what little formal legislative rights and other rules are in place (Sharma and Sharma 2006).³⁰ In this informal water market, the authors argue that lack of clarity in the rights regime permits exploitation of buyers by sellers (by charging exorbitant prices), and encourages excessive withdrawals. The specifics of the case appear to be related to broader political economy of groundwater-based irrigation in India, including substantial energy subsidies for farmers which enable unsustainable pumping.

A further two studies were identified which simulated changes in water rights trading using integrated hydrologic-economic models, drawing on field data from Chile and Tunisia. Due to the difficulty in measuring hydrological changes across numerous small farmers in the field, modelling may appeal as a means to estimate the hydrological implications of different water rights interventions – but such exercises are based on numerous assumptions. In the Chilean study (using data from the Maipo River Basin) the authors find that simulated water trading leads to water moving to higher-value industrial and domestic uses, but argue that agriculture and thence agricultural production do not necessarily lose out, due to an overall increase in water efficiency and the potential for farmers to gain from sales of water (Cai et al 2006). In the Tunisian study, using data from Bouhertma in Jendouba province, the authors find that simulated gains to income through trade are negligible, and that trading in times of peak demand (when it might be most expected) is limited by pipe capacity, pointing to the importance of adequate infrastructure for tradability of water rights.

Three studies were identified that employ contingent valuation to test farmers' willingness to pay (through higher water fees) for various changes in water management regimes, including changes to the water rights system. This does not provide direct evidence of impacts, willingness to pay for certain changes in water rights may help public policy makers weigh up reform options. Evidence from contingent valuations in South Africa, India and Tunisia suggests that farmers are prepared to pay significantly more in water fees, in return for changes in water rights, including enhanced transferability and assured supply. However, segmentation of the sample population appears to indicate that poorer farmers are less willing to pay for water rights changes. The studies do not, moreover, consider the transaction costs associated with increasing water rights transferability or security, either by market or administrative means (Speelman et al 2010; Speelman et al 2011; Veetil 2011).

Conclusions

Neither the anthropological nor the economics studies directly enumerate household welfare outcomes (income or food security). Consequently, the evidence is insufficient either to confirm or refute that formalisation of water rights increases rural household welfare in and of itself. Nonetheless, the evidence points to certain other factors which help to provide secure access to water for productive purposes, or should be taken account of in designing and implementing water rights regimes.

The evidence from anthropological papers suggests several key findings:

- Informal/customary regimes often continue to exist after a formalisation attempt, and in practice people will use the regime which serves their purpose at a given time.
- Infrastructure for measuring and conveying water, as well as institutional capacity, is a vital pre-requisite for ensuring water rights on paper can be claimed in practice.
- Powerful actors may be able to manipulate a formal system to their advantage – while this is also possible for informal/customary regimes, the new 'rules of the game' of a formal system, and how the system can itself be played, may be better understood by economic and political elites.

³⁰ Technically, groundwater is an easement attached to land under the relevant legislation, which appears to mean it should be sold for profit apart from the land on which the well or borehole is sited.

The more limited economics papers focusing mainly on tradability of water rights suggest that markets for water rights are also open to manipulation by elites, and require infrastructural and institutional capacity for their effective functioning. Some benefits of trading water rights may be adduced in terms of the efficiency of water use (which may ultimately increase water availability and thence the welfare of rural households) but findings are often drawn from models and based on a number of assumptions.

4.3 Evidence for research question 2: land and water rights

2. What does the evidence say about the appropriate relationship between land and water rights, in terms of maximising household welfare?

None of the papers identified looks specifically at the impact of separation or integration of water and land rights on household welfare. In terms of disciplinary alignment, the identified papers are a mix of economic and anthropological; those referred to below were graded medium to high quality. The papers do not have sufficiently unified focus for any 'bodies of evidence' to be identifiable. However, several help to shed light on important considerations for land and water management and access.

Implications of land rights and tenure on water rights and access

Looking at a range of studies on the how land rights affect water rights, the overarching finding is that while riparian and similar systems (whereby rights to water depend on rights to land) may be inequitable and do not recognise the fundamental differences between land and water, separating out rights regimes for land and water in a way that ignores their interdependencies is also problematic.

- A case study of a traditional irrigation scheme in Bida region, Nigeria, highlights a problem for riparian systems, whereby if water is not allocated on a separate basis to land, those land-holdings near the source of water (the 'head' of the scheme) are potentially more productive than those further away (e.g. the 'tail end'). The authors find that the system leads to unfair distribution not only in water but also in labour contributions (according to the rules of the scheme contributors to scheme maintenance are meant to have assured access to water, with the result that 'tail-enders' are more motivated to contribute labour) (Fu et al 2010).³¹
- A case study in South-Eastern Palakkad in Kerala, India, supports the notion that riparian systems are likely to reinforce existing inequities embedded in the distribution of land (giving land holders privileged access to water as a means of production). The authors argue that the equity aims of redistributing land plots have been undermined by ignoring hydrology and the pre-existing access to water associated with each plot – with groundwater in particular treated as a private good belonging to the land holder on which a well is sited, under a riparian doctrine (Krishnan and George 2009).³²
- In the aforementioned econometric case-study of groundwater markets in Rajasthan the authors argue that, besides location of land holdings, fragmentation and size of plots can also affect water rights and access under a riparian system (Sharma and Sharma 2006). The authors identify a correlation between increased fragmentation of holdings (and, to a lesser extent, size of holdings), and purchase of groundwater. They argue from this that marginalised farmers with small and fragmented holdings are caught in a low-level equilibrium trap whereby they remain purchasers rather than sellers of groundwater in an exploitative market, while those farmers with larger holdings sell water at more than three times the (publicly subsidised) cost of extraction.

³¹ It should be noted that the negative correlation identified between distance of plot to the head of the scheme and gross production of rice was weak (correlation coefficient -0.33) and weaker still for the correlation between this distance, and gross income from off-season crops.

³² Quantitative evidence of impact on water withdrawals or sustainability or equity of access to water is not assessed.

- While the above examples suggest a need to separate water rights from land rights, they also show that existing hydrology cannot be ignored in land reform. Two anthropological case studies from South Africa support this point and reinforce the need for integration between land and water rights regimes. South Africa's land and water rights reforms are widely regarded as having strong social dimensions, aiming at redistribution to previously dispossessed groups. The authors of the case studies, in the Inkomati (Krishnan and George 2009) and Thekula (Kemerink et al 2011) river basins, nonetheless argue that water aspects have not been sufficiently taken account of in land redistribution. In former homelands, particularly, institutional structures further disadvantage potential irrigators because they are reliant on the provincial Department of Agriculture to secure water, rather than the main (and more effective) statutory processes for reallocation of water rights, supervised by the Department of Water Affairs.
- A study of a rather different nature highlights that land rights reforms may also need to consider the implications for water for drinking and health purposes (whereas the previous studies focus on water for productive uses such as irrigation). The analysis, from Busia and Butere-Mumias districts of Kenya, employs revealed preference valuations³³ of households' willingness to pay for spring protection, in order to estimate the effect of alternative (land) property rights norms on drinking water quality. The authors find that simulated private property norms, which would permit the owners of land containing naturally occurring springs to charge for water, do not yield higher social welfare than existing social norms which permit communal access to such springs.³⁴

Implications of water rights and access for land use

Examining the problem from the other direction, the impacts of water (infrastructure and attendant rights to use it) on land use should also be carefully considered, although care is needed to interpret the evidence.

- Case study evidence from Niger and Senegal is used by the authors of an FAO study to highlight some of the ways that interventions which change water rights (e.g. by reshaping physical means of access) can have implications for land rights and management (Cotula et al 2006).³⁵ One example is the provision of modern wells and boreholes for pastoralists that are in practice open access (in contrast to traditional, customarily managed wells), and which may under dry-season conditions attract increasing numbers of herders and livestock to restricted portions of open-access grazing land, leading to degradation of the land resource. At the same time, private boreholes with highly controlled access were also observed as being used by wealthier herders to disrupt customary regimes and *de facto* limit access to portions of previously common property rangeland. Nonetheless, it should be noted that these points should not be used to draw a conclusion that permanent water sources should not be constructed for pastoralists. Rather, that where seasonal fodder and water availability give rise to these risks, questions of access need to be carefully managed.

Conclusions

The limited available evidence suggests that, in terms of an appropriate relationship between land and water rights for maximising household welfare, some separation is required. Water rights that are derived on the basis of land rights (riparian) alone can entrench existing

³³ Found to be considerably smaller than stated preference valuations and valuations commonly used by health planners

³⁴ The selected proxy for social welfare is investment in spring protection – shown in a randomised control trial conducted as part of the study to reduce fecal contamination by 66%, with child diarrhoea falling by one quarter. Sensitivity analysis suggests even a small change in income levels, lower cost of spring protection, or increasing water scarcity would yield the opposite conclusion (i.e. private rather than communal access is preferable) although the study admits that transaction costs associated with enforcing private property norms are omitted from the analysis.

³⁵ The study forms the empirical counterpart to the previously cited study by Hodgson 2004.

inequities – with not only the location of plots mattering for water access but also their size and fragmentation. At the same time, as both land and water are necessary for many household activities in rural areas, rights regimes for one must be designed with the other in mind. The interdependencies are most obvious in irrigated agriculture but the identified papers suggest they can also matter for livestock watering among pastoralists, and the essential drinking and health needs of rural communities.

4.4 Evidence for research question 3: water rights and large-scale land acquisition

3. Does the emerging evidence on the recent phenomenon of large-scale land acquisitions indicate that these pose new challenges to designing and implementing water rights in support of household welfare?

A small body (nine studies) of medium to high quality evidence was identified, reflecting an energetic response to a new and contentious field of study, despite limitations in the available data.

Taken together, the evidence implies that the large-scale land acquisitions do not pose new challenges to designing and implementing water rights in support of household welfare but that existing challenges may intensify due to the greater scale of land and water involved, and the increased financial and political stakes. These intensified challenges are discussed under three headings, below: understanding basic hydrological constraints; navigating power asymmetries; and integrating pluralism.

As in the case of the empirical literature identified for research questions one and two, few papers evaluate end household welfare outcomes (e.g. food security and income) specifically. Furthermore, as in the case of research question 2, the papers – predominantly case studies – are heterogeneous in the issues and countries on which they focus.

Hydrological constraints

Several studies suggest that a core problem is that hydrological availability is being ignored or only summarily treated in designing large-scale land acquisitions. This can be understood as an extension of the concern highlighted under research question 2: that the equity implications of any redistribution of land must take into account how it alters access to water. The focus to date has been on blue water, although land redistribution may also affect access to green water.³⁶

- Attempts to understand the water requirements of known land acquisitions using blue water in a given country or area have been undertaken using hydrological models for Ethiopia (Bues and Theesfeld 2012) the Limpopo basin in Mozambique and the Tana delta in Kenya (van der Zaag et al 2010). The authors of these studies question how far countries receiving investment are aware of hydrological constraints when leasing land to investors, taking account of factors including: likely crop water requirements; the assurance (probability that water will be available in a given year) required for commercial irrigation; and an appropriate measure for available water (dry season flows, rather than a simple annual average). The calculation undertaken for Mozambique suggested that the maximum area that could be irrigated with 80% assurance (i.e., with the probability of insufficient water in one out of five years) was less than the area for which the government was, at the time, seeking irrigation investment. In the case of Ethiopia, analysis of likely water requirements associated with foreign investments at the scale of the country, selected regions, and a single irrigation scheme, shows the

³⁶ Blue water is water in liquid form (surface or groundwater) which can be withdrawn for irrigation, as opposed to green water, which is stored in the soil, available for uptake by plants, and which arises from rainfall and other hydrological processes.

importance of choosing the appropriate scale to assess impacts on existing water use and users. The study in Kenya's Tana delta suggests that even where environmental impact assessments are undertaken they are insufficiently sophisticated to take account of hydrological complexities, and underestimate crop water requirements and water quality impacts through pesticide and fertiliser use.

- Evidence assembled through key informant interviews in London and the Middle East suggests that many investors among both governments and the private sector are largely unaware of the role that water resources will play in the success, or otherwise, of their investments. This contrasts with their comparatively greater understanding of social issues, including land rights, and some non-water environmental risks (Keulertz 2012).
- Assessment of groundwater availability and likely yields across sub-Saharan Africa suggests uneven distribution and limited potential for the kind of high-yielding boreholes (providing more than 20 litres per second) that are needed to support intensive agriculture. The authors of this study recommend that availability of groundwater for irrigation cannot be assumed in any prospective large-scale land acquisition (MacDonald, Taylor and Bonsor 2012).

Power asymmetries

Other identified papers suggest that the complexity and potential asymmetry of power relations may intensify under large-scale land acquisitions, with greater potential for more powerful actors to manipulate water (and land) rights to their advantage.

- A case study undertaken in Ada'a woreda, in Ethiopia's Oromia region finds that external investors were able to shape institutional arrangements to their advantage – including a new association for managing irrigation water shares between investment and existing farms. Nominally, both parties are represented on the association but a review of the terms of the association suggests existing farmers, while paying less per hectare irrigated, are governed by more association rules, and required to pay higher fines if they break these rules. The authors undertake a qualitative analysis of power disparities to argue that in most cases the investment farms possess greater bargaining power in devising the new institutional arrangements (Bues and Theesfeld 2012).
- A case study of a large-scale land deal in the Iringa region of Tanzania, suggests the potential for water, and existing water rights holders, to be invisible in official negotiation processes over large-scale land acquisitions. In this case, institutions of Tanzania's 'formal' rights system, i.e. the water user association (holding formal rights to two springs on the rented land) and Basin Authority, did not participate in the negotiations, and nor did customary users of land and water (Arduino et al 2012).³⁷
- A similar phenomenon is observed in a case study of large-scale land acquisitions in Mali's Office du Niger scheme, where even the regional institution for regulating access to land and water (the Office du Niger) is frequently bypassed. Instead, deals are agreed between investors and national level actors, with limited attention paid to technical hydrological considerations (Hertzog et al 2012).

Pluralism of rights, users and uses

A final pair of papers suggest that large-scale land acquisitions, due to their scale and often monolithic design, may be poorly equipped to navigate large numbers of potential users and uses, and pluralism in existing rights regimes.

- Mixed methods analysis of three recent large-scale land acquisitions in Ghana suggests that the potential impacts, water-related and otherwise, on different

³⁷ The case study, which reports contamination of a neighbouring community's water supply following the associated land-use changes, shows that water impacts of large-scale land acquisitions changes need to be understood in terms of quality, as well as quantity.

actors pursuing varied livelihood strategies in the area, were not considered in any detail in the mandated environmental impact assessments (Williams et al 2012). The authors argue that the underlying reasons for this include information asymmetries between investors and the traditional councils which hold the right to alienate land, and absence of regulatory oversight.

- A long-term anthropological study of an irrigation scheme in Nante, Mozambique, suggests that even a model legislative framework may not offer sufficient protection to small-scale water users where large-scale acquisitions of land occur. The Mozambican system allows small users (below 1ha) to withdraw water without a license and grants this common usage priority. However, where there are powerful financial incentives, as in many land deals, smallholders' existing water use and future water needs may be overlooked by an authority seeking to attract external investors by promoting the availability of abundant, unused water (Beekman and Veldwisch 2012).

Conclusions

Emerging evidence suggests that large-scale land acquisitions do not pose radically different challenges from those encountered around other interventions that significantly reshape access to land and water resources. However, evidence suggests that the water impacts of large-scale land acquisitions are rarely being given proper consideration, and that transactions analysed to date are inherently unsuited to safeguarding the water rights of smaller users, due to their scale, monolithic nature, and the potential for more powerful investing parties to shape arrangements to their advantage. As such, challenges for effective design of water and land rights identified under research questions 1 and 2, , remain relevant and arguably intensify.

5 Evidence gaps and research needs

Stepping back from the evidence surveyed, it is clear that it does not, as a body, suffice to answer the research questions with any conclusiveness. Research question 1, and the associated search strategy, were framed around the hypothetical theory of change, which was in turn assembled following a survey of the theoretical literature. Given the apparent gap in the evidence, it is worth asking: was the right question asked?

Research Question 1 asked whether ‘formalisation of water rights increases rural household welfare *in and of itself*’, or whether other factors are essential. The evidence allowed for a number of such ‘other factors’ to be identified, insofar as they were attested by specific cases.

Examples include ensuring sufficient infrastructure and institutional capacity to regulate and enforce a water rights system; and adequately integrating multiple uses and users of water (in particular, not just irrigators and not just men). These are issues which are not necessarily lacking from formalisation processes – but which in practice tend to be. So the first concern may be to look beyond a narrow framing of water rights regimes using binary distinctions like formal and informal, modern and customary, state and non-state. From an acknowledgement of diversity, the fundamental question becomes not whether a rights regime is formal or informal but whether it succeeds in allocating water in such a way that household welfare is maximised in the long term. This remains the pressing need given observed trends including increasing competition for water (of which the large-scale land acquisition phenomenon is only the most prominent); and proliferation of technologies such as motorised boreholes for abstracting groundwater.

The theory of change was constructed as a hypothesis for how an effective and secure system for water rights might lead to increased household welfare. In it, the term ‘formalised’ encourages a focus on crude administrative distinctions about who assigns and maintains the right.

Although the theory of change is not in any way endorsed by this review, it may yet provide a starting point for adequately articulating, and then challenging, our assumed causal pathways – especially if modified to move the emphasis away from ‘formalisation’.

The task of challenging assumed causal pathways will, in turn, be aided by econometric analysis which has been more apparent to date in the literature on land. Ultimately, however, such methodologies will remain better suited to asking whether rights regime x is better than regime y. To answer the ‘why’ question will require combining econometric analysis with the anthropological and ethnographic approaches that get to the roots of livelihood strategies and how these shape, and are constrained by, natural resource availability and access.

With these overarching observations in mind, a few particularly striking research needs are identified:

- While the concept of pluralism (not only of rights but also of uses, users, bases and strengths of claim, and safeguarding and mediating institutions) has made a significant theoretical contribution, it is not yet clear how far it is taken account of in policy and programming decisions. With the increasingly high stakes of natural resource competition, exemplified by large-scale land acquisitions, there is a compelling need to identify simple principles to assist an under-resourced public official to improve the security of water allocations and access for low-income households, while balancing competing requirements such as increasing the contribution of water to national economic development.
- The inadequacies of riparian rights regimes, from the perspective of both equity and sustainability, do not mean that the links between land and water should be disregarded. Experiences from countries like South Africa, which have

comparatively progressive policies for both land and water, demonstrate the continued need to consider synergies. This is, of course, not just a property rights issue, and encompasses a broader struggle to better integrate land and water management, generally. This is an area in which rigorous political economy analysis is needed, so that actors can better understand the incentives and constraints that condition not only their own actions, but also those of their counterparts in other sectors.

- Emerging research has begun to show that the hydrological implications of large-scale land acquisitions are significant. While this area is still new, the next step must be to attempt to characterise the end-impact on livelihoods and welfare. Ultimately, the link between reduced water availability, and reduced livelihood opportunities and lower household welfare, is not linear. Such an assessment therefore needs to interrogate not only changes in the distribution of water allocation and access, but also in the end benefits derived from resource use, both positive and negative (and including less tangible cultural and environmental benefits, as well as material and financial benefits). There is also a need to better understand how development of rainfed crops, on the scale envisaged, will alter local hydrology through evapotranspiration of soil moisture, since the focus to date has been on the more visible issue of acquisition of land for irrigation. This research will be a long-term endeavour, but it requires an adequate baseline which should be established in the nearer-term.

References

- Arduino, S., Colombo, G., Ocampo, O.M. and Panzeri, L., 2012, 'Contamination of community potable water from land grabbing: A case study from rural Tanzania' *Water Alternatives* 5, 2, 344-359
- Armitage, R.M., Nieuwoudt, W.L., and Backenberg, G. R., 1999, 'Establishing tradable water rights: Case studies of two Irrigation districts in South Africa'. *Water SA* 22, 3
- Bauer, C.J., 2004, *Siren Song - Chilean Water Law as a Model for International Reform*, Washington DC: Resources for the Future
- Beekman, W., Veldwisch, G.J. The evolution of the land struggle for smallholder irrigated rice production in Nante, Mozambique (2012) *Physics and Chemistry of the Earth*, 50-52, pp. 179-184. [Working paper version reviewed, <http://edepot.wur.nl/217692>]
- Benjaminsen, T.A., Lund, C., 2002, 'Formalisation and informalisation of land and water rights in Africa: An introduction' *European Journal of Development Research*, 14, 2, pp. 1-10.
- Besley, T. and Ghatak, M. 2010 'Property Rights and Development'. In D. Rodrik and M. Rosenzweig (eds) *Handbook of Development Economics*. Vol. 5. Pp4525-4595. North-Holland, The Netherlands
- Budds, J. 'Water Rights, Mining and Indigenous Groups in Chile's Atacama', in Boelens, R., Getches, D., and Guevara-Gil, (eds), 2010, *Out of the mainstream: water rights, politics and identity*, London and Sterling, VA, Earthscan, 366 pp
- Bues, A. and Theesfeld, I., 2012, 'Water grabbing and the role of power: Shifting water governance in the light of agricultural foreign direct investment' *Water Alternatives* 5, 2, pp.266-283
- Cai, X., Ringler, C., Rosegrant, M.W., 2006, Modeling water resources management at the basin level: Methodology and application to the Maipo River Basin Research Report of the International Food Policy Research Institute, 149, pp.1-151. Available at: http://waterwiki.net/images/2/29/Romano_Leporati_2002.pdf
- Cameron, D. 2012. Combating Poverty at Its Roots: Economic development requires aid, but also sound institutions. Britain can lead on both fronts. *Wall Street Journal*, November 1, 2012. Available at: http://online.wsj.com/article/SB10001424052970204712904578090571423009066.html?mod=googlenews_wsj&buffer_share=5f47c&utm_source=buffer#articleTabs%3Darticle
- Cotula, L. (Ed), Hesse, C., Sylla, O., Thébaud, B., Vogt, G. and Vogt, K., 2006, *Land and water rights in the Sahel : tenure challenges of improving access to water for agriculture*, International Institute for Environment and Development, London
- Deribe, R., 2008, Institutional analysis of water management on communal irrigation systems in Ethiopia: the case of Atsbi Wemberta, Tigray Region and Ada'a Woreda, Oromiya Region. MSc Thesis, Addis Ababa University, Addis Ababa
- DfID 2004. Better Livelihoods for Poor People: The Role of Land Policy
- DfID 2004. Better Livelihoods for Poor People: The Role of Land Policy
- DFID undated b. Research and Evidence Division: The research evidence relating to a "golden thread of international development": a rapid review
- DfID undated a. Assessing the Quality of Social Science Research Evidence: Summary
- DfID undated. Assessing the Quality of Social Science Research Evidence: Summary
- Eguavoen, I.; Derib, S.D.; Deneke, T.T.; McCartney, M.; Otto, B.A. and Billa, S.S., 2012, Digging, damming or diverting? Small-scale irrigation in the Blue Nile basin, Ethiopia. *Water Alternatives* 5, 3, pp.678-699
- European Union 2004. Land Policy Guidelines. Guidelines for support to land policy design and land policy reform processes in developing countries, November 2004. EU Task Force on Land Tenure. http://ec.europa.eu/development/icenter/repository/EU_Land_Guidelines_Final_12_2004_en.pdf
- Fu, R., Abe, S., Wakatsuki, T., Maruyama, M., 2010, 'Traditional farmer-managed irrigation system in central Nigeria' *Japan Agricultural Research Quarterly*, 44, 1, pp.53-60
- Gazmuri, R. 1994. 'Chile's Markets-Oriented Water Policy: Institutional Aspects and Achievements', in Le Moigne, K., and Easter, K., W., (eds.). 'Water Policy and Water Markets: Selected Paper and Proceeding from the World Bank's Ninth Annual Irrigation and Drainage Seminar, Annapolis, Maryland, 1992'. World Bank Technical Paper 249, pp.65-78. Washington, D.C

- Hertzog, T., Adamczewski, A., Molle, F., Poussin J.-C. and Jamin, J.-Y., 2012, 'Ostrich-like strategies in sahelian sands? Land and water grabbing in the Office du Niger, Mali' *Water Alternatives* 5, 2, pp.304-321
- Hodgson, S., 2004, *Land and Water – the rights interface*, FAO Legislative Study 84, FAO, Rome.
- Hodgson, S., 2006, *Modern water rights: Theory and practice*, Food and Agriculture Organization, Rome.
- Juma, I.H. and Maganga, F.P., 2004, Formalization of Water Rights and its Implications for Equitable Sharing of Water Resources in Tanzania. 5rd Waternet/ WARFSA Symposium: IWRM and the Millennium Development Goals: Managing Water for Peace and Security; Windhoek, 2-4 November 2004
- Kemerink, J.S., Ahlers, R., and van der Zaag, P., 2011, 'Contested water rights in post-apartheid South Africa: The struggle for water at catchment level' *Water SA*, 37, 4, pp.585-594
- Keulertz, M., 2012, 'Land and water grabs and the green economy', in Allan, T., Keulertz, M., Sojamo, S. and Warner, J., (eds.). *Handbook of Land and Water Grabs in Africa: Foreign direct investment and food and water security*, London, Routledge, 446pp
- Komakech, H.C., van der Zaag, P. and van Koppen, B., 2012, 'The last will be first: Water transfers from agriculture to cities in the Pangani river basin, Tanzania'. *Water Alternatives* 5, 3, pp.700-720
- Krishnan, J., George, A., 2009, 'Ecology and equity in rights to land and water: A study in south-eastern Palakkad in Kerala' *Water Alternatives*, 2, 1, pp. 1-15.
- Kzito, F., Williams, T.O., McCartney, M., Erkossa, T., 2012, 'Green and blue water dimension of foreign direct investment in biofuel and food production in West Africa: The Case of Ghana and Mali', in Allan, T., Keulertz, M., Sojamo, S. and Warner, J., (eds.). *Handbook of Land and Water Grabs in Africa: Foreign direct investment and food and water security*, London, Routledge, 446pp
- MacDonald, A., Taylor, R.G. and Bonsor, H.C., 2012, 'Groundwater in Africa. Is there sufficient water to support the intensification of agriculture from 'land grabs'', in Allan, T., Keulertz, M., Sojamo, S. and Warner, J., (eds.). *Handbook of Land and Water Grabs in Africa: Foreign direct investment and food and water security*, London, Routledge, 446pp
- Mehari, A., van Koppen, B., McCartney, M., Lankford, B., 2009, 'Unchartered innovation? Local reforms of national formal water management in the Mkoji sub-catchment, Tanzania IWRM reforms and water rights in Tanzania'. *Physics and Chemistry of the Earth*, 34, 4-5, pp.299-308
- Meinzen Dick, R. 2000, 'Legal Pluralism and Dynamic Property Rights'. CAPRI Working Paper no. 22. International Food Policy Research Institute, Washington, DC
- Meinzen-Dick, R., & Bakker, M., 2001, 'Water Rights and Multiple Water Uses—Framework and Application to Kirindi Oya Irrigation System Sri Lanka' *Irrigation and Drainage Systems*, 15, 2, 129-148
- Namara, R.E., Hanjra, M.A., Castillo, G.E., Ravnborg, H.M., Smith, L., Van Koppen, B., 2010, 'Agricultural water management and poverty linkages', *Agricultural Water Management*, 97, 4, pp.520-527, p.x, citing van Koppen et al. 2007
- Newborne, P. 2004, 'Right to water: Legal Forms, Political Channels', ODI Working paper, Overseas Development Institute, London
- Perry, C. J., Rock, M., Seckler, D., Rock, M. T., & Seckler, D. W., 1997, *Water as an economic good: a solution, or a problem?* International Water Management Institute, Colombo.
- Romano, D. and Leporati M., 2002, The distributive impact of the water market in Chile: A case study in Limarí Province, 1981 – 1997. *Quarterly Journal of International Agriculture* 41 2 pp.41-58
- Schlager, E. & Ostrom, E., 1992, 'Property-rights regimes and natural resources: A conceptual analysis', *Land Economics* 68(3): 249–262, cited in Meinzen-Dick and Bakker, op. cit.
- Selvetti, C. 2012. Rapid review of the literature on Property Rights - 31 October 2012. DfID
- Sharma, P. and Sharma, R.C., 2006, 'Factors Determining Farmers' Decision for Buying Irrigation Water: Study of Groundwater Markets in Rajasthan'. *Agricultural Economics Research Review*, 19, pp.39-56.
- Smaller, C. and Mann, H. (2009) *A thirst for Distant Lands: Foreign investment in agricultural land and water*, International Institute for Sustainable Development, Winnipeg.
- Sokile, C. S., & Koppen, B. V., 2004, 'Local water rights and local water user entities: the unsung heroines of water resource management in Tanzania' *Physics and Chemistry of the Earth, Parts A/B/C*, 29, 15, pp.1349-1356
- Sosa, M. and Zwarteveen, M., 2012, 'Exploring the politics of water grabbing: The case of large mining operations in the Peruvian Andes' *Water Alternatives* 5, 2, pp.360-375

- Speelman, S., Farolfi, S., Frija, A., D'Haese, M., D'Haese, L., 2010, 'The impact of the water rights system on smallholder irrigators' willingness to pay for water in Limpopo province, South Africa', *Environment and Development Economics*, 15, 4, pp.465-483
- Speelman, S., Frija, A., Buysse, J., Van Huylenbroeck, G., 2011, 'The importance of irrigation water rights: Lessons from South Africa and Tunisia', *Water Policy*, 13, 5, pp.663-676. Working paper version reviewed, available from: <http://ageconsearch.umn.edu/bitstream/95954/2/53.%20Water%20property%20rights%20in%20SA%20and%20Tunisia.pdf>
- Thobani, M., 1995. 'Formal Water Markets: Why, When, and How to Introduce Tradable Water Right'. *The World Bank Research Observer*, 12, 2, pp.161-79.
- Uphoff, N., 1986, 'Improving international irrigation management with farmer participation. Getting the process right' *Studies in Water Policy and Management*, No. 11, Westview Press, Boulder
- van der Zaag, P., Juizo, D., Vilanculos, A., Bolding, A., & Uiterweer, N. P., 2010, 'Does the Limpopo River Basin have sufficient water for massive irrigation development in the plains of Mozambique?' *Physics and Chemistry of the Earth, Parts A/B/C*, 35, 13, pp. 832-837
- van Koppen, B., 1997, 'Water rights, gender, and poverty alleviation. Inclusion and exclusion of women and men smallholders in public irrigation infrastructure development'(1998) *Agriculture and Human Values*, 15, 4, pp. 361-374.
- van Koppen, B., 1998, 'Water rights, gender, and poverty alleviation. Inclusion and exclusion of women and men smallholders in public irrigation infrastructure development', *Agriculture and Human Values*, 15, 4, pp.361-374
- van Koppen, B., Giordano, M., Butterworth, J., 2007. 'Community based water law and water resources management reform in developing countries', In: *Comprehensive Assessment of Water Management Series 5*, CABI Publishers, Wallingford, UK
- van Koppen, B., Sokile, C., Lankford, B.A., Mahoo, H., Hatibu, N., Yanda P., 2006, 'Water rights and water fees in Tanzania', in Molle, F. and Berkoff, J. (eds) *Irrigation Water Pricing Policy in Context: Exploring the Gap Between Theory and Practice*. Comprehensive Assessment. IWMI/CABI
- van Koppen, B., Sokile, C.S., Lankford, B.A., Mahoo, H., Yanda, P.Z., and Nuhu Hatibu, 2004, 'Formal water rights in Tanzania: Deepening the dichotomy?' Working Paper 71. Colombo, Sri Lanka: International Water Management Institute
- Veettil, P. C., Speelman, S., Frija, A., Buysse, J., & Van Huylenbroeck, G., 2011, 'Complementarity between water pricing, water rights and local water governance: A Bayesian analysis of choice behaviour of farmers in the Krishna river basin, India', *Ecological Economics*, 70, 10, pp.1756-1766
- Vogel, I. 2012. Review of the use of 'Theory of Change' in international development Review Report. August 2012. Available at: http://www.dfid.gov.uk/r4d/pdf/outputs/mis_spc/DFID_ToC_Review_VogelV7.pdf
- Wagle, S.; Warghade, S. and Sathe, M., 2012, 'Exploiting policy obscurity for legalising water grabbing in the era of economic reform: The case of Maharashtra, India' *Water Alternatives* 5, 2, pp.412-430
- Ward, F.A., 2010, 'Financing irrigation water management and infrastructure: A review' *International Journal of Water Resources Development*, 26, 3, pp.321-349
- Williams, T.O., Gyampoh, B., Kizito, F. and Namara, R., 2012, 'Water implications of large-scale land acquisitions in Ghana' *Water Alternatives* 5, 2, pp.243-265
- Woodhouse, P., 2011, "'Environmental Sustainability", Agricultural Intensification and Water Resources Development in Sub-Saharan Africa' *Revista de Economía Mundial*, 27, pp.149-169.
- Woodhouse, P., 2012, 'New investment, old challenges. Land deals and the water constraint in African agriculture' *Journal of Peasant Studies*, 39, 3-4, pp.777-794
- Zekri, S., Easter, W., 2005, 'Estimating the potential gains from water markets: A case study from Tunisia' *Agricultural Water Management*, 72, 3, pp. 161-175
- Zelege, T., 2007, Water rights and the processes of negotiations among irrigators in West Shewa Zone: the case of Indris Scheme in Toke Kutaye District. MA Thesis, Addis Ababa University, Addis Ababa
- Zheng, H., Wang, Z., Hu, S., Wei, Y., 2012, 'A Comparative Study of the Performance of Public Water Rights Allocation in China', *Water Resources Management*, 26, 5, pp.1107-1123
- Zwarteveen, M. Z., 1997, 'Water: From basic need to commodity: A discussion on gender and water rights in the context of irrigation' *World development* 25, 8, pp.1335-1349, citing Uphoff, 1986

Zwarteveen, M., & Meinzen-Dick, R., 2001, 'Gender and property rights in the commons: Examples of water rights in South Asia' *Agriculture and Human Values*, 18, 1, pp.11-25

Annex 1: Water rights experts contacted in search strategy

Expert Name	Affiliation	Area of expertise
Carin Smaller	Works with Howard Mann at IISD (recommended by Ruth Meinzen-Dick)	The relevance is to large-scale land acquisitions (according water rights also) combined with the legal principles and clauses of bilateral investment agreements between States and big private sector investments
Miguel Solanes	Head, Department of Economic and Institutional Analysis, IMDEA Water	Water law, privatisation, regulation, rights, Chile
Carl J. Bauer	Associate Professor, School of Geography & Development, University of Arizona	Expert on water rights in Chile - author of <i>Siren Song: Chilean Water Law as a Model for International Reform</i> , 2004, Resources for the Future, Washington DC
Paul Mathieu	Senior Officer, Natural Resources Management and Environment Department, Climate, Energy and Tenure Division, FAO	Legal aspects of tenure of land and water; Voluntary Guidelines on tenure security and the work conducted by FAO
Ruth Meinzen-Dick	Senior research fellow, IFPRI	Water rights, legal pluralism, land, gender