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Improving water markets in Spain: Lesson-drawing from the Murray-Darling Basin in Australia
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1. Introduction

The impacts of future climate change and demand growth on water supplies are already present in our social-ecological systems. Extreme weather events, natural disasters, biodiversity loss and ecosystem collapse, and water crises suggest a need for policy-makers to redouble climate change mitigation and adaptation efforts (World Economic Forum, 2019). To address water crises through climate change mitigation and adaptation investment policy-makers face two main choices: supply-side (e.g. engineering instruments to expand water availability) and demand-side (e.g. economic instruments to modulate demand). While most suitable locations for additional large-scale engineering infrastructure have already been exploited (World Bank, 2010), there are also rising concerns about relationships between additional storage and increased consumption (Di Baldassarre et al., 2018). Such concerns have also been raised in discussions surrounding the adoption of efficient irrigation technology as a means of saving water for applications elsewhere (see for example Adamson and Loch, 2014; Gómez and Pérez-Blanco, 2014). Thus, while supply-side instruments may be politically-expedient and popular with policy-makers/development investors, they may not be sufficient on their own to mitigate climate change impacts. Further, common supply-side instrument implementation within poor water accounting frameworks, often with fixed-site-benefit characteristics, suggest a lower likelihood of effective climate change adaptation.

Better management of water demand is thus essential for adaptation to climate-induced changes in water resources and water management challenges. This intimates that prudent policy-makers will explore and increasingly couple demand-side to supply-side arrangements in the management of scarce water resources. Demand-side instruments include regulatory instruments, such as quotas and security-differentiated water rights, and economic instruments such as pricing and charges, user-subsidies, drought insurance, non-pecuniary cooperative agreements/payment for ecosystem services, and water markets. All offer a range of investment choices for policy-makers to achieve climate change mitigation and adaptation outcomes. However, the successful design and implementation of demand-side

instruments in water management contexts involves high transaction costs, wide institutional change, collective action at different levels; and non-trivial economic impacts on users (Gomez et al., 2018).

Among economic instruments, water markets are particularly costly to design and implement (Loch and McIver, 2013; Wheeler et al., 2017). However, over time water markets have proven their capacity to respond to water scarcity impacts (see for example Bauer, 2010; Connor et al., 2011; Saliba, 1987; Wheeler et al., 2015; Wittwer and Griffith, 2011). In Europe, Spain has pioneered the adoption of economic instruments in general, and water markets in particular, becoming a "blueprint nation" for other member states who wish to employ economic instruments. For over 20 years, Spain has implemented private-private and public-private (i.e. buyback) water markets in sites of high demand pressure using a wide array of institutional settings ranging from public tenders and clearinghouses to bilateral agreements among users. However, in comparison to other contexts with long-term market structures, Spain's water market activity remains narrow, immature and heavily linked to drought events (Montilla-López et al., 2018; Palomo-Hierro et al., 2015).

In a context of increasing water scarcity, competition, and heightened supply uncertainty it may be prudent for Spain's policy-makers to re-examine water markets as an economic instrument with a high probability of future usefulness. However, as a precursor to that re-examination is there an existing governance context with sufficient conditions and institutional requirements to enable effective adoption lessons? What might Spanish policy-makers learn from a governance context with mature water markets that could inform effective adoption/policy-transfer? Finally, is there a targeted set of lessons that policy-makers could focus on to help improve Spain's water governance and expand the total set of management options for mitigating and adapting to future climate change?

The main aim of this paper is to develop and apply a policy transfer framework that can be used to draw lessons for Spanish water marketing arrangements from alternative contexts where water markets are in more advanced stages of development. The key innovation of this framework is its focus on transferability between contexts, rather than on the examination of parallel independent cases that is typically found in the literature. We test our framework using, as a benchmark for the comparison,

lesson-drawing and policy transfer the Murray-Darling Basin water market in Australia where water markets have been operating for over 30 years, and now include sophisticated instruments such as forward contracting and extended leases (Bayer and Loch, 2017). The objective of the comparison is a set of governance lessons for Spanish policy-makers which identifies market barriers, institutional investment opportunities and key focal points for progressing water marketing development. We view these insights as critical for successful adaptation to growing water scarcity as Spain continues to experience increasing demand, diminishing and inelastic supply, more frequent and intense droughts, growing competition/conflict and increasingly relevant economic costs of management.

2. Policy transfer theoretical framework

Policy transfer is defined as a process where the knowledge of policies, administrative arrangements, institutions and ideas of one political system (past or present) is applied to the development of similar features in another (Dolowitz, 2000). Policy transfer frameworks are concerned with how/whether a governance procedure that is successful in one context can be positively transferred or provide lessons (e.g. policy projects, programs or best practice) to another (Rose, 1991).

Policy transfer is often linked implicitly to rational policy-making. However, positive or negative impacts on policy success/failure are less clear in the literature (James and Lodge, 2003). That said, increased complexity and uncertainty underpinning modern governance may motivate policy-makers to engage in higher future policy-transfer activity (Evans and Davies, 1999). Recent globalising forces have also increased the scope and intensity of policy transfer activity which can occur via voluntary, negotiated or coercive lesson-drawing formats. Dolowitz and Marsh (1996; 2000) argue that policy transfer typically occurs via the free choices of political actors in the face of an emerging problem, or because of dissatisfaction with the status quo. More recently, Dolowitz and Marsh (2012) describe the policy transfer framework as a heuristic method providing a basis for empirical investigation. As such, it is argued that policy transfer can both stimulate or guide policy transformation (Benson and Jordan, 2011). Past studies appear to focus on soft forms of policy transfer among non-state actors under globalisation conditions (Stone, 2012). But significant scope is also suggested for constructivist

approaches to policy transfer (Benson and Jordan, 2011) to identify what is known, what needs to be known, and for assessing effective performance and application.

In the pursuit of positive adaptive institutions to cope with risky and uncertain future water supply conditions we may therefore need to think about adaptive capacity as a key institutional performance metric within dynamic biophysical systems (Anderies and Janssen, 2013). In that respect, applications of the policy transfer framework to an evaluation of successful economic instruments and their capacity to be adopted in other contexts through comparative analysis appears to have value. However, while comparative study is recommended for policy-transfer, in practice few studies adopt the methodology (Evans, 2009).

2.1. Comparative water market studies

Comparison studies are evident in many analyses undertaken in the field of water resources research. Examples include water resource management and policy (Hurlbert and Diaz, 2013; Poddar et al., 2014), water institutions (Saleth and Dinar, 2005), water governance arrangements (Araral and David, 2013; Grafton et al., 2013; Heinmiller, 2009), indigenous rights to water (Durette, 2010), and river basin management approaches (Schlager and Blomquist, 2008). In the area of water market comparisons there are also examples in the literature. For example, Shatanawi and Al-Jayousi (1995) reviewed the options and possibilities for water markets in Jordan by comparing cases from Chile, Mexico and California to draw lessons about legislative change requirements, institutional restructuring, data challenges and water manager/farmer reservations about market benefits. These same contexts were used to inform water market adoption by developing countries as a means to address future water scarcity issues (Rosegrant and Gazmuri S, 1995). Other lesson drawing examples from comparative water market analyses have determined: i) key institutional function requirements (Bjornlund and McKay, 2002; Marino and Kemper, 1998; Nieuwoudt, 2000); ii) that relatively few areas have the necessary conditions to support water markets (Levine et al., 2007); iii) there are many critical water market development requirements including a need to carefully manage possible third-party impacts, find common strong links between market approaches and sustainable water governance objectives, and develop insights

into market differences between contexts (Bauer, 2010; Grafton et al., 2012; Grafton et al., 2011); iv) the usefulness of water markets for addressing environmental flow needs in different contexts (Garrick et al., 2009); v) the importance of high quality economic/scientific research and paying attention to the opportunities presented by crises in groundwater markets (Wheeler et al., 2016); vi) the relevance of transaction costs on achieving market objectives at both public institutional (Garrick et al., 2013) and private transfer (Loch et al., 2018) levels; and vii) the key steps needed to implement effective water marketing arrangements (Wheeler et al., 2017).

While these fields of research are very interesting and helpful in our understanding of water markets as economic instruments, in the taxonomy of policy transfer these studies would be classed as common comparative analyses examining countries/localities in simple terms as parallel independent cases (Rose and Mackenzie, 1991). As such, they do not highlight how positive outcomes from one context (e.g. Australia) might be applied to achieve similar outcomes in another (e.g. Spain), as well as opportunities to learn from past failures or assess future outcomes. In a policy transfer framework as described by Rose (1991) the critical question of whether programs can be transferred between contexts requires more comprehensive analysis focused on water governance principles and water market outcomes.

2.2. Water governance principles and market outcomes as a basis for policy transfer

Rey et al. (2019) offer a useful critique of the barriers to trade in Spanish water markets which include information gaps, high transaction costs, temporal limitations of trade allowances (e.g. linked to droughts), uncertain property rights, and unclear conditions under which interregional transfers can occur. These barriers pose significant cultural challenges to the implementation of water market governance institutions and principles that adhere to international best practices. However, several high-level organisations have identified opportunities for *ex-post* analysis of policy processes and outcomes to inform governance principles for other contexts to adopt *ex-ante* through partnerships and knowledge transfers (Global Water Partnership, 2011; OECD, 2002, 2015) which may present opportunities for change. Most recently, Gruère and Le Böedec (2019) have stated that where countries are interested in

navigating pathways to water reform in agriculture, governments should continue to improve their water governance systems through relevant scientific and policy research and the setting of evidence-based goals. While reform pathways are not generalizable, some guiding principles based on lessons from other jurisdictions may assist policy-makers to increase the likelihood of adoption and implementation of necessary policy change (Gruère et al., 2018) based on good water governance.

There are many definitions of good water governance. The United Nations Development Programme defines water governance as political, social, economic and administrative systems which regulate the development and management of water resources and service provisions at different levels (as reported in Baumgartner and Pahl-Wostl, 2013). Alternatively, water governance consists of the processes and institutions (mechanisms) by which decisions that affect water are made—excluding routine management functions (e.g. modelling) and water resource outcomes (Lautze et al., 2011). While some governance researchers similarly argue for a separation of water governance process and outcome functions (Rauschmayer et al., 2009), others suggest that both must be analyzed to identify the relevant drivers of change and their (positive/negative) results (López-Gunn et al., 2013). For the purposes of this paper it is most useful to draw on both these principles of good water governance to "create important bases for assessing the state of water governance in a given location, and … opportunities for improvement" (Lautze et al., 2011, pg. 3), and a process for evaluating whether the transfer may result in positive policy improvements. This provides an analytical foundation for our policy transfer comparison and lesson-drawing with respect to water governance/market arrangements in Spain, and clarification of improvement needs under a constructivist approach to identify what is known, what needs to be known, and assessments of effective adaptation performance and application.

Therefore, we propose a framework based firstly on Lautze et al.'s (2011) good water governance qualities which comprise openness and transparency, broad participation, rule of law (predictability) and ethics (integrity, control of corruption). This is then linked to Grafton et al.'s (2011) integrated water market framework to evaluate outcomes in the form of institutional foundation requirements, economic efficiency, and environmental sustainability. Governance arrangements that underpin water markets are important since they inform the way in which marketing and trade develop and change over

time. Even though good governance does not always lead to good outcomes (Cleaver and Hamada, 2010), the combination of good water governance principles and adaptation performance assessment will allow us to identify i) key lessons, ii) links via a constructivist approach to awareness, assessment and application, and iii) future prospective policy evaluation if the mechanisms are transferred between our case study locations. Below we define and characterize each component of the combined framework, and how they interact.

3. Methods

The combined framework results in eight critical (effective) water governance principles that are grouped using two functions: i) transparency, accountability, adaptive capacity, participation, rule of law (which as a group address governance as *process* [GAP] issues to provide the base institutional foundations as discussed in Grafton et al. (2011)); and ii), efficiency, environmental sustainability, and equity (which as a group address governance as *outcome* [GAO] issues). We expand on each of these functions below.

Where markets are accepted by policy makers as an appropriate water demand governance mechanism, attempts are often made to adopt existing exogenous institutional arrangements to provide a basis for structuring procedures in the new context. The following function descriptors detail ideal governance processes/systems. To provide *transparency*, information should flow freely within a society with processes and decisions open to scrutiny by the public. In practice, this requires demonstrated willingness by governments to share information related to water sector policy, legal and regulatory changes, development plans, water allocation decisions, water resources status and uses. To achieve *accountability* governments, the private sector and civil society organizations should be answerable to the public or the interests they represent. In practice, governments and other organizations active in water governance should openly disclose their actions and the results of governance decision-making and should practice subsidiarity, mandating that decisions be taken at the lowest competent level. Governments should also undertake actions to reduce corruption and illicit personal gain in water sector decision-making. For governance mechanisms to achieve *adaptive capacity*, or to assess how

redesign might be needed, there must be variety in the solutions proposed consistent with multi-level (subsidiary) participation discussed previously, some capacity to learn and autonomously change as required, sufficient resources (financial, human, authority) in support of objectives, and visionary leadership coupled to fair governance practices that provide legitimacy (Gupta et al., 2010). These characteristics will ensure that managers can provide the conditions and mechanisms necessary to reduce people's vulnerabilities to environmental change. In terms of *participation* all relevant stakeholders (governmental and non-governmental alike) should have a voice; directly or through intermediate organizations representing their interests throughout the water governance policy formulation and decision-making. In practice, this requires demonstrated willingness by water managers to solicit and consider input from stakeholders in civil society and elected legislators. It also requires demonstrated willingness by government leaders to make changes and adjustments on the basis of received advice. Finally, for an *effective rule of law* (predictability), all legal frameworks should be fair and enforced impartially. In practice, decisions should be made in conformity with specified laws, practices and procedures with predictability across all stakeholders, both internal and external to the process.

Governance outcomes from effective water markets provide useful evaluation criteria following any policy transfer process. This is analyzed in relation to three further functions. Markets are typically described as providing *economically efficient* (re)allocation of scarce resources under neoclassical assumptions. However, other potential efficiencies include political, social, environmental and cultural goals which need to be balanced against simple economic outcomes. It is also essential that governance systems do not impede transfer activity. For example, minimizing transaction costs will go a long way toward political and economic efficiency and increasing market gains for those that participate (Loch et al., 2018). Further, although there may be a range of objectives linked to the implementation of water markets, one common objective in the literature is *environmental sustainability*. If long-term sustainability for water resources is the main objective, current and projected water demand should be evaluated against future water use impacts. Relevant policies should be information- and incentive-based to manage inevitable social and/or economic pressures. This can come from accurate market data

and research into costs, benefits and transitions over time for all stakeholders—together with an agreed mechanism for taking risk/uncertainty into account (see for example state contingent methods for risk assessments in Loch et al. (2019)). Finally, policy-makers typically seek to achieve equity between and among various water interest groups, stakeholders and consumers. With such trade-offs in mind it will be necessary to carefully monitor market uptake and impacts throughout the policy development and implementation process as part of the institutional design, process, and modification (where needed). The complete combined comparative evaluation framework is illustrated in Table 1.

Table 1: Combined framework for comparative policy transfer study

Principles of good Water Governance	**Evaluation Item**
Governance as a process	
Transparency	Public and accessible digital register of property rights Publicly accessible water trading information
Accountability	Administrative capacity Administrative and Legal Clarity Enforcement Vertical/Horizontal Links (State/River basin management) Hydrological integrity of different sources
Adaptive capacity	Water trading options Definition of entitlements as unit shares Unbundled water rights / and access to new users
Participation	Recognition of Public Interest Compulsory Public Participation
Rule of Law (Predictability)	Clearly defined and assigned water rights (Security) Existence of a CAP on water resources Entitlement shares issued for long-term periods
Governance as an output	
Efficiency	Number of transactions Breadth of the markets Market price formation and availability Gains from water trade Low transaction costs
Sustainability	Third-party effects Provision for Environmental flows
Equity	Priority of use

We adopt the above framework to enable our comparative evaluation of the two case study areas (i.e. Australia and Spain) and draw lessons. Evaluation and lesson-drawing are inextricably linked and no lesson(s) can be drawn without previous comparative analysis. A lesson includes judgement about a

programme in effect elsewhere and the position of a potential user. Only if another country is doing better in handling a specific problem can a positive lesson be drawn. On the contrary, if it is evaluated as doing worse, then any lesson will be about what not to do. Accordingly, the dynamic question is whether a policy in effect in one country could work in another in the future (Rose, 2005), where a starting point is an observation of differences between two cases at a given point in time.

To provide this starting point we benchmark and comparatively assess water market development and performance in the different contexts via a policy diffusion approach (Stone, 1999). The policy diffusion approach takes different national circumstances between countries into account during comparative assessment, based on an assumption that policy transfer may arise as a consequence of structural forces. Following this approach, the comparative analysis for our case studies is conducted according to four key stages of lesson-drawing defined by Rose (1991): i) *searching* for sources of lessons (in our case Australian markets serve as a source of inspiration for Spain), ii) *making a model* of how the policy or practice works in situ (see Section 4.1), iii) *creating a lesson* by assessing what can be extracted from the practice in the exporter jurisdiction to produce the desired results in the importer jurisdiction (Section 4.2), and iv) *prospective evaluation* of the way in which the policy or practice is likely to work in the importer jurisdiction including any adaptions needed to make it work (Section 4.3). In this regard, Rose (1993, pg. 118) notes that "a major task in lesson drawing is to identify the prospect of whether policy lessons can be transferred from one place to another". This is incorporated into the analytical framework by scoring each of the function criteria above for the Spanish transfer context in terms of importance for effective market function, and amenability to change. For instance, although changes to administrative capacity may be classified as a priority because they are relatively easy to accommodate in the governance process, such changes may not be absolutely essential for the effective function of water markets, and hence in the final scoring that may attract a 'medium' importance rating.

We illustrate this model in Figure 1 as a means of detailing the process involved, and then introduce the two case study sites below.

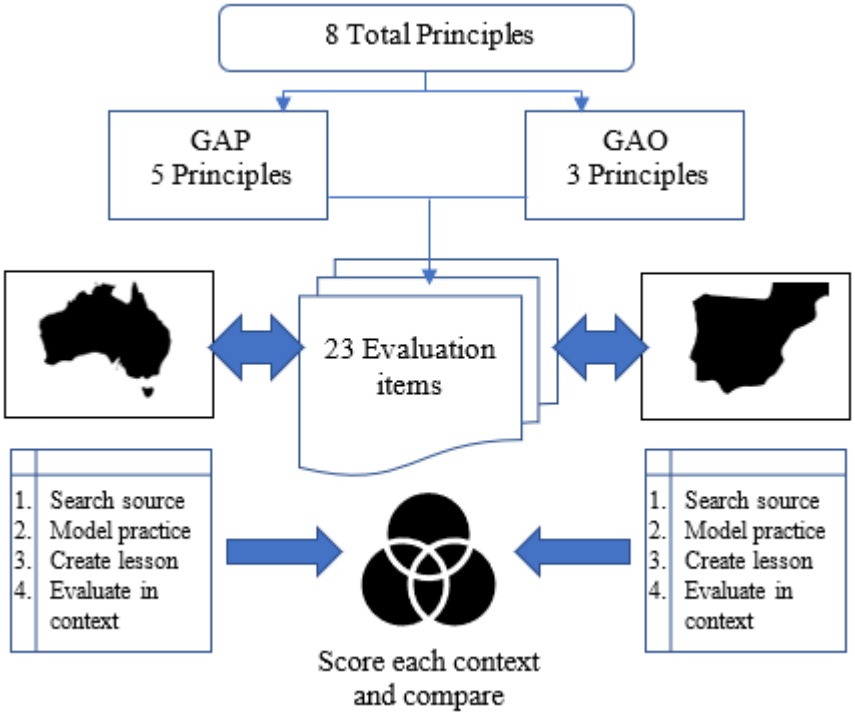

Figure 1: Method process for lesson drawing

4. Results

4.1. Stage 2 Modelling: Australia versus Spain as case studies

Before the detailed comparison is undertaken it will be necessary to first describe the policy transfer contexts to make a model which will determine their broad comparability and suitability for further examination. With respect to each evaluation item a complete set of data is provided in Appendix A which should be read in conjunction with the paper to ensure a full set of data is appreciated as both a basis for the comparisons, policy transfer contexts, and scoring processes undertaken at the later stages of the methodology. However, for the purposes of the paper Table 2 offers a summary of outcomes for the two countries. The between-country comparison shows areas of commonality and difference, as expected. Importantly, the two contexts are comparable across all of the evaluation criteria and in-situ data can be extracted in every instance which enables a model to be constructed. In turn, this allows us to draw lessons for policy-makers in the importer country (i.e. Spain), as discussed below.

4.2. Stage 3 Lesson-drawing

A comparison of conditions, mechanisms/instruments and ultimate outcomes between the exporter and importer countries in the model enables lessons to be drawn for each evaluation criteria in the governance as a process (GAP) and governance as an outcome (GAO) sets. The full data set for the two context assessments and criteria scoring are contained in Appendix A online. Here we summarize the main lessons:

Lesson GAP1: Existing use/s should be recorded to ensure total water use is on the register, and matched with renewable and accessible resources. The register should be updated to account for dozers (i.e. un-/under-used rights) in the system. This because once markets are implemented and the potential gains from trade revealed, dozers' water may be activated and transferred between users. If sufficient matching resources cannot be identified, regulators may have to cancel sleeper/dozer rights ahead of marketization to ensure resource caps are not breached.

Lesson GAP2: online, readily available and transparent information on trade prices and volumes is needed to know who's selling, how much, and at what price. Recent issues with poor data in Australia have highlighted the opportunity for price manipulation and misleading conduct by brokers, to the detriment of users. Ideally, all data is centrally held, checked and managed to avoid manipulative outcomes and provide confidence in price signals and trade movements (e.g. avoid bubbles and limit speculation). In this regard, the Spanish law helpfully allows for two alternative market settings: spot markets and exchange centres, the latter being a clearinghouse where all trade is centrally managed by the public sector and related information is made publicly available. Exchange centres would address the need for accessible and public trading information, possibly after paying a fee to the public sector. More transparency is also needed for spot markets. For exchanges in spot markets, river basin authorities are informed and they have two months to approve; else, the law of positive silence applies. Given the limited administrative capacity of river basin authorities, it would be useful to make trading requests public (including information on volumes traded and exchange prices), thus allowing any interested party to be informed and heard prior to the formal approval.

Table 2. Framing the Case for Each Country

	Searching for Sources	*Making a model*	
	Evaluation Item	**Spain**	**Australia**
	Governance as a process		
Transparency	Public and accessible digital register of property rights	Registers with each River Basin Authority, including maximum concessions and limits. Rights are defined in terms of water use, not consumption/depletion of the resource.	Registers in each state, and useful data on location and use constraints. Rights are defined in terms of water use, not consumption/depletion of the resource.
Transparency	Publicly accessible water trading information	Public institutions openly declare when and where trading is allowed, yet trading data (quantities, prices, location) is neither gathered in registers nor made publicly available.	There is a public register of all property rights (or entitlements) on issue in each state, which is supported by a central federal government register housed with the Bureau of Meteorology.
Accountability	Administrative capacity	Administrative capacity is limited. To prevent delays, the law of positive silence applies; if no response from the public administration is received that trade is automatically approved.	Trade administrative capacity has much improved in the last 10-15 years as processing times have decreased and the time required to finalize a trade has diminished markedly. Overall governance though remains poor as flagged by recent inquiries.
Accountability	Administrative and Legal Clarity	The Spanish legal framework is clear, internally coherent, protective of environmental/priority uses, and widely regarded as exemplar. Yet differing interpretations of EU laws have resulted in suits against beneficiary-pays based interventions, which include markets.	Good performance in Australia after many years of reform, and reasonably settled with respect to trades.
Accountability	Enforcement	Water theft is widely documented in some hotspots (e.g. Doñana, Mancha Occidental Aquifer). Informal water use (non-authorized dozer-type uses that are known and tolerated by water authorities) is common throughout Spain. Informal trading has been reported to exceed formal trade volumes, although no register exists.	This is generally good, although there have been some instances of water theft in regional areas. Entitlements in general are fully enforced, as are extraction limits and transfers between users.
Accountability	Vertical/Horizontal Links (State/River basin management)	Spain was the first EU country to establish river basin authorities more than a century ago. The role of the state is that of supervising and creating a common framework, while arbitrating inter-basin conflicts.	In the MDB this is overall satisfactory, with a long history of use and understanding with respect to system limits and conditions.
Accountability	Hydrological integrity of different sources	The Spanish legislation is protective and exemplar in this regard. Yet, there are legal loopholes (e.g., by exploiting the law of positive silence to increase consumptive uses and economic returns—which in turn may reduce return flows and water availability downstream).	There is an improved understanding, appreciation and incorporation of hydrological realities into transfer and deliver decisions in connected catchments such as the southern MDB. However, there have been concerns raised about whether all hydrological factors are being properly

			considered. Water consumption to use ratio concerns exist as well.
Adaptive capacity	Water trading options	Two options: exchange centres (clearinghouse operated by the public sector) and spot markets (bilateral agreements among users).	Mainly entitlement (permanent) and allocation (temporary or seasonal) trade. Futures and derivative trades also now possible within trade zones and regulatory arrangements.
	Definition of entitlements as unit shares	Entitlements are defined in absolute terms (i.e. m3/ha). These entitlements can be reduced during a drought, where river basin authorities can (arbitrarily) reduce supply by a given percentage depending on the drought intensity.	All water rights are defined as shares of a specific and defined pool of water. Allocations against those shares are made annually (and semi-annually if not fully allocated at the open) as resources are/become available for use.
	Unbundled water rights / and access to new users	Water rights are bundled to land.	Almost all water rights are completely unbundled from land.
Participation	Recognition of Public Interest	All trades are subject to the public interest tests.	Water is now managed in the national interest under *Environmental and Biodiversity Provision Act* powers at the federal level.
	Compulsory Public Participation	All relevant planning must undergo compulsory public consultation before approval.	Public participation is voluntary in all aspects of water reform or management, although many users tend to get deeply involved.
Rule of law	Clearly defined and assigned water rights (Security)	Rights are issued in absolute volumes rather than shares.	There are several security levels with respect to rights across the country, and even within connected and centrally managed systems (e.g. the MDB).
	Existence of a CAP on water resources	Caps are set in the river basin management plan for every user but enforcement, as noted above, is far from ideal.	There has been a cap on further extractions/diversions in the MDB in place since 1995/96 set at the 1993/94 level of development.
	Entitlement shares issued for long-term periods	Water belongs to the public domain and water rights only reflect the right to use the resource, not the property right. Rights are allotted for up to 70 years, and automatically renewed provided use continues.	While all rights have retirement date built into them under state legislation (20-25 years), in reality if the user ensures timely reapplication and processing to renew then water rights will be granted in perpetuity.

Searching for Sources		*Making a model*	
Evaluation Item		**Spain**	**Australia**
	Governance as an output		
Efficiency	Number of transactions	Low. Limited to drought periods where institutions allow trading to occur. Limited willingness to participate among farmers. Irrigator representatives conduct negotiations and then reallocate water among farmers.	Very high, with thousands of transactions each year.
	Breadth of the markets	Markets occur mostly within the agricultural sector. Exchanges cannot occur between holders and non-holders	Mostly agricultural trade, but with growing environmental and external (i.e. investment) participation in the market via former irrigation rights.
	Market price formation and availability	Through bilateral negotiation in spot markets and through a clearinghouse in exchange centres.	No central clearinghouse so prone to opportunistic misrepresentation and manipulation by water brokers on the basis of high information asymmetry.
	Gains from water trade	From medium-high in intra-basin markets to very high in subsidized inter-basin markets.	Can be very high, either in terms of protection from capital losses, sale of limited water assets during drought, or via speculation on future price movements due to uncertainty.
	Losses from water trade	Trading can lead to asymmetric and non-negligible impacts on rural economies and lead to opposition to trade by third parties.	Systems attempt to minimize losses to third parties, but externalities still apparent (see below).
	Low transaction costs	Transaction costs are high due to the limited number of participants and information asymmetries, particularly in spot markets; and the fact that rights are granted to water user associations (which make communal decisions through voting), instead of farmers.	Transaction costs have been lowering over time in the more well-established markets, and have become less of a barrier to trade than they once were.
Sustainability	Third-party effects	High. If subsidies are removed and if third party effects are considered trading potential and economic surplus can significantly decrease.	Some third-party impacts (e.g. increased salinity, delivery disruptions or possible waterlogging) are taken into account when making transfer assessments.
	Provision for Environmental flows	Again, the Spanish legislation is very clear and exemplar in this regard, but application is ineffective.	Environmental flows are provided in two ways: under planned water arrangements or via held environmental water rights. This has increased the equity afforded to environmental needs.
Equity	Priority of use/equity gains	Inter-personal equity priorities are clear: irrigation is a low priority use behind environmental and urban uses. Interregional equity has proven more challenging and resulted in recurrent conflicts between public administrators.	Critical human needs (e.g. drinking water) in times of drought are prioritized. Basin-wide trade in sMDB has achieved inter-regional equity objectives.

Source: Own elaboration based on literature review

This raises the question of what's preferable: a public, centralized trading clearinghouse that constrains every agent to trade through such clearinghouse, gathering and offering timely information on prices and quantities at the relevant level (irrigation district, catchment, basin), or multiple, local spot markets without the involvement of the administration in the trading. In either scenario providing all traders with a unique identifier available only to them, and offered by a central regulatory body, is instrumental to limiting market manipulation and price inflation/deflation in the market.

Lesson GAP3: supervision of trading to prevent the upstream consumption of return flows at the expense of downstream uses is necessary to avoid equity issues, but may involve non-trivial processing charges. One option to reduce processing costs is to automatically reduce trading to the consumed fraction (Huffaker, 2008) which may have considerable economic costs (Pérez-Blanco et al., 2020). On the other hand, hydrologic basin models that distinguish between recoverable/committed and non-recoverable/uncommitted return flows could allow higher economic surplus. What is critical for trade is a common ontology for water terms and conditions that are applied nationally (and possibly wider where relevant for international catchments). For example, clear water accounting that distinguishes uncommitted/non-recoverable from committed/recoverable return flows is needed to maximize benefits of trade. This is not apparent in Australia or Spain, and would improve outcomes significantly for administration, user comprehension, and discussions around reform. Clear accounting also allows capacity for centralized administration to effect better control, processing and monitoring, and achieve recognition and visibility of public interests.

Lesson GAP4: the law in both countries reflects best international practice and detection is improving with the use of remote sensing techniques and data. The issue is not the law, regulatory power or technical issues regarding detection; it is enforcement on the ground via sufficient resources (administrative capacity) and well-structured frameworks for prosecution and conviction. In Spain, it is necessary to reduce water theft and informal water use (non-authorized uses that are known and tolerated by water authorities) by establishing a clear limit to the overall amount of water that can be used in a given area, to achieve more effective enforcement of existing entitlements. In Australia a future issue will be increased penalties for unlawful use.

Lesson GAP5: understanding nested systems and natural limits is key, particularly in mature basins where supply is inelastic and cannot accommodate additional use. Recognizing and incorporating resource limits to accommodate high uncertainty (Randall, 1981) will be key, particularly with respect to water. If supply risk/uncertainty is not properly factored into market prices through supply system management arrangements and forward planning (e.g. possible future restrictions on agricultural production growth and/or perennial commodities which require water in all states), extreme price fluctuations and speculation may occur as seen recently in Australia. These impacts can have significant negative effects on market confidence and outcomes.

Lesson GAP6: An environmental regulator or institution that supervises environmental impacts should have a role in the oversight/evaluation of water trading. The role of this institution could be further strengthened through recognition of legal rights of water bodies (e.g. rivers as legal persons). Entitlements should also be periodically updated to account for changes in irrigation efficiency, so that water consumption cannot be increased at the expense of third parties through the adoption of 'hi tech' systems, and equity does not decrease between users. This would discourage investments in irrigation systems that expand consumption at the expense of other users through reduced recoverable return flows, but needs not discourage investments that expand consumption at the expense of non-recoverable return flows (water flowing to a sink such as the sea or a saline aquifer) or non-beneficial consumption (such as evapotranspiration by weeds). As before, this lesson is relevant for effective recognition of public interests.

Lesson GAP7: water trading options are dynamic and should be revised as the market progresses towards a mature state (Wheeler et al. 2017). In early development stages market power by public agents (monopsony-monopoly setting) can be exerted for arbitrage gains via monopolistic/monopsonist practices (Gómez-Limón et al., 2020; Gutiérrez-Martín et al., 2020). Curbing market power enhances allocative efficiency while raising public revenue towards financing market setup (e.g. restoring the balance in overallocated basins). Movement toward a mature market may see increased use of derivatives, option contracts, etc. as confidence, experience and trader expertise grows.

Lesson GAP8: Water rights should be defined as shares over the available pool of resources instead of absolute entitlements. As the pool of resources reduces/increases in dry/wet years the water entitlement changes accordingly. Adopting shares and security levels introduces certainty on the reliability of the supply being traded, and can favour capitalization of the farm towards higher yield and profit (high security) or avoid unintended risky investments and capital loss (low security).

Lesson GAP9: shares need to be clearly set with regards to an observable indicator, e.g. water stored in a reservoir, and not decided at the discretion of an institution—as it is done at present in Spain with drought management. Further, users should be informed/made aware of the relative shares that relate to each type of security on offer (e.g. high reliability rights versus lower reliability rights). If, as happens in Australia, higher reliability rights require a majority of storage volume to achieve security (e.g. 70% of dam volume), then this will impact water availability/equity for others and how they assess their future supply risk.

Lesson GAP10: Water can be reallocated independent of land as long as resources are in the same hydrological unit and no third party impacts are predicted; but where impacts are observed, allocative choices should be rapidly reverted to ensure hydrological integrity.

Lesson GAP11: Entitlement shares are similar in both countries. Although *de jure* all water in both countries belongs to the public, and private uses can be cancelled where needed, used rights are *de facto* granted in perpetuity with little evidence of cancellation. While rights in perpetuity are useful for investment certainty, it is advisable to hold some form of cancellation power in reserve as a means to ensuring compliance with regulations and change requirements, especially with respect to future scarcity drivers and needs for climate change adjustment.

For the governance as an output (GAO) set we can further observe:

Lesson GAO1a: A wide and deep trading base (e.g. high volume of trade volume and price variation) is necessary to develop the economies of scale that lead to successful market outcomes, price signalling, and effective/efficient transfers between users. In Australia, although initially not supported by irrigators, water markets are now a well-entrenched risk management tool that most would want to

retain. That said, recent price signalling has been non-transparent due to the inclusion of unregulated brokers and unidentifiable trade activity. These issues must be managed to ensure confidence and transparency in market activity for effective adaptation.

Lesson GAO1b: Breadth of trade enables two positives: capital injections to agriculture and other industries from a variety of sources enabling greater risk spreading, and greater efficiency in trade as values and prices attached to water are tested and enlarged. If individually identifiable, correct price signals will also enable analysis of trade sources and drivers to ensure accurate market understanding.

Lesson GAO2: Good price signals come from central registries/trade platforms that are overseen by strong regulation and independent authorities. This enables ease of access to 'real' price signals, and avoids manipulative opportunities (as discussed in Lesson GAO1a/b).

Lesson GAO3: Water markets can be used as a tool for raising revenue towards achieving public policy goals, particularly during the transition to full-fledged water markets. In the case of Spain, water institutions can deploy water markets where the state buys water at low prices and sells at high prices. This makes it possible to raise resources to increase environmental flows at a lower price than would be observed in full-fledged water markets (Gómez-Limón et al., 2020). In Australia, both environmental and commercial users pay water fees, and this ensures the costs of water management continue to be met after reallocation of resources between user groups.

Lesson GAO4: Gains from trade including positive indirect impacts on third parties not directly involved in trading (e.g. food sector) should be periodically assessed and reported both to ensure greater engagement by non-adopting users and identifying positives from regulator decision-making. It is also necessary to assess and report on the negative externalities of trade to ensure costs can be incorporated into prices (i.e. improved equity).

Lesson GAO5: It is necessary to develop instruments that prevent/mitigate negative third party impacts from trading (e.g. impacts of reduced environmental flows on threatened species), including exit fees to minimize negative impacts from stranded assets or compensation mechanisms that reallocate trade surpluses through taxes.

Lesson GAO6: Address any remaining third-party impacts ahead of fully-fledged market establishment. This can be done through buyback programs and/or (early stage of market development) benefiting from a monopoly/monopsony setting to restore the balance in overallocated basins at low or even zero cost. If any additional costs emerge, charges or fees may be added to water trades to recover (at least a part of) the associated costs. This process must be reassessed over time, as new third-party impacts are identified (e.g. salinity in Australia).

Lesson GAO7: Environmental flows are protected in accordance to EU laws, but often are not enforced. Market fees could be used to incorporate the costs of overallocation into the market price to limit/recover the costs of over-abstraction. Markets can also introduce flexibility to acquire/sell environmental flows where there are punctual needs (e.g. pulse flows to conserve/restore critical ecosystems) or in cases where regulated flows have been unrealized.

Taking the lessons above into account, we are now able to move to the final stage of our analysis which involves a scoring and evaluation of both their importance for effective implementation and continuation of water markets in the importer country (i.e. Spain), and the potential amenability of that country to the changes required. The score values, partly based on data contained in the Appendix materials, inform our final view of the usefulness of lesson-drawing and policy transfer in this case.

4.3. Stage 4 Prospective Evaluation

Table 3 summarizes our scoring/evaluation of important market conditions and Spanish amenability to change in support of water markets. As shown, most of the water governance criteria included in the assessment have a medium or high importance to effective water marketing. Only the number of options available in a market is assessed as having low importance, where at least seasonal (spot or temporary) and long-term (permanent) rights transfers should be available at a minimum. Options and futures trade products are of lesser relevance.

Our assessment of Spain's amenability to change in support of meeting those water market governance arrangements is more mixed. Among the GOP elements, the *transparency* criterion can be realistically met to support water markets leveraging on clearly defined and publicly available central

registers, which provide a sound basis for trading management and simplifies the gathering of trading data. The *accountability* criterion can be also met in a relatively straightforward way, building on a sound legislation body that clearly recognizes the priority of the public interest above all other private uses and makes public participation compulsory in every major policy reform. Further, the *rule of law* criterion is mostly amenable to change towards supporting water markets; although some challenges may arise, including in the definition of security levels. Agricultural users (a low priority, after higher priority urban and environmental uses) frequently experience water restrictions during droughts but these restrictions are based on a solidarity principle (same percentage reduction in water use among irrigators within the same catchment). Establishing high or low security rights in a formal way based on seniority is likely to face considerable opposition among farmers who have planned ahead (e.g. investments in irrigation modernization or permanent crops) based on the pre-existing legal doctrine. Different (lower) legal security levels could be adopted for newly granted rights, although their role would be marginal given that Spanish basins are closed or closing. Issuing water rights in perpetuity is also challenging since water users in Spain are never granted the property right over water, which ultimately belongs to the public, but rather the right to use it. In practice though, the right to use water is automatically renewed provided effective use continues providing a sufficient degree of predictability to support market development.

Achieving *accountability* also presents challenges notwithstanding exemplar and clearly established administrative and legal principles. For example, trade that negatively affects third parties should be banned according to the law, but the rule of positive silence and limited administrative capacity to supervise all exchanges has often negatively affected the environmental quantitative and qualitative status of water bodies. In addition, infrastructure to enhance inter-basin connectivity has bypassed traditional and centralized coordination exerted by river basin authorities, creating non-trivial and deeply embedded inter-regional conflicts (known as “Spanish water wars”). These wars have negatively affected coordination between central, regional and basin administration and lowered equity among users. All the above negatively affects the hydrological integrity of water bodies.

Regarding *adaptive capacity* a major challenge for market adoption relates to the definition of entitlements as unit shares. As discussed above for the security levels, water use rights in Spain are issued in absolute terms and, although restrictions during droughts are common, users (particularly farmers) typically perceive these as water storage and delivery system failures that can be addressed through additional/better infrastructure rather than accepted and managed through economic and regulatory instruments. Changing this paradigm will be costly, and arriving at a point where uncertainty is acknowledged through water right shares that can be adjusted to the vagaries of the water cycle and climate will take time.

Among the GAO elements, we can see that water markets are likely to lead to a satisfactory performance in terms of *equity*, in part due to some of the issues noted above (lack of security levels, solidarity-based response to droughts, improved third-party outcomes etc.) *Sustainability* performance is less satisfactory mainly due to the accountability issues that threaten hydrological integrity, which may lead to non-trivial third party impacts where upstream systems grow at the expense of downstream users (notably the environment). Finally, while efficiency from a neoclassical economics standpoint would be expected to increase sharply following market adoption due to a number of factors (see Table 3), institutional efficiency is rather low due to the manifold barriers to reform identified for the GOP elements above (priority use, inter-regional conflicts, etc.) and, as in Australia, may take time to fully emerge. Low institutional efficiency may also affect capacity to achieve balanced outcomes (e.g. higher market gains at the expense of poor environmental performance). Thus, if sustainability objectives are to be met, institutional reform towards market adoption will involve in its early stages non-trivial transaction costs—including time. Although the Australian case suggests transaction costs related to market adoption can be reduced over time (Loch et al., 2018), ad-hoc studies for the Spanish case will be needed to monitor institutional efficiency/effectiveness.

Table 3. Comparative assessment of Water Trading Governance Transferability to Spain

Principles of good Water Governance	*Searching*	*Prospective evaluation*	
	Evaluation Item	Importance for Effective markets	Amenability to change
Governance as a process			
Transparency	Public and accessible digital register of property rights	♦♦♦	♦♦♦
	Publicly accessible water trading information	♦♦♦	♦♦♦
Accountability	Administrative capacity	♦♦♦	♦♦
	Administrative and Legal Clarity	♦♦♦	♦♦♦
	Enforcement	♦♦♦	♦
	Vertical/Horizontal Links (State/River basin management)	♦♦	♦♦
	Hydrological integrity of different sources	♦♦♦	♦♦
Adaptive capacity	Water trading options	♦	♦♦♦
	Definition of entitlements as unit shares	♦♦♦	♦
	Unbundled water rights / and access to new users	♦♦♦	♦♦
Participation	Recognition of Public Interest	♦♦	♦♦♦
	Compulsory Public Participation	♦♦	♦♦♦
Rule of Law (Predictability)	Clearly defined and assigned water rights (Security)	♦♦♦	♦♦
	Existence of a cap on water resources	♦♦♦	♦♦♦
	Entitlement shares issued in perpetuity	♦♦	♦♦
Governance as an output			
Efficiency	Number of transactions	♦♦♦	♦♦♦
	Breadth of the markets	♦♦♦	♦♦♦
	Market price formation and availability	♦♦♦	♦♦♦
	Gains from water trade	♦♦♦	♦♦♦
	Low transaction costs	♦♦♦	♦
Sustainability	Third-party effects	♦♦	♦
	Provision for Environmental flows	♦♦	♦♦
Equity	Priority of use	♦♦	♦♦♦

♦♦♦ High, ♦♦ Medium or ♦ Low importance/amenability ratings; ✕ Not satisfied/missing/not operational.

5. Discussion and Conclusions

This study has made a first attempt of testing lesson-drawing approaches to water market reform in Spain using information from the Murray-Darling Basin, Australia. The results reported here provide a preliminary comparative analysis framework as well as some early findings about key lessons and policy transfer potential to stimulate and enhance Spanish water markets. With respect to our research questions, we have determined that Australia's mature water market does enable other contexts to draw effective adoption lessons—particularly in the case of Spain where several key similarities exist. Further, after taking due account of relevant differences in time, institutional and country characteristics it is considered that Spain could certainly benefit from Australia's experiences with water markets and lessons learned over the last 30 years. In this regard policy transfer directions on market adoption and institutional reform are assessed as extremely valuable to Spain as the blueprint country for other EU nations. This suggests Spain's water governors can draw insight from the Australian cases to the benefit of improved future adaptive capacity in their national water resources.

Spanish water governors will face challenges though, including the provision of formal and perpetual water rights in support of effective transfers, subsidiarity problems between different levels of administration which have caused hydrological uncertainty for future use/users, which in turn drives issues around costly and continuing preferences for infrastructure (supply-side) solutions over demand-side (water marketing). Our study demonstrates that with respect to the key adaptive capacity evaluation criteria specified above, Spain could benefit from the wider adoption of market mechanisms in favour of increased future reallocation objectives that will be necessary as scarcity increases. Further, as shown here future supply uncertainty—regardless of infrastructure decisions taken today—will continue to accumulate and must be successfully mitigated by Spanish water governors for effective adaptive capacity outcomes. This will require reform as detailed above but where considerable existing expertise, competence and faculty are evident in current Spanish arrangements (see Table 3). Ultimately, individual and sectoral adaptation to supply constraints are more readily achieved via market instruments than slow/unwieldy central planning or governance arrangements; especially when

there is a need to address rapid or continuing supply shortages and a requirement to reallocate resources in response. It is this motivation for change that will drive future consideration of water markets as an instrument for resource reallocation—where as we have seen equity concerns can also be achieved. As climate impacts increase this need will become more urgent. In our view, Spain is therefore well placed to adopt water markets despite current political efforts to prohibit such institutions, and could begin that transition on the basis of the lessons provided by this study for future adaptation gains. A starting point for this change could involve the wider discussion of its findings and recommendations by all relevant stakeholders in the Spanish context—or at the very least, a representative context with pressing scarcity reallocation requirements—to achieve feedback on our suggestions for reform and to map a pathway forward. As this research team involves members from both countries, they would be willing to design that process and undertake it in a willing context. That would answer our final research question related to targeted management options for addressing future scarcity and adaptation requirements.

Nevertheless, the framework is still in its early stages. Many questions must be addressed to support its further development as a basis for better understanding water governance in specific situations, and as a diagnostic tool for interventions that support better outcomes from water markets. This will be the subject of further research by this team in other EU jurisdictions.

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