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Research into water allocation through effective water trading

Phase 1 - Stakeholder engagement

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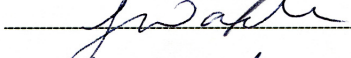
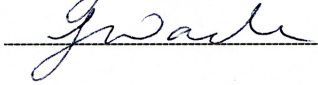
Approved 

Authorised 

Summary

Research into water allocation through effective water trading

Phase 1 - Stakeholder engagement

Report EX6807
September 2012

The overall goal of the research is to address the question: "What is an effective water trading system and what are the implications for stakeholders concerned with sustainable water abstraction?" The objectives of the research are as follows:

- To establish the feasibility of an effective trading system at a catchment level;
- To provide stakeholders with a shared, credible, evidence base about water trading at a catchment level;
- To generate evidence to inform policy rather than make policy recommendations.

The research was carried out in the Upper Ouse and Bedford Ouse catchment in East Anglia. East Anglia is facing acute short-term and long-term water resources issues.

Phase 1 of the research comprised engagement with a variety of stakeholders comprising: abstractors who hold abstraction licences in the catchment; innovators (who have implemented innovative water management techniques) and delivery agents such as the Environment Agency. The main findings of the Phase 1 stakeholder engagement were as follows:

- The interrelationship between type of licence, use and timing creates a set of complex conditions in which water is managed. As a result, each abstractor encounters a different set of challenges and opportunities in managing their water resources. This will need to be taken into account in designing and operating trading systems;
- Currently, abstractors engage in a number of water management practices in order to ensure they have enough water at the right time and place for their businesses. This includes "informal" trading, between trusted sources at times of need;
- There were perceptions amongst many abstractors that the introduction of a water market would 'force' them into trading;
- There is widespread lack of knowledge and awareness of water trading across all types of stakeholders. As a result, the space exists to be able to discuss trading. We did not find entrenched views: there was neither outright rejection nor committed support for increased trading in water or a new system to facilitate it;
- Across this catchment, there is evidence of the existence of valuable social capital including: Bonding capital (close knit groups with support from family/friends); Bridging capital (wider networks, bringing people involved in different groups together providing access to wider resources) and Linking capital (hierarchical networks between people in local areas and organisations with power and influence). In the recent drought, these relations facilitated the introduction of voluntary restrictions on groundwater abstraction. The introduction of a market in water could change these relations and potentially affect the ability to implement alternative methods for managing water abstraction and use;
- The issue of ring fencing was made by many abstractors. There was a perception that farmers would lose out to larger abstractors if trading of licences were to be introduced;
- Innovators appear to provide links between farmer abstractors and regional or national delivery agents such as the Environment Agency and the Internal Drainage Boards.

Glossary of terms

Abstraction – The removal of water from surface waters (i.e. lakes, reservoirs, rivers) and groundwater for agricultural, domestic, commercial, power and industrial uses.

Abstraction licence – A licence that gives the holder a right to take a certain quantity of water from a source of supply (e.g. inland waters such as rivers or streams or an aquifer).

Abstractors – Holders of water abstraction licences within the Upper Ouse and Bedford Ouse catchment.

Bonding capital – This is the social connectedness that uniquely follows when individuals from within a particular group relate closely to one another.

Bridging capital – This is the social connectedness that results when members of dissimilar groups engage with one another.

Catchment – The area drained by a watercourse.

Catchment Abstraction Management Strategies (CAMS) – CAMS are produced at a catchment level in England and Wales by the Environment Agency in order to provide a consistent and structured approach to local water resources management, recognising the reasonable needs of abstractors and the needs of the environment.

Central pool method – A method of trading via which all water rights would be traded via a catchment manager through a “central pool”.

Delivery agent – An organisation that is currently responsible for water management and regulation in England and Wales such as the Environment Agency and Ofwat.

Drought – There is no single definition of drought. A drought is caused by shortage of rainfall; however, the nature, timing and impacts will vary according to the location and the different sectors affected such as public water supply, agriculture and industry.

Equity – The state, quality, or ideal of being just, impartial, and fair.

Environment Agency – The organisation responsible for managing and regulating water resources and the environment in England and Wales.

Externality – This is the effect of a purchase or use decision by one set of parties on others who do not have a choice and whose interests were not taken into account.

Groundwater – Water that collects or flows beneath the earth's surface, filling the porous spaces in soil, sediment, and rocks. Groundwater originates from rain and from melting snow and ice and is the source of water for aquifers, springs, and wells. The upper surface of groundwater is the water table.

Hands off flow – The flow below which an abstraction licence holder cannot abstract water from a watercourse.

Innovators – Organisations and people with abstraction licences who are carrying out innovative water management practices and/or are interested in the trading of water rights.

Linking capital – This refers to the social connectedness of individuals or groups belonging to different “levels” of a society or organisation.

Pair-wise trading – This is where trading takes place between two separate parties.

Reservoir – A natural or artificial body of water used for the storage and regulation of water.

Ring fencing – The act of putting restrictions on an abstraction licence so that it can only be used for a particular purpose e.g. irrigation.

Social capital – The network of social connections that exist between people/organisations, and their shared values and norms of behaviour, which enable and encourage mutually advantageous social cooperation.

Social connectedness – This relates to how people and organisations come together and interact. Components of social connectedness include: the duration of the relationship; the frequency of interaction; knowledge of the person or organisation's goals and how familiar someone is with the "social circle" of the other people or organisation.

Surface water – Water naturally open to the atmosphere i.e. water in streams, rivers, reservoirs, lakes, ponds, estuaries and seas.

Thin trading – A condition where there is little trading activity in the market because there is a lack of buyers and/or sellers.

Tipping point – The point at which a significant change takes place.

Water trading – The process of buying and selling entitlements to water.

Contents

Tables

Contents continued

Figures

Appendix

1. Introduction

1.1 BACKGROUND TO THE RESEARCH

The University of Cambridge Programme for Sustainability Leadership (CPSL) has launched a Collaboratory on Sustainable Water Stewardship, chaired by Lord Selborne who is Treasurer of the UK Government's All Party Parliamentary Water Group. A key strand of this work is focused on water allocation through water trading.

The overall goal of the research is to address the question: "*What is an effective water trading system and what are the implications for stakeholders concerned with sustainable water abstraction?*"

The objectives of the research are as follows:

- To establish the feasibility of an effective trading system at a catchment level;
- To provide stakeholders with a shared, credible, evidence base about water trading at a catchment level;
- To generate evidence to inform policy rather than make policy recommendations.

The research has been focused on the Upper Ouse and Bedford Ouse catchment. . East Anglia is likely to be affected by the issues around over-abstraction earlier than other parts of the country. Data for East Anglia shows approximately 66% of licensed groundwater, and 69% licensed surface water, was actually abstracted. This compares to a figure of around half for England and Wales (Frontier Economics, 2011). Water resources assessments carried out by the Environment Agency indicate that pressures on abstraction, and the associated uncertainty and risks for security of supply in East Anglia, are likely to continue for some time into the future and that climate change will only serve to exacerbate these (Frontier Economics, 2011).

The work is being carried out in two Phases as follows:

- Phase 1 – Engagement with the key stakeholders to document and assess their understanding of how water trading could work in the future;
- Phase 2 – The setting up of an interactive water trading platform for the Upper Ouse and Bedford Ouse catchment to demonstrate to abstractors in the catchment how different types of water markets could work.

This report covers Phase 1 of the research. This work was commenced on 15 May 2012 and the completed on 29 June 2012.

The research has been funded by Anglian Water and the Department for Food, Environment and Rural Affairs (Defra). The research is guided by a Working Group that comprises Anglian Water, Defra, the National Farmers Union (NFU), Natural England, Cranfield University, the Royal Agricultural Society of England, the Royal Society for the Protection of Birds (RSPB), the Broads Authority, Association of Drainage Authorities, Environment Agency, Atkins, World Wide Fund for Nature (WWF), CPSL and the Water Services Regulation Authority (Ofwat).

HR Wallingford is leading a research team that comprises Collingwood Environmental Planning who are responsible for stakeholder engagement, Dr Julien Harou of University College London and Dr John Raffensperger of the University of Canterbury in New Zealand who are developing tools for the Upper Ouse and Bedford Ouse catchment that can assist in promoting the trading of water and Professor Mike Young, director of the Environment Institute at Adelaide University in Australia, who will provide expertise on water entitlement and water allocation systems used worldwide.

1.2 BACKGROUND TO WATER ABSTRACTION LICENSING IN ENGLAND AND WALES

The White Paper of 2002 entitled “Directing the flow” launched substantial changes to the arrangements for water abstraction rights. These changes were later encoded in the Water Act 2003 (Defra, 2002). The Environment Agency has described progress in implementing these and in the practice of abstraction trading within the current licence regime (Environment Agency and Ofwat, 2009). More recently, significant restructuring of the water industry was proposed, to expand the scope of upstream competition (Cave, 2009). The Government in its recent White Paper has chosen not to implement Cave’s recommendations in full, but nevertheless is bringing forward significant proposals for market reform (Defra, 2011a, 2011b), to which the outputs of this research will contribute.

Across England and Wales, about 20,000 abstraction licences enable the holders to draw water from surface and groundwater sources. Excluding public water supply companies, the largest group of abstractors is the power generation sector; other industrial users are also large water abstractors. Agriculture accounts for around 1% of abstraction on average across England and Wales, although this proportion varies considerably between regions and seasons.

Water use in England and Wales is considerably higher than in many other developed countries. Climate change will result in an increase in average temperatures and changes in seasonal patterns of rainfall. Although potential changes in future rainfall patterns are harder to estimate, current climate projections (based on the Met Office UK Climate Projections 2009 (UKCP09), Met Office 2010a) suggest that the summers are most likely to have less rainfall and that drought conditions will become more common. A recent study by the Met Office suggests that England and Wales may experience ten times as many significant droughts by 2100 compared to today, with a drought like the one in 1975 to 1976 occurring on average every ten years (Met Office, 2010b).

The current system of abstraction licences was set up in the 1960s and it was not designed to safeguard the environment or to manage competing demands. Abstractors were given licences to take a fixed volume of water from rivers or aquifers. The abstraction licensing system has evolved in recent years, with some more modern licences requiring the amount of water abstracted to be reduced when the source of water is under pressure. However, little has changed for the majority of abstractors. A third of catchments are already estimated to be over-abstracted or have too much abstraction licensed; two-thirds of catchments are closed to new abstraction licences, and 1 in 10 rivers have environmental damage as a result of over-abstraction (Defra, 2011a).

Currently abstraction licence costs do not reflect the relative scarcity of water in England and Wales, therefore end users have little external incentives to change their behaviour in order to save water. The system fails to incentivise stakeholders to manage current climate variability and future climate change on a least cost basis. The costs of addressing the problem of damaging over-abstraction under current arrangements are estimated to be between £3.7 billion and £27 billion (Defra, 2011a). Some argue that progress towards sustainable abstraction is very slow, and at current rates it could take between 45 and 335 years to achieve (Defra, 2011a). This is without taking into account trends such as population growth and changes to rainfall patterns.

As a consequence, a reform of the current abstraction licensing system in England and Wales is vital to ensure that the system is able to cope with a water stressed future and can continue to deliver sufficient water to end users, as well as protect the environment. The new abstraction licence regime needs to:

- Be equitable;
- Drive efficiency;

- Be flexible;
- Meet reasonable end user demands without harming the environment.

1.3 BACKGROUND TO WATER MARKETS AND THE IMPORTANCE OF STAKEHOLDER ENGAGEMENT

Global experience suggests that reform to the water sector to implement water markets takes time (Young, 2012a). No country has made the transition to water markets in one step; it is invariably a slow and adaptive transition with incremental changes and some false starts and blunders. In several cases, notably in Australia, detailed policy and water resource analysis has helped to enable a smoother transition to an "effective" water market.

Typically water markets suffer from small numbers of abstractions (i.e. thin trading) and the process of trading can be very bureaucratic and time consuming. Other issues can include high transaction costs and the problems of externalities on third parties, including the environment. These issues apply to England and Wales, where there has only been approximately 50 trades between 2003 and 2011. This research aims to build on past successes, and to learn from past failures, to examine the potential water management, environmental, economic and social benefits that an effectively functioning water trading system could offer.

Reforming the current abstraction licensing system in England and Wales will involve taking decisions about how to accommodate the needs of a range of users as well as those of the natural environment. Making decisions in the face of uncertainty about future demand and behaviours involves assumptions and value judgments which need to be made as transparent and clear as possible. This can be described as 'institutionalising social choice': choices have to be made so that decision making processes take due account of the social dimensions involved and in particular the interests, priorities and values of different sectors.

The importance of engaging stakeholders in decisions about how water is managed was formally recognised in Europe with the adoption in 1998 of the United Nations Economic Commission for Europe (UNECE) "Arhus Convention". The Water Framework Directive (WFD) was one of the first Directives to implement Arhus. In the Directive, public participation covers the provision of information, consultation and the active engagement of stakeholders. In England and Wales the Environment Authority is the Competent Authority for the implementation of the WFD.

1.4 BACKGROUND TO THE CURRENT WATER TRADING SYSTEM IN ENGLAND AND WALES

Water rights trading is where a person sells all or part of their abstraction licence rights, permanently or temporarily, to another person. This means trading rights, not actual water. As detailed above although trading can take place in England and Wales, to date the trading of water rights has been relatively limited. Trading of rights can be either permanent or temporary. In a permanent trade the seller gives up their licence, whereas at the end of a temporary trade the seller keeps their licence and the abstraction right returns to them.

The Environment Agency's role in trading is to:

- Make information about abstractions, water availability and the approach to licensing available to all;
- Advise before an application whether the proposed trade is likely to be licensed;
- Licence abstractions arising from water rights trading, as long as proposals do not lead to further environmental damage beyond that already occurring.

The Environment Agency does not act as a broker, or get involved in negotiating trading prices. The approach to licensing water rights trades depends on the water resource availability where the buyer and seller are located. The trading scenarios that are currently possible are outlined in Table 1.1.

Table 1.1 Current possible trading scenarios

Trading scenario	Description	How the trade is licensed	Who pays
Whole, permanent	The whole of the seller's abstraction right is sold to the buyer on a permanent basis	Grant a new or varied licence to the buyer and revoke the seller's licence	The buyer
Whole, temporary	The whole of the seller's abstraction right is sold to the buyer on a temporary basis. The seller retains their licence, although they would not be allowed to use it for the period of the trade	Grant a new or varied licence to the buyer, and vary the seller's licence with a condition preventing the seller from using their licence for the duration of the trade	The buyer
Part, permanent	Part of the seller's abstraction right is sold to the buyer on a permanent basis	Grant a new or varied licence to the buyer, and reduce the quantities on the seller's licence	The buyer and seller
Part, temporary	Part of the seller's abstraction right is sold to the buyer on a temporary basis. The seller gets back all of their abstraction right at the end of the trade	Grant a new or varied licence to the buyer, and reduce the quantities on the seller's licence for the duration of the trade	The buyer and seller

*Note: Cost of trading is as follows: There is a £135 application fee which the buyer must pay, together with the cost of the public notice and a £100 advertising fee if the application is advertised. (Source: Environment Agency, 2011)

Trading can only take place where there is a surface water or groundwater link between the seller's abstraction point and the buyer's proposed abstraction point. The water cannot be sold without this connection, which may be based on each abstractor being within the same surface water catchment or the same groundwater aquifer.

The approach to licensing is based on the water availability as defined by the Catchment Abstraction Management Strategies (CAMS). Where a CAMS shows "water availability" then trading of the licences' "used and unused water" is acceptable; however, where a water body is "over-abstracted" then only trades of "used water" part of the abstraction licence are allowed. In over abstracted reaches the Environment Agency will recover unused water for the environment as part of a trade (Environment Agency, 2011).

The buyer can apply to change the use of the abstracted water as part of the trading process. The Environment Agency's water availability assessment takes into account the proportion of abstracted water that is returned to the environment, because it affects the environmental impact of an abstraction. Changing the purpose of an abstraction may affect how much of the seller's right can be traded. The Environment Agency may include different conditions on the buyer's licence. The Environment Agency also considers the impact of where abstracted water is returned to the environment, as it may alter the environmental impact of an abstraction; this is because a new abstractor may return flow to a different part of the catchment or even a different catchment. Water returned may be beneficial to the environment in one instance, but detrimental in another.

The conditions of a traded licence usually fall into two categories:

i. Those that provide catchment-wide protection for the environment and existing water uses;
ii. Those that mitigate against local impacts.

Wherever possible the Environment Agency licenses changes to a new location on the same terms as the existing licence. However, this depends on the conditions of the seller's licence, and whether the abstraction at the buyer's location impacts on the environment and on the rights of existing abstractors and water users. For part and temporary trading transactions, the seller's licence will revert to its existing terms and conditions when the trade ends (Environment Agency, 2011).

Trading groundwater abstraction rights is generally more complex than surface water especially if there are environmentally sensitive features and other abstraction rights near to the proposed location. The Environment Agency is legally required to limit the duration of all new licences arising from a water rights trade, even if the seller's licence does not have a time limit. The Environment Agency also puts time limits on licences that are varied, so that the licence reverts back to its original terms when the limit expires. The Environment Agency does not apply a time limit to a licence if it is varied to reduce the licensed quantities (Environment Agency, 2011).

1.5 CURRENT RELEVANT RESEARCH PROJECTS

A number of relevant, but separate, research projects are running in parallel to this work. Defra has recently commissioned a research project entitled "Impacts of abstraction reform options on non-public water supply abstractors". This project is assessing the impacts that different reform options have on people and organisations which rely on water taken directly from rivers and ground water focusing on six case study catchments throughout England and Wales. The work is considering the different benefits, costs and risks of each regime option and, as far as possible, quantifying the level and distribution of these impacts (Defra, 2012). The research is combining hydrological models, which describe surface and ground water flows, with models that will be developed of how individual abstractors may behave under different abstraction reform options.

Cranfield University is carrying out research called "Transforming water scarcity through trading". The objectives of this work are to: inform the current move towards water markets; show how active markets could transform the current water management system; value the available water spatially and dynamically, revealing its opportunity cost; identify the economic benefits of trading water licenses at basin scale; research the opportunities for novel engineering options for increasing supplies, such as distributed reservoirs, enhanced aquifer recharge, and rainwater harvesting, and how/whether they might be funded by downstream buyers; investigate the rules and restrictions necessary to protect the environment and avoid unwanted consequences; and investigate options for incorporating payment for ecosystem services, to enhance environmental benefit (Cranfield University, 2012).

Owing to their programmes both of these research projects are yet to formally report their results. However, the ongoing lessons learnt from these projects have been taken into account via members of the project team and members of the Working Group who are involved in both these projects.

1.6 DETAILS OF THE TRADING SYSTEMS TO BE RESEARCHED

The following trading systems are to be researched as part of this work:

- The current trading system known as a pair-wise trading system as described above;
- An improved pair-wise trading system;
- A smart market or central pool method.

The improved pair-wise and central pool methods are described in Sections 1.5.1 and 1.5.2. These methods will be demonstrated in the Upper Ouse and Bedford Ouse catchment. Brief details of this catchment are described below.

1.6.1 Improved pair-wise trading

A pair-wise trade of abstraction licences has two steps:

- Step 1 - An abstractor wanting to buy or sell water rights must search for and make arrangements with another licence holder;
- Step 2 - The trade must be approved by a central regulator (e.g. the Environment Agency).

Currently initiating a trade and getting regulatory approval can take a long time (i.e. several months). By improving the current system, water rights trading would still be regulated, but could be less bureaucratic and time consuming than it is currently. One way of improving efficiency could be through the use of an online management system. Users would place expressions of interest to sell or buy on a web page, and a computerized water accounting system would assist their trades. This system is shown in Figure 1.1.

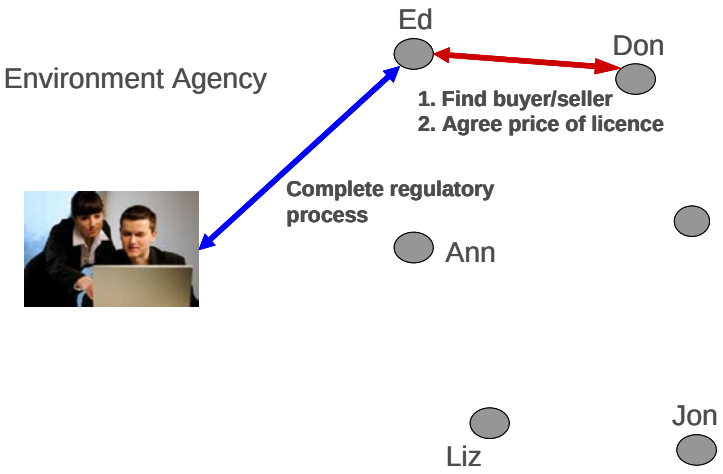


Figure 1.1 Improved-pair wise trading

1.6.2 Central pool method

In the central pool method, there are no pair-wise trades. All water rights would be traded via a catchment manager (such as the Environment Agency) through a “central pool”. Users would not need to search for a trading partner, write contracts, or wait long for approvals. Instead, users would place offers to sell or bids to buy on a web page, and the catchment manager would clear all trades at once, using a computerised water accounting system, following a regular schedule (weekly or even daily). The water accounting system would ensure that environmental flows were satisfied. Users could offer to sell or buy for future weeks, improving their certainty. Within minutes of the market-clearing, users would have firm rights for the immediate period and reasonably

reliable rights for the future periods. An illustration of the central pool method is shown in Figure 1.2.

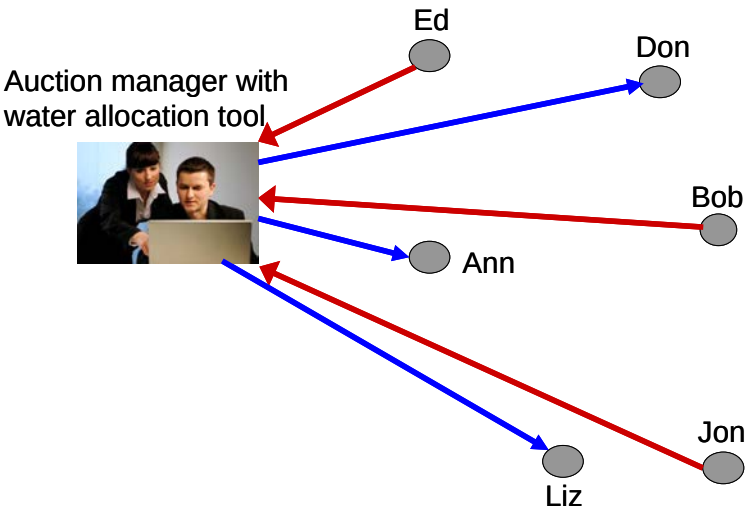


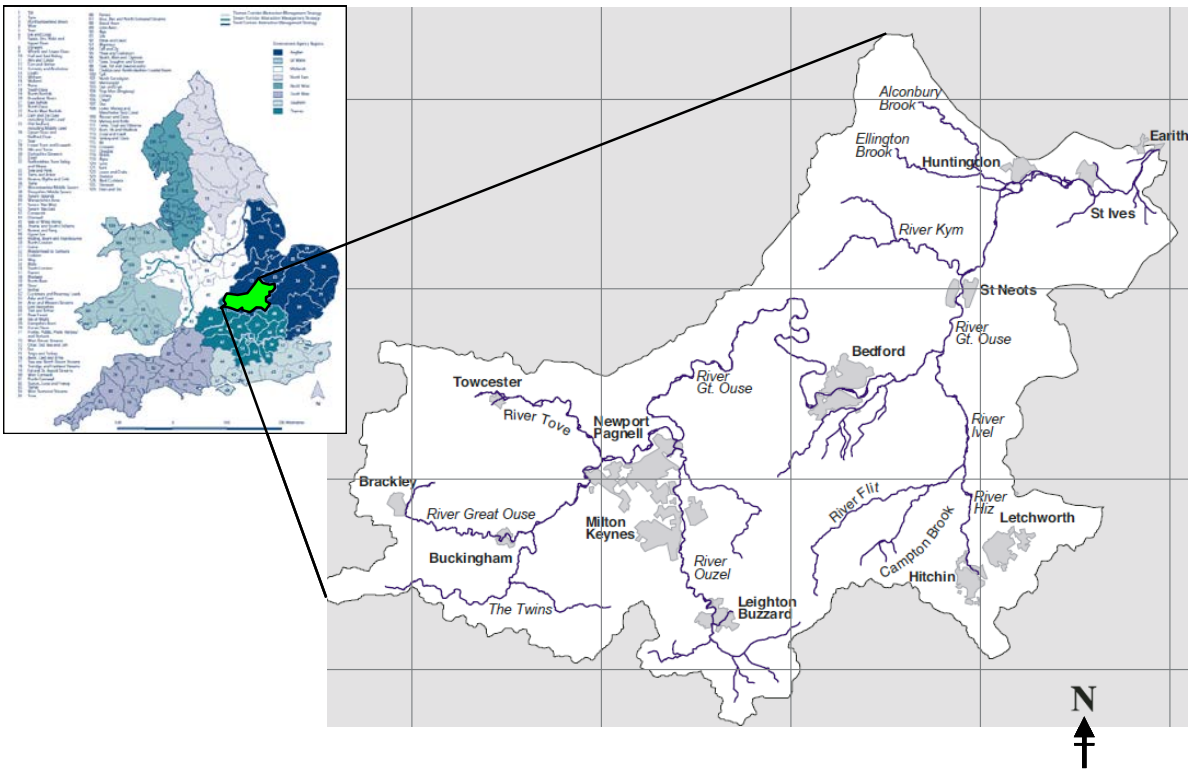
Figure 1.2 Central pool method

1.7 BACKGROUND TO THE UPPER OUSE AND BEDFORD OUSE CATCHMENT

The research has focused on the Upper Ouse and Bedford Ouse CAMS area, shown in Figure 1.3. The CAMS covers an area of approximately 3,000 km^2, the character of the land varies from the gently rolling upper catchment moving to more extensive river valley flood plains and flood meadows downstream. The area is predominantly rural with development concentrated in established cities and towns. Major urban areas include Milton Keynes, Leighton Buzzard, Bedford, Hitchin, Huntingdon and Brackley (Environment Agency, 2005).

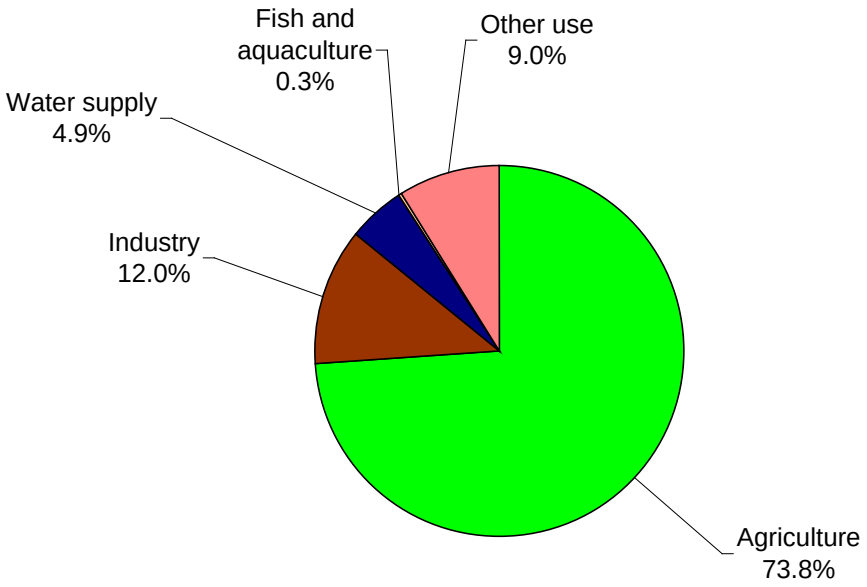
The Upper Ouse and Bedford Ouse CAMS area covers the River Great Ouse catchment and a number of its tributaries down to the village of Earith. Natural flows in the catchment derive from three main sources. These are surface runoff resulting from rainfall, surface or near surface drainage, and baseflow, derived from spring flow and groundwater. Springs are found in the south-east of the area in the Woburn Sands and Chalk and in the north and west in the Great Oolite Group (Environment Agency, 2005). Rainfall is highest to the west of the catchment, in the more upland areas. The long-term average rainfall varies from 670 mm in the west of the catchment to 540 mm in the fenland areas in the east. Generally the amount of rainfall in each month is fairly constant throughout the year. In summer, evaporation exceeds rainfall, giving a net loss from the catchment (Environment Agency, 2005).

There are approximately 250 licences in the Upper Ouse and Bedford Ouse CAMS. The distribution of these licences together with the amount of water abstracted by each sector is shown in Figures 1.4 and 1.5 respectively.



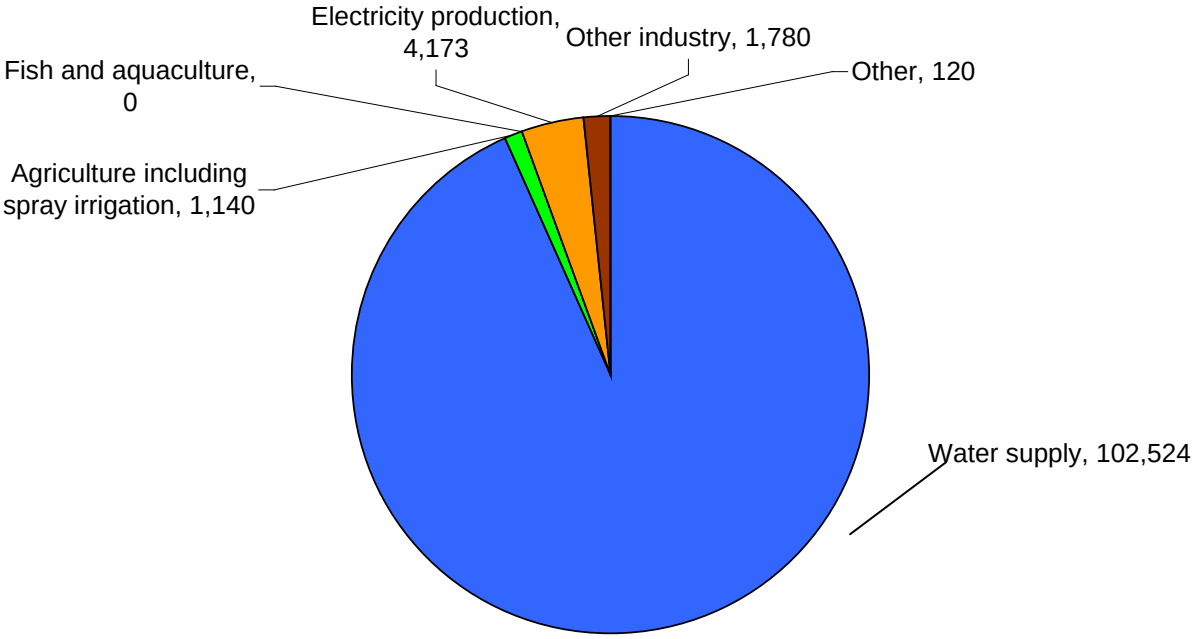
(Source: Environment Agency, 2005)

Figure 1.3 Upper Ouse and the Bedford Ouse catchment



(Source: Environment Agency, 2009)

Figure 1.4 Distribution of the number of abstraction licences by sector in the Upper Ouse and the Bedford Ouse catchment



(Source: Environment Agency, 2009)

Figure 1.5 Distribution of the actual volume of water abstracted by sector in Ml/year in the Upper Ouse and the Bedford Ouse catchment

2. Stakeholder engagement

The focus of Phase 1 of the research was on understanding the perspectives, assumptions and appetite for water trading of abstractors in the Upper Ouse and Bedford Ouse case study catchment, as well as their views on barriers and opportunities to trading. In particular, we wanted to explore the approaches and mechanisms they use to manage water in the context of recent drought conditions and to see what level of support there might be for improved water trading systems.

In order to ensure that the above objective was met the project team contacted a representative number of licence holders from a cross-section of sectors. The stakeholders were grouped into three categories according to their role within or relationship with water management and trading:

- **Delivery Agents** – These were representatives of organisations currently involved in managing water resources both within and external to the Upper Ouse and Bedford Ouse catchment. These included the Environment Agency, Ofwat, Internal Drainage Boards and Natural England;
- **Abstractors** – These were holders of abstraction licences within the Upper Ouse and Bedford Ouse catchment; and
- **Innovators** – These were organisations and people recommended by the project's Working Group members as abstractors carrying out innovative water management practices and/or interested in the trading of water rights. The innovators were not necessarily located within the Upper Ouse and Bedford Ouse catchment; however, most were located in East Anglia.

Abstractors and Innovators

In total 89 abstractors and innovators were contacted during Phase 1. These stakeholders were identified by an analysis of the Environment Agency's database of licence holders. Figures 2.1 shows that there was a close match between the sectors of the stakeholders contacted for this research and the sector distribution of licence holders in the catchment shown in Figure 1.4.[1]

Of the 89 stakeholders who were contacted, 52 responded (58% of the total number contacted). There were 37 licence holders who did not respond in spite of multiple attempts to reach them. A number of contact details proved to be out of date in the abstraction licence database. This suggests the kind of problems that might be encountered in trying to set up a more efficient trading system within the catchment on the basis of the information currently available.

Of those who responded 39 stakeholders responded positively. A number indicated that they were interested in the study and its results but that they could not engage with this phase of the project. Reasons given were time constraints, prior commitments or there being more appropriate persons in their organisation to discuss trading with. However, some of these people did provide interesting insights as part of their communication with the project team. The 13 people who responded negatively explained that they were not interested in engaging with the project as they did not feel it was relevant to their organisation or interests.

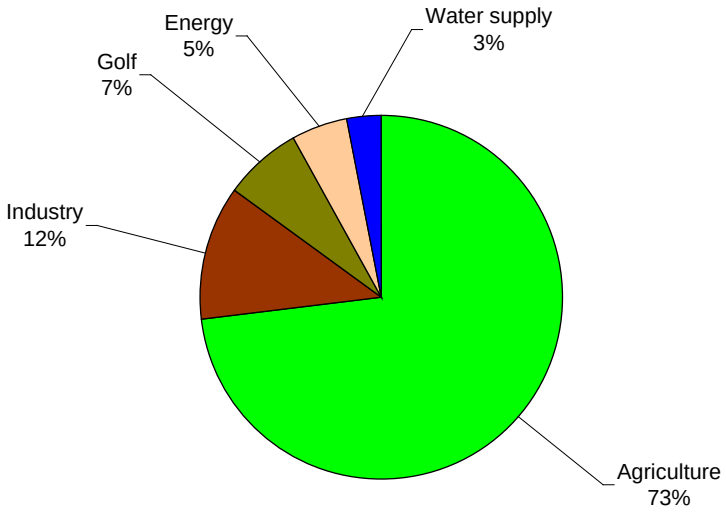


Figure 2.1 Sectoral analysis of stakeholders contacted in Phase 1

Delivery Agents

In addition to the abstractors and innovators, the team contacted 11 delivery agents covering national and local Environment Agency teams, Ofwat, an Inland Drainage Board and Natural England.

[1]In those instances where licences were held for multiple use we have categorised them based on their primary use: for example a cement company holds licences for environment, industrial and agricultural use but we have categorized these as industrial; a golf course has golf and private water supply licences but we have categorized these as golf; and, a local council has energy and environmental licences and we have categorized them as energy.

Focus groups and interviews

The project team arranged interviews or participation in focus groups depending on what was convenient for participants. Table 2.1 gives a breakdown of those who were directly engaged with the study, by stakeholder type (Abstractor, Delivery Agent or Innovator), sector and the activity in which they participated.

National Farmers' Union (NFU) Regional Abstraction working group

In addition to the focus groups and interviews, we were able to attend an East Anglian NFU regional abstractors group. The group of farmers had been meeting since November 2011 to discuss the drought situation. We had an hour long structured discussion around current and possible future water management issues, together with a short presentation of the innovative trading methods being researched.

Table 2.1 Details of the stakeholders who participated in Phase 1

Group	Interview	Focus group
Abstractors (17)	2 Farmers	8 Farmers
	1 Power company	1 Golf course
	1 Aggregates company (joint interview with two members of staff)	1 Race course
	1 Water Company (joint interview with two members of staff)	1 Food processing company
		1 Local Authority
Delivery agents (7)	1 Ofwat	
	4 Environment Agency	
	1 Natural England	
	1 Internal Drainage Board	
Innovators (3)	3 Farmers / Land Managers	*Structured discussion with 11 Farmers from the regional NFU abstraction working group

3. Method

Interviews and focus groups were used to explore the topics of interest. Schedules of semi-structured questions were developed for the focus groups and interviews: each schedule covered the same topics, but the questions were slightly different, tailored to the different roles and experience of the people involved. The questions were designed to encourage discussion and to explore views, generating qualitative findings.

Table 3.1 provides an overview of the high-level topics under which specific questions were structured. The Abstractor topics were also the basis for discussions during the focus groups.

Two focus groups were carried out with nine and three abstractors respectively. The first group was predominantly farmers and the second group was made up of abstractors from other sectors. Four interviews were carried out face-to-face and the rest were carried out by telephone. In addition we were able to carry out a structured discussion as part of the NFU Regional Abstractors Group meeting.

Table 3.1 Overview of interview schedule high-level topics

Innovators	Abstractors	Delivery Agents
1. Setting the scene: your involvement in water abstraction and water trading today	1. Context – current and future water management practices	1. Setting the scene: the current context for water allocation and water trading
2. Barriers and opportunities for innovation in water allocation	2. Understanding, awareness and views on the concept and process of water trading, generally and in the catchment	2. Barriers and opportunities for effective water management in conditions of scarcity
3. Attitudes towards innovative systems of water trading: • Improved pair-wise • Central pool	3. Introduction to innovative approaches to water trading and exploration of views and enthusiasm for these approaches: • Improved pair-wise • Central pool	3. Attitudes towards innovative systems of water trading: • Improved pair-wise • Central pool
4. Any other comments	4. Any other comments	4. Any other comments

The analysis presented in Section 4 draws out the key findings in each area of research interest, based on the input obtained from engagement with the three categories of stakeholder. A note on how the data were collected and analysed is presented in Appendix A.

4. Findings

This chapter details the main findings of the stakeholder engagement. The findings have been grouped into three sections:

1. Current water management context;
2. Current system of trading and other innovative approaches to water management;
3. Attitudes towards innovative water trading approaches.

Within each section the findings are grouped by the main categories of stakeholders who took part in the research with, these were:

- Delivery agents;
- Abstractors;
- Innovators.

4.1 CURRENT WATER MANAGEMENT CONTEXT

4.1.1 Delivery agents

Experience and functioning of current mechanisms for abstraction licensing

The existing legislative framework for abstraction licensing was introduced in the 1960s and all the delivery agents interviewed felt that it is not able to meet current challenges.

While the Environment Agency has the role of assessing and determining licence applications, it was argued that there is little scope within the current system to allocate water or manage water resources effectively:

"...at the moment... no one has the authority or the responsibility to make decisions on where water is of best value, it is simply running a regulatory process which splits water between people and the environment and then allocates the water to people on a first come, first serve basis." Delivery Agent 2.

Environment Agency staff 'on the ground' are consulted on applications for new licences for water abstraction and variations to licences including trading. Other institutions consulted on water abstraction licences and variations are Natural England and the Internal Drainage Boards (IDBs) in the area. As there is so little formal water trading at the moment, even staff in institutions with regulatory roles have little awareness of it:

"I have to say up front I don't have a lot of experience of trading and I'm not sure that any of my colleagues would have really. Trading takes place presumably within the licences that currently stand within the catchment." Delivery Agent 6.

However, the increasing interconnectedness of water systems and greater awareness of their multiple functions has meant that institutions like the IDBs, that saw themselves as being at arm's length from the abstraction licensing system in the past, are now more aware of the potential impact of decisions on their own infrastructure and operations:

"I think historically there's been a lack of coordination of actually having the system policed….throughout the different chains of management and different authorities... So, of concern is a lack of joined up thinking in terms of abstraction and proposed national water transfer systems. How will it be managed to ensure flood risk isn't increased?" Delivery Agent 5.

Environment Agency staff described how the organisation is making efforts to apply the current system as flexibly as possible, in order to help abstractors, particularly farmers, to manage their water resources more effectively in the face of drought pressures and a changing climate. Whereas during a drought in 1976 the Environment Agency's predecessor told farmers to stop abstracting water with immediate effect, today the Environment Agency works more closely with farmers in catchments like the Upper Ouse and Bedford Ouse, to provide information about trends in water availability and to encourage preventative action. For example, the Environment Agency suggested abstractors make a voluntary 20% reduction in groundwater abstraction at the beginning of 2012 in order to make existing resources last longer.

The Environment Agency is also seeking to be flexible in the interpretation of its regulatory powers, in order to facilitate abstractors' access to available water resources, recognising the impact of current restrictions, particularly for agriculture. Examples of this flexibility are:

- Extending winter abstraction licences into 'summer' months. Winter licences usually run from 1 November to 31 March when high flows are used to fill reservoirs. In recent years rain has come later (April or May), when the Environment Agency's charges are higher:
  "We're moving away from thinking about the abstraction year in terms winter and summer, and more about periods of high and low flow. A more flexible approach means the rates can be kept the same as the 'winter' rates." Delivery Agent 1.
- Issuing dispensation letters to enable farmers to use neighbours' licences and storage. These letters are time-limited agreements between the Environment Agency and abstractors which avoid the formal application process. They are used for temporary changes; permanent changes still require a formal application.

Many Environment Agency staff do not consider that there is any contradiction between their regulatory role of controlling water abstraction and their involvement in facilitating access to water in times of scarcity; they point out that there are 'get-out' clauses that can be employed to avoid detrimental effects to the environment. Temporary dispensations also only apply to transfers within the same catchment.

While staff feel that the Environment Agency is right to take a flexible approach in the context of drought, there are also concerns that this should not become the status quo and be seen as an alternative to reforming the abstraction system:

"We're encouraging our staff to take the risks in the right way. Having said that, perpetually using a system where you're taking risks against what the legal framework is not sustainable, so yes we look at what could change and be better in the long term." Delivery Agent 3.

Views on changes needed in the future

The water allocation system was described as facing two major challenges:

- Dealing with a "considerable backlog of inappropriate historical abstractions" with negative impacts on the environment and particularly on designated sites;
- Responding to increasing pressure on water resources: whereas in the past most people who wanted water could probably get a licence for abstraction in most catchments, today new users may be unable to access the water they need.

The interviewees agreed that the abstraction licensing system needs to be changed and looked forward to the outcomes of the current review and modernisation of water abstraction licensing.

One interviewee emphasised that any new system should take a more holistic view of planning water abstraction, rather than the current ad-hoc approach. The catchment-based approach put forward in the Water White Paper provides a good basis for this:

"Going forward, what we probably need to do is look in a more holistic way. I'm not sure if we'll be using that word, but looking at how... what the need is in catchments for water, across a range of different activities. How we can integrate the use of water by the population, by agriculture, by industry and hopefully by the environment. Be a little bit more intelligent about how we plan water in terms of excess and in times of drought as well." Delivery Agent 6.

Policy staff recognise that the lack of an effective water allocation system represents a significant political risk. One delivery agent felt that the government would want to avoid being drawn into making decisions about who should get water in conditions of restricted supply:

"I think government and others have become acutely aware that if it extends into a three winter drought, that would start to introduce some very serious challenges in how we allocate water between sectors and between sectors and the environment because there are clearly some sectors which would be of more value to others. Government don't want to have to make those decisions and that is why we are working hard to mitigate the effects of a third dry winter. And I think it has really polarised the government, the need to have a regime which is more flexible and enables market forces to drive that allocation more." Delivery Agent 2.

4.1.2 Abstractors

Current water management practices and issues

From discussion with the abstractors a picture emerges that water management is the result of the interrelationship between their various characteristics and circumstances, this is shown in Figure 4.1. The nature of this interrelationship is such that each abstractor has different circumstances, making the context in which trading might occur quite different from one abstractor to another. These factors are discussed in more detail below.

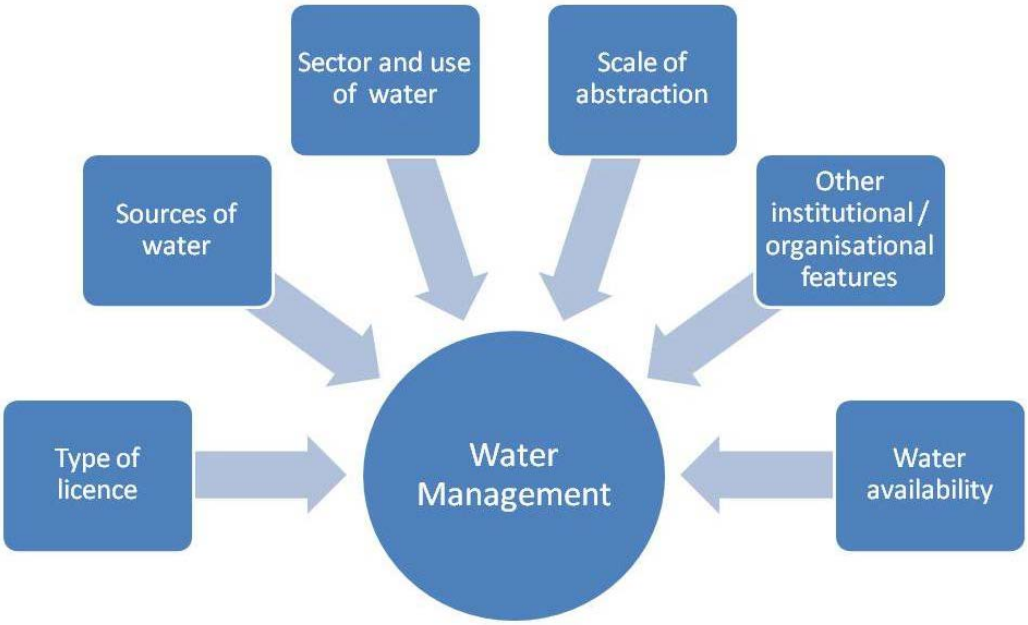


Figure 4.1 Water management's influences

Factors influencing water management

Type of licence

Abstraction licences as issued by the Environment Agency vary in that they can be summer only, winter only or all year round. They may be limited or unlimited in how much water can be taken and may have hands off flow provisions in place which mean that at below certain levels of river flow, abstractions are not allowed. Since October 2003, all new water abstraction licences in England have been time-limited, i.e. the abstraction has been granted for a fixed period rather than indefinitely. When the Environment Agency approves an abstraction licence for the first time, it is likely to be for between six and 18 years to link it to the common end date. When licences are renewed they normally last for another 12 years (Environment Agency, 2010a).

Sources of water

The water of the abstractors we spoke with comes from: surface water abstraction (i.e. rivers, brooks); groundwater abstraction (i.e. boreholes); and, water storage (i.e. reservoirs). It was common for abstractors to have a range of water sources and more than one abstraction licence which enables a degree of flexibility in being able to access water when it is needed. In particular, agricultural water storage was an important feature in the context of winter licences as this meant that abstractors could move water on to their land when flows were high and save it for later, drier times.

Sector and use of water

There were clear differences in water management depending on sectors, with farmers using their abstraction either to irrigate crops directly or to fill reservoirs for later irrigation. Using water for irrigation is a precise process as the extent and frequency of irrigation determines the quality and hence price (or even saleability) of produce. There are also certain key establishing stages to each crop when water is a necessity for delivering viable produce; these stages are common to all farmers using a particular variety. The current water management system for the farmers we spoke to generally relies on rain. The abstracted water is used seasonally and for specific uses. As one famer suggested "*in an ideal world you would not need to abstract*" (Focus group 1).

In relation to a race course, irrigation is needed two days prior to a race to ensure that the "going" is right and safe for the horses and jockeys but this is usually only during April/May and sometimes October. Overall water is only needed during the race season which is November to June. The water needs of a golf club relate to keeping the greens properly and these needs are mainly focussed on the summer months of June, July and August.

Operators of a food processing plant use water in the preparation of food e.g. slicing onions to sell to a pizza company and the production of ingredients for ready meals. Their water use is driven by which crops they are processing, for example onions need less water therefore the processing plant's water use changes depending on the season and what crops have been harvested and need processing.

The power company requires a consistent supply all through the year and the water company requires security of supply so that their reservoirs can be filled and their commitment to deliver the public water supply can be maintained. Another issue for power companies is the environmental impact of their abstraction and how that can be minimised.

Scale of abstraction

Clearly there are large differences in the amounts of water needed and therefore abstracted between the different sectors with the public water supply taking 80% of the water and agriculture taking around 2% of the water. The use of water for the farmers especially is a precision process and "*a lack of water is a limit on growth*" (Focus group 1). Having such different scale of abstraction means that ensuring there is enough water when it is needed is a very different issue for different abstractors, with small farmers possibly being able to work informally with neighbouring farmers whilst the water companies have to consider much larger solutions.

The quotes below show how these different water management factors come together for different abstractors:

"*Our main aim for the watering is consistency of going for horses and safety of the horses and the jockeys. I've only got 63,000 cubic metres at my disposal. So, I'm not a high user.* **How do you irrigate it?** *We have towlines…. that's a 20 year old towline with modern sprinklers on……So, with two of those we can do 440 yards at a time. And with the idea of that it gives me an option of timings ……***And what's your pattern of watering them …?** *Hopefully if nature helps itself we wouldn't water…..What we tend to do, no watering in the winter,…. just April, May and then perhaps a bit in October depending on the season. During the winter no watering at all and nothing really during the summer*. **And is your licence a…?** *I've got an all year round. I was very lucky when I did mine.* (Focus group 2)

An aggregates company stated that:

"XXXX operates a large portfolio of quarry sites, some of them are big limestone and hard rock quarries and we also operate a number of brick pits and cement quarries around the country. All of which will use water to some degree or another. To give you an extreme, we have got mineral washing at one end, we have got perhaps water for cooling in the cement process, [which] would be the other end of the scale if you like and in between we have a lot of downstream businesses as well which include making concrete, ready mixed concrete, concrete products and other sorts of building products if you like, all of which will have a demand for water. Much of which will come from abstraction because that is subject to availability [and a] more affordable and economic source of water than mains water typically is." (Abstractor 2, aggregates).

Changes made to management of water in context of recent drought, and future droughts

Generally reduced water availability owing to a prolonged drought was raised as a concern for the abstractors with the larger farmers in the NFU meeting regarding a third winter as a *"doomsday scenario"* but the smaller farmers and industry abstractors were more phlegmatic and suggested the impact had been more limited. There were some farmers that "gambled" on it raining by planting crops and using water from their storage reservoir in the hope that when the water ran out in May/June it would have commenced raining. There was a feeling that although a significant risk, managing water shortages was part of their businesses.

"The drought period wasn't terribly relevant, other than the fact that we were aware that the soil was depleting further down and further down and that would have implications for things like oil seed rape or winter wheat if the rain hadn't come. Obviously it had implications for other crops such as potatoes and onions. They needed establishment and we did need water, and we applied water to establish them. From then on the good lord has dealt with it quite effectively." (Focus group 1).

"I…….how does drought affect your business?
……..we haven't actually been really affected but anyway I think we know where we have a number of water storage lagoons from which we can draw water for the process. Obviously the level has dropped quite significantly but because we have a large number we were always able to find water for the process from somewhere, from somewhere in that system." (Abstractor 2 aggregates)

For the racecourse the drought had meant a possibility that the course may not be suitable for a meeting on Boxing Day the cancellation of which would have led to a serious loss of revenue. The golf club indicated that they could lose greens and fairways if there were a continued drought *"Because if you lose a fairway it's…you've got acres of grass there, you've got to reseed and it takes ages to recover. So it's a difficult problem if it gets bad*" *(Focus group 2)* Many of the abstractors were complying with the voluntary 20% reduction in groundwater abstraction that the Environment Agency has been promoting, this is (as at June 2012) still in force although a number of the abstractors we talked to hoped that it would be removed soon.

Abstractors differed in their ability to respond to drought in part based on whether they had on site water storage such as reservoirs. For example, an industry abstractor compared the impact of the drought on two of their sites, one with storage and one without. There had been discussions about closing the site without storage if the drought had continued for much longer as they would not have been able to abstract water from their surface water source as the river would have dropped to a hands off flow level.

The specific changes to water management practices that abstractors had made, considered or were considering for the future included:

Changing or improving existing processes

- Investment in increased and more efficient irrigation over the past few years, investing in irrigation booms;
- Guaranteeing fewer irrigation periods for potatoes for supermarkets. One farmer said "*I think one thing we've done is where we have potatoes and we're growing them on contract, rather than six irrigations we'd normally guarantee we've got down to guaranteeing less, typically four irrigations, and we've shared the risk on that. That's now past but it's something we've struggled to guarantee"* (Focus group 1)*;*
- A food processing plant had implemented a series of training exercises with their staff in water management and also educated their staff in the way that they managed water and operated (e.g. reducing the operating pressures for certain operations). This led to a reduction in water used of 27% over a period of two years and a saving in water tariffs of approximately £200,000;
- Re-cycling water was achieved successfully in one instance but a food processing company said they had looked at this possibility but that it was too expensive and had a 43 year pay back. Education of staff had proved a more effective way of reducing water consumption as detailed above;
- Looking for somewhere else to grow crops, for example farms with reservoirs "*Only as much as looking for somewhere else to grow your crops, to farms that already have reservoirs"* (Focus group 1);
- Using wetting agent to increase water penetration;
- Irrigation at night to reduce losses via evapotranspiration; however, this was "*not practical quite often because your infrastructure doesn't allow you to get round the crops in time"* because irrigation at night is generally a slower process than applying water during the day owing to limited visibility *(*Focus group 1).

Reducing production

- Reduced area of crop;
- Reviewing areas at risk from water shortage and juggling crop varieties so that the most drought resistant were in areas where there might not be as much water;
- Focussing production to more water secure areas, for example, where water storage was available:
  "1. A lot of people this spring were faced with low water reserves and opted to reduce area [of crops]. We didn't reduce the area but we certainly, in terms of potatoes, we juggled the varieties about to make sure the ones that are most drought resistant were in areas where we might not get water.
  2. Another thing we did was to change fields, ……to allow cropping to be on the winter stored water rather than surface abstracted water because we were aware that there could be a problem with surface abstraction." (Focus group 1);
- Some businesses have little choice (e.g. energy production) in their water use, and lack/reduced supply means that production needs to cease. One abstractor said that owing to having the hands off flow constraint on their licence they have to close a site reliant on this abstraction when low-flows are reached. *"...for us reliability of supply is a big issue because we would shut down within a few hours if we didn't have the supply of water." (*Abstractor 4, energy sector).

Managing existing processes

- Use river abstraction first so that reservoir abstraction is available if restrictions come into place but it was acknowledged that it was not possible for everyone to have reservoirs*; "I think where possible you'll use the river extraction first so you've got the reservoir extraction where you can have the option to use that if restrictions came in place."* (Focus group 1);
- It was reported that in other lowland catchments the Internal Drainage Board was trying to keep water levels higher in the summer so that abstractors can continue abstracting.

Developing water storage infrastructure

- A golf club was looking at a reservoir but it was considered too expensive especially given that membership numbers were down; however, with the commencement of rain in April 2012 the urgency for this had declined. *"So, the only difference [in] our thinking now is we were thinking that we really have to do something and we'd better move on with this reservoir even though we really can't afford it. Now, we're thinking well maybe we'll leave it another year."* (Focus group 2);
- A number of abstractors across the sectors indicated increased interest in storage capacity on site (e.g. reservoirs). An industry abstractor working in the minerals sector indicated that reservoirs had more uses than just for storing water, currently they are used for angling and recreation. Managing these more specifically for water storage and delivery would be a significant change in focus. Storage was not always felt to be relevant however, for example abstractors with very large volumes of abstraction stated that for storage to be useful it would have to be large to make any difference and that would not be practicable from an economic or planning point of view;
- Agricultural abstractors also indicated that they were looking at alternative water storage and delivery systems, such as rainwater capture and drip-irrigation (though cost is an issue).

In relation to the management of stored water, mention was made of the difficult decisions that still have to be made, even when storage is available. For example, one farmer described the decision to keep watering that had to be taken in 2011 as that was also a very dry year: "*We were getting to this position last year where in late June things were looking like even the winter storage reservoirs were going to run out of water. You have to take the decision do you hold back and space out your ... in essence we decided it was better to keep going, keep the crops going rather than expect that you might need to use it further down the line. So there has to be a difficult decision taken quite often, and we came to the conclusion it's better to keep watering"* (Focus group 1).

But whilst abstractors did express anxiety about decisions made during the drought there was less of a sense of it being very unusual for some as indicated by the discussion below:

Participant 1 *One thing I've noticed with looking back at applications per year – both potatoes and onions, I can't speak for cabbage – but we always end up irrigating probably five or six times a year through the crops.*
I: ***So fairly consistent.***
Participant 1: *Fairly consistent.*
Participant 2: *But interestingly not always the same periods.*
Participant 3: *Not always the same period.*
Participant 1: *I think one year all the irrigating was before the end of June and the next year all the irrigating was after the end of June."(Focus Group 1)*

Another participant felt that "*mother nature will sort it out in time*" suggesting that the amount of water would even out over time.

Views and understanding of current practice regarding unused licences

In terms of their use of licences, at the focus groups abstractors were presented with the statistic that agriculture uses 28% on average of their licences; public water supply uses 80%. This was met with a general perception that it was because there were quite a few unused licences, specifically in the area around Great Barford and Sandy which had previously been a large vegetable growing area.

"*After '75 and '76 veg was very expensive and a lot of the bigger farms grew more veg. They had irrigation systems put in. By the middle 80s that had all gone to pot and they went off growing veg and didn't use them..."* (Focus group 1).

In terms of their licence use the average across the abstractors who participated in this research was felt to be around 60% to 80% with a couple at 20% to 30%.

The interviews with abstractors reflected the outcomes of the focus groups, with all farmers interviewed saying that it was changes to cropping practices (for commercial reasons) which had led to them now not using their full licence. However, those abstractors interviewed were also all unwilling to consider giving up their licences. Licences are often kept or maintained even when not being used as an insurance against future water needs. For example abstractors in the farming sector said that the crops that are commercially viable have changed dramatically in the last 20 years, and it is not possible to predict what might be viable in future: thus water needs may increase again.

"We have always felt that we have got sufficient licence volume for our operations at the moment anyway and we have tended to want to hold on to those in case we need them somewhere else for ourselves as opposed to necessarily wanting to give those up to others, albeit even on a temporary basis" Abstractor 2 (aggregates).

In this sense, the ability to abstract water is seen as a basic condition for production, particularly by farmers. As a result, landowners who want to keep open the possibility of farming certain crops in the future are unwilling to give up their abstraction licences on a permanent basis.

4.1.3 Innovators

Current water management practices and issues

One innovator expressed real concern about the future and the ever growing demands for water, together with increasing uncertainty about its supply, and in particular increasing unpredictability of precipitation meaning historical cycles can be relied on less and less:

"We've got more people demanding more water, we're trying to grow more food and yet we're starting to think that the climate is going to take water away from us." (Innovator 2).

Innovators' day-to-day water management practices appear to differ little from those stakeholders categorised as abstractors. However, the innovators interviewed all play a broader role in water management, over and above the management of water related to their own business interests. For example, the setting up and management of water abstractor groups in an area or catchment, and acting as a 'go-between' and coordinator vis-à-vis the needs of groups of abstractors to improve management practice within the group and also to provide a common voice in discussions and agreements with the regulator/delivery agent.

An example of a cooperative water management activity raised by one innovator was the development of shared storage capacity between a group of farmers. The innovator said this has the advantage of spreading initial investment and ongoing management costs, but also being more likely to be awarded a grant from Defra. It was however also noted that the uptake of such grants from Defra has increased significantly since eligibility rules were relaxed to make it easier for individual farmers to access them, suggesting many farmer still prefer to control their own water storage and management systems.

Changes made to management of water in context of recent drought, and future droughts

Generally the innovators interviewed employed the same types of management practices as other abstractors, although one innovator said they had requested a

modification to the timing of their abstraction licence to allow them to abstract earlier in year for irrigation purposes.

4.2 CURRENT SYSTEM OF TRADING AND OTHER INNOVATIVE APPROACHES TO WATER MANAGEMENT

4.2.1 Delivery agents

Views on water trading: impact on allocation

Alongside other drivers of innovation, water trading is seen as one of a number of mechanisms that should be deployed to resolve the challenge of allocating scarce resources, alongside efforts to reduce demand for water (e.g. through water conservation, the use of new technologies to control leakages) and the reform of the abstraction system.

"...many of us believe that a greater rebalancing between the use of market forces and regulation will be critical to the new regime and particularly so that it responds more dynamically to environmental conditions as they change rather than assuming a fixed status." Delivery Agent 2.

Many of the delivery agents interviewed referred to the increasing use of market-based mechanisms such as competition and incentives to encourage balance between supply and demand as a positive development. This is referred to, for example, in Ofwat's Water Resources Planning Guidance for water companies:

"Vigorous competition can drive innovation in a more dynamic way that regulation ever will" (Ofwat, 2008).

In the past the water industry price reviews did not provide incentives for companies to speed up the introduction of sustainable practices. The next price review process will move in this direction. This should encourage water companies to develop innovative approaches to reducing demand for water including water re-use methods and modern systems for leakage control. More efficient use of existing water resources will benefit customers through lower prices and make more water available for use by other abstractors and for leisure and other activities that benefit the wider society.

It was suggested that a barrier that has held up innovation in the past is risk aversion on the part of water companies.

"There is concern that the way Ofwat has regulated in the past has encouraged water companies to respond to what the regulator wants, ticking regulatory boxes, rather than innovating to deliver what customers want. Ofwat is changing that with its planned outcomes-based approach." Delivery Agent 7.

It was suggested that in future there will be less requirement for water companies to deliver specific schemes and more onus on them to deliver agreed outcomes. The use of market-based instruments is expected to promote a more customer-focused approach. New entrants to the market are being encouraged to develop sources of water with incumbent companies; this should encourage greater competition in terms of the offer to customers.

The delivery agents interviewed who have had most involvement with water trading argue that the current system is not suited to trading and needs changing and that the change is likely to have to be quite radical:

"I think the retro-fitting that is being done and will be done to the current regime is essential and will be helpful but it will never be as efficient as a regime which is

designed with market forces being integral to the way the system operates." [Delivery Agent 2].

The small number of abstractors currently trading is seen a problem for the development of trading in the future by the delivery agents. The market is limited, with few people finding it worthwhile to buy and sell water and it is considered difficult to identify potential opportunities to trade. Some of the reasons given by delivery agents for the lack of interest in trading are:

- In many parts of the country it is still possible to apply for and obtain an abstraction licence;
- Farmers do not see water as a commercial resource. Their incomes come from their crops and water is a means to an end. *"…at the minute [farmers] hang onto what they don't need because a) it's not costing them anything and b) they're not making anything by giving it away."* Delivery Agent 4.

The Environment Agency staff said that their experience of trading so far suggests that it is mostly of interest to farmers. They believe that industry does not use this mechanism because their water use is "non consumptive", i.e. the water goes back into the river, so their abstraction licences usually do not have such stringent conditions. The characteristics of individual catchments are an important factor in the current system in determining how easy or difficult it is to trade. The majority of trades in East Anglia are in the fens where it is easier to move water owing to the topography and drainage system.

Environment Agency staff had different views about how far they should get involved in promoting or facilitating water trading. For example, some felt that putting abstractors in touch with one another is not within the Environment Agency's remit but recognised that in practice this sometimes happens.

Examples of innovative approaches and mechanisms

Most delivery agents felt that it was not just the abstraction licensing system that needed to change. Like the innovators, they emphasised that climate change and population growth were putting pressure on resources and that abstractors, particularly commercial abstractors, needed to be looking for efficiencies through innovation:

"...we want companies to innovate and the reason we want them to innovate is chiefly that we want them to deliver secure water supplies cost-effectively and sustainably." Delivery Agent 7.

Water management initiatives

The Environment Agency is heavily promoting winter storage by encouraging farmers individually or collectively to construct winter storage reservoirs.

"The drought is coming back. It's a taste of things to come, so we're heavily promoting winter storage and getting farmers individually or collectively to put in winter storage reservoirs." Delivery Agent 4.

Drought is expected to become a common phenomenon in the future and farmers who have the infrastructure to store water on their land will be better able to cope with periods of water scarcity. While storage was mentioned by a number of abstractors, it is not clear whether their awareness of storage has changed or how the promotion of storage by public bodies like the Environment Agency may have contributed to any change in perception.

Information and planning

The Environment Agency has increased the amount of information it is providing to

enable abstractors to take decisions based on the best possible intelligence about future weather conditions and water availability. One significant source of information is the Environment Agency's drought prospects report. The first was published in spring 2012; with an update in the summer. The report provides the Environment Agency's best guess about what is likely to happen in dry, average and wet scenarios.

"If there's a reasonable prospect of restrictions on irrigation then the farmers will plan accordingly and they will substitute their high water demand root crops for something else. I know that happened." Delivery Agent 4.

Regulation

In its relations with industrial abstractors in areas affected by water scarcity the Environment Agency is using the Environmental Permitting process (formerly Pollution Prevention Control permits), to encourage and push permit holders to be as efficient as they can. Water is an important resource in sectors like the intensive livestock sector and the food and drink sector more generally. The Environment Agency is trying to develop a best practice tool and a league table as a way of driving improvements in companies that are not performing well.

4.2.2 Abstractors

Understanding of current trading system

Understanding on trading before any material was given out to the focus groups was very varied. For instance:

Can I just have a general view about what people's understanding is of the current system of water trading?

Participant 1. *I haven't got a clue.*
Participant 2. *I believe you can do it. I've seen something on the Environment Agency website about it.*
Participant 3. *It's got to be fairly close.*
Participant 2. *Yes, it's quite restrictive.*
Participant 3. *It can't be a mile up the road.*
Participant 2. *It's got to be in the same catchment.*
Participant 4. *That's the idea is to ... you're in the Ouse catchment. The Ouse goes out to the Wash, so you've got a vast area you can trade over there. I'm all for freeing up trading because you've got ... round this table here you've got a guy who would like to trade out and* [someone else] *would probably like to trade in. You've got a trade there straightaway and it's ridiculous that you are restricted to that little area…"* (Focus group 1).

It was felt that there was very little advertising or publication about trading and that although it had been discussed within the NFU regional group it was not something on the radar of the smaller farmers or of other smaller volume abstractors.

A similar view emerged from the interviews with abstractors and especially smaller scale/volume abstractors expressing low awareness of trading:

"If I'm honest I was unaware of a water trading system…" Abstractor 3, farmer

In the focus groups one agricultural participant had carried out a formal trade under the current system. The food processing and race course participants had carried out trades but they did not immediately recognise this as trading under the current system.

"The estate was being sold so I transferred the farm's [licence] into our name……We used their's [water] *anyway but it was… because the land*

was going to be sold we had to get it [the licence] *into our racecourses name. Because it does have a commercial value of course…." (Focus group 2).*

The food processing participant added that in exchange for the farm giving up a borehole the company part funded the construction of a reservoir on the site for the farm to use.

This sort of experience seemed quite common with it becoming clear that there are a number of ways in which abstractors undertake activities which could be termed "informal trading", for example:

- Renting land with water attached;
- Sharing water supplies.

"We varied our licence so that part of it was allocated to spray irrigation and the remainder of it was for mineral processing. But that, certainly in this region, in the Bedford Ouse region, that is the only example I can think of where we have actually done something with I suppose the potential that we have, where we are able to allocate some of our licence quantity for use by a local farmer." (Abstractor 2, aggregates).

These practices were not explored in detail with abstractors but it is an area that would merit further exploration to help in understanding what factors are important in trading so that any new system could reflect (and not conflict with) abstractors' current needs and practices. One aspect that could be of interest is whether abstractors perceive that they are trading water or licences and the extent to which this might colour their willingness to trade.

When discussing trading the abstractors raised a number of main concerns. These issues with explanations are given in Table 4.1.

Table 4.1 Main concerns of abstractors related to trading

Issue	Explanation
Concern about losing the rights permanently	There was a strong sense that if you have a water licence it is important to keep hold of it even if it is not being used fully. The value of the licence was recognised together with a desire to keep what was regarded as owned by the participant, in particular when the water comes from what is viewed as the abstractors' property. *"And I think we tend to be quite traditional, it's mine, I've got it and I don't want anything to, you know, I don't want anybody interfering with it." (Focus group 2)* *"and we have tended to want to hold on to those in case we need them somewhere else for ourselves as opposed to necessarily wanting to give those up to others, albeit even on a temporary basis" (Abstractor 2, aggregates).* Another concern about losing rights that was raised was that the Environment Agency might try to take back anything unused "*clawback*"
Questions about demand	A common view of trading is that in a catchment either there will be plenty of water and thus no one will want to buy, or there will be a lack of water and no one will want to sell: thus doubt was expressed that a truly effective market could exist Likewise, responding to the background information note provided in advance that indicated that only 53 trades have been made

Issue	Explanation
	between 2003 and 2011, a number of abstractors said this showed that it was not a common occurrence, and also that this might indicate there is not much demand/need for trading. This was reiterated with the NFU group who made the point that there were many high water users in the room but that none of them had considered trading before suggesting that there was limited demand.
Transaction costs and other economic barriers (time and money)	The one person who was in the middle of a current trade said that it was taking a long time to do the paperwork and in fact the paperwork would not be finished till the next season, however, he has been allowed to have the water. "*It's just mind-blowing, it's bureaucracy*". (Focus group 1). A number of abstractors interviewed mentioned that the costs associated with trading, in particular the infrastructure required, act as a major barrier (especially in the farming sector). For example making use of a trade would require costs, such as investment in infrastructure or extended storage facilities.
Questions about how it could work	There was a sense of participants pondering how it could work, especially if everyone wanted water at the same time, which is what happened in a drought. In addition, understanding constraints of location on how trading could work was raised. *"If everyone say in this square mile or whatever buys all the licences and you all start abstracting out of the Ouse here from… How does that work because there's only a limited resource?* *Yes, it's in the same catchment area isn't it?" (Focus group 1).* *We are locationally fixed and that for us presents I suppose, we think, probably presents the biggest barrier to trading water because unless you have got somebody next door to you in the same water source, it would be difficult for us to understand how we could trade water somewhere, another part of the country perhaps that was water rich, to supply water to an operation in an area that there is perhaps over abstracted or over licensed plans and I think that is probably most critical to us in the East Anglia area.(Abstractor 2, aggregates)*
Price uncertainty	The fact that there was no agreed market or prices meant that there were issues around transparency and value for money. One abstractor stated that he had been offered a trade but did not want to bid as he had no idea what the price would be. *"It's fair to say there haven't been many and we don't get people banging on our doors enquiring about trades, and I don't necessarily think that's because the people aren't looking to trade. I just don't think ... well, I'm not sure. This doesn't seem to be a great deal of people making those ...* *There's a lot of unknowns. I think people don't have a feel for how much it's going to cost and that's a genuine blocker when people are investigating the alternatives." (Abstractor 1, water company)* Discussions in the NFU abstractors group included an example of

Issue	Explanation
	a farm being offered an abstraction licence for sale but no bid being made as there was uncertainty on what a "sensible" price was for the licence. There is *"no idea about what a reasonable offer (for a licence) is"*. *(NFU Regional Abstractors Group)*
Equity issues: winners and losers	There was clear agreement among the farmers that there should be "ring fencing" within sectors for trading as it was felt that industry or water companies would be the winners and agriculture the losers in any system. Ring fencing would entail putting restrictions on certain abstraction licences so that they could only be used for a particular purpose. *"Presumably if it was industry they'd want it for a longer basis than an annual basis, whereas agriculture is much more annually orientated, depending on your cropping for that year. Yes, the danger is though they can afford to pay far more for water and that's the way you're going to lose"* (Focus group 1). There were also concerns that the ability of industry and water supply to pay significant amounts of money for abstraction licences would mean that farms would sell their licences and close. This would have a very significant impact on rural communities. However, other abstractors felt that the benefits would be to agriculture rather than to the public water supply: *"I think it's going to be for agriculture [who benefits]…..I'm struggling to see how public water supply is going to benefit significantly from opening up trading because I just don't….the scales I think are quite different*" (Abstractor 1, water company)
Disparity between amounts available to trade and whether it was worth their while	It was commented that given the relative amounts the water companies and other sectors abstract (roughly 80% vs. 20%) that the non-water company participants could not see how it would be worth anyone trading between sectors as what was a significant amount of water to one group was not relevant to the other. *"Yes, I mean every now and again people might come and offer a licence to us but when that happens ... there's been a few I can think of over the last few years but they've been fairly small licences in terms of their value to us. We haven't pursued them just because of the scale of them. They tend to be quite small, agricultural ones that perhaps are only summer only or things like that, or an irrigation type licence that would be of limited value."*(Abstractor 1, water company)
Uncertainty of outcome	Uncertainty was a key theme through discussions about trading, with respect to costs, process and outcome. Interviewees wondered, if there was not enough water, what would there be to trade. ***"Yes, it could be. Maybe if this drought carries on for another six months or ...*** *But then what are we going to trade?"(Abstractor 1, water company)*

Issue	Explanation
Needing a change of mindset in order to benefit from trading	One abstractor remarked that there needed to be a change of mindset in order for trading to become regarded as an opportunity expressing what others had said more indirectly: *"Well there should be*.[benefits] *I mean the concept seems to be a sound one. Realities of it are, particularly historically we tended to hold on to these things and see them as assets as opposed to assets which are tradable let's say is how we have tended to view. So there is a bit of a changing your mindset that needs to take place before we see these things as tradable assets."* (Abstractor 2, aggregates) This links to the idea that water is seen as a basic asset for most productive activities and therefore something to be held on to.

Barriers to innovative approaches and mechanisms

Regarding non-trading innovative approaches the main barrier was felt to be around constructing on-farm storage. As previously noted both Cranfield University, Environment Agency and Defra are keen to promote on site storage and the majority of abstractors who mentioned it recognised that value of storage in giving them greater flexibility in managing their water (Knox et al, 2007) However, this was not usually a feasible option for tenant farmers as it was not their land that they were using. Other issues such as a change in capital allowances meant that reservoirs were now classed as buildings making them less financially attractive. There were also numerous concerns that the planning system made it too costly and time consuming to put reservoirs in place. In addition geological and topographic constraints (such as the river or a road crossing a farmers land or there being insufficient flat land) meant that storage was not always an option.

4.2.3 Innovators

Experience of trading, views on and changes being considered for future

As with the abstractors, innovators said that as far as they are aware little trading is currently going on, certainly little trading of abstraction licences:

Equally there is uncertainty about whether trading could work in practice: *"I don't think there's much demand for it because if you think of all the categories, if there's water available you can go and apply for it yourself so why would you buy it? If it's in balance the EA would probably allow the trade but you've still got to find someone with the rights and that's difficult"* Innovator 1.

However, other practices were noted, which might amount to trading, though are probably not currently considered as formal trades:

"There are all kinds of other things going on, which amount to trading, and the most common is, for example, Farmer A has land and an abstraction licence and so water, and the land with water is suitable for growing potatoes but he doesn't want to grow potatoes himself so he lets the land on a one year basis to his neighbour, or whoever, who comes and grows a crop of potatoes and uses the water to grow the potatoes. Now, is that trading of water?" Innovator 2.

One innovator described the current system as *"horribly clumsy"*. Another innovator said that the time to go through the whole process with the Environment Agency acted as a barrier to trading in the current system. Furthermore, levels of

awareness/knowledge of trading appear to be very low, with one innovator saying *"...lots of people have no idea how you go about trading water at the moment. A vast number have no idea."* Innovator 3.

A further key barrier in the current system (and which would need to be overcome in any new system) is that abstractors have significant concerns that by entering into a trade their abstraction licence will be reduced in future by the regulators. Uncertainty about the current rules and implications of trading is a major barrier: several interviewees mentioned that abstractors are wary of entering into trades for fear of losing their licences.

In addition one innovator said that the potential for emergency variations of licences for spray irrigation under the Water Resources Act[2] to be implemented at any time mean that people may be reluctant to trade as you might trade the right to abstract a certain amount of water, but still not be allowed to use it.

One innovator said that, from the perspective of farmers at least, being in the *"trading game"* would make water more expensive: *"… I think farmers are going to have to decide whether they want to be in a trading game, in which case they would have to be on a level playing field [with other abstractors] in which case they're going to be paying more for the water".* Innovator 2.

A further issue raised by an innovator was that the difference between historical and new abstraction licences means that *"abstractors within a group are not equal"*. This was cited as one of the reasons that licences since 2003 tend to have more onerous hands-off flow requirements than licences issued prior to 2003.

"I think in any process of trying to equalise things, we have to take into account those inequalities because why should the person who is feeling reasonably well-protected, why should he or she give anything up to somebody who has only recently joined the party?" Innovator 2.

The two-part tariff under which farmers abstract was also mentioned as a barrier in the current system. Under this system farmers pay a certain tariff to maintain the right to abstract, and then pay an additional tariff for water abstracted. This adds complexity to possible trading arrangements.

The same innovator said that a current barrier to farmers trading is that water used for agricultural purposes is viewed as consumptive rather than non-consumptive, which means that the water is not returned to the watercourse after use, as happens in the case of some industrial uses. The consumptive or non-consumptive character of water use is one of the conditions on abstraction licences. The innovator said that this acted as a barrier as it meant farmers were not on a "level playing field" with other abstractors.

Other innovators mentioned practical and cultural barriers to trading (which might also be present under a new system). For example there are limits to the distance it is rational to move water, and infrastructure required for the successful movement (and management) of water represents potentially very significant investment. In relation to cultural barriers, one innovator said *"for example, if you put half a dozen farmers together and they decide to build a single reservoir to service their farms, whose farm do you put it on?"*

Examples of innovative approaches to water allocation

The main innovative approach mentioned by the innovators is the establishment of abstractor groups in a particular catchment. Such groups are established to facilitate a coordinated approach to water management, and to provide a common voice, and line

[2] Water Resources Act 1991, Section 57

of communication between abstractors and regulators in relation to abstraction issues. The examples of abstractor groups discussed in the interviews were all from the same business sector: agriculture.

"…there's a lot of change happening and we've actually got to intensify our effort, we've got to become a little bit better organised and actually be prepared to put more effort into entering into discussions, into lobbying, into making sure that people understand" Innovator 2.

Another example given was that of farmers informally 'trading' hands-off flow licences. For example, where the owner of a lower flow licence does not need the water, they may come to an informal agreement with the owner of a higher flow hands-off licence, who otherwise would not be allowed to abstract. This example was described as an informal agreement, suggesting that it did not involve formal approval from the Environment Agency.

A further suggested example that could be explored was ensuring that industrial buildings/warehousing with large surface areas of roofing have rain-water harvesting systems which can feed, where possible, into local agricultural uses. The interviewee did say however that arable crop growing and industrial units may rarely be in close enough proximity.

4.3 ATTITUDES TOWARDS INNOVATIVE WATER TRADING APPROACHES

During the interviews and focus groups, stakeholders were presented with information about two potential water trading approaches. The material used is included in Appendix A. In most cases, participants took some time to get to grips with the two systems; inevitably, the information that could be provided in such a short time was also quite limited.

4.3.1 System 1 – Improved pair-wise trading

Delivery agents

Delivery agents had different opinions about the value of improving the current pair-wise system of trading. For staff working in the field, improving the pair-wise system appeared to be a pragmatic approach to streamlining management of water resources especially when water is scarce:

"During a period of drought members of staff are spending most of the day on the phone talking to various farmers, micro managing abstraction, watching water levels by the centimetre and saying "Okay, you can extract now", "Switch it off now and switch it back on tomorrow." There's a real will to work with abstractors to make the best of a situation for them. So in that sense I guess we are ... we're facilitating ... we could be facilitating the trading, I suppose, and then helping them to help themselves, which is more of a pragmatic approach, I guess." Delivery Agent 4.

The benefits of this system were seen to relate primarily to improved information and a faster process in the initial stages. The system would provide abstractors with more transparent information that would enable them to make better decisions on how they managed their water resources. It would be less bureaucratic and less costly, thus addressing two significant barriers to water rights trading.

Several delivery agents suggested that the system could be especially beneficial for farmers who need to access water resources rapidly but felt that it would probably not be of much interest to water companies who would not be able to access significant additional resources and might find the costs of making large numbers of small

transactions off-putting. One delivery agent suggested that water companies have much greater resources therefore it is easier for them to manage water supplies without recourse to trading.

Other delivery agents felt that the improvements offered by the improved pair-wise system were not great enough to encourage significant numbers of abstractors to get involved in trading. So whilst they could not see that there would be any real losers, neither did they believe that the system would put water trading on a new footing.

Abstractors

The main value of the improved pair-wise system was felt to be that over time a transparent price would emerge and that this would allow abstractors to engage with trading more easily compared to the current system. Some of the concerns around the current system were also felt to be common to this system although some noted that it made sense to improve the current system as potentially it could work if it was more transparent and quicker.

Innovators

The overall view from innovators interviewed is that any changes which reduce the complexity, bureaucracy and time required by the current system would be welcomed. However, some doubts were raised as to the practicality of changes proposed. One innovator asked how it would work in practice, saying that the Environment Agency has generally been reluctant to act as broker in trading, and the proposed system appears to assume such a role will be played, presumably by the Environment Agency.

Another issue raised was that, even with an improved system, some existing barriers would remain, especially the fear expressed by abstractors that they would lose their licences if they trade as this indicates to the regulators that they are not using them. Equally one innovator said that to work there would have to be sufficient volume of trading to make it worthwhile and interesting financially. Even under an improved system, an issue raised by one innovator was the actual value of water. Its relatively low unit value means that the trades made, even if relatively large in volume, will not generally represent a significant amount of money, which may deter (or simply not interest) people from getting involved in trading.

However, one innovator was quite positive about the improved pair-wise option, saying that it will *"probably release all this unused water and that is quite important: people have licences but there's an awful lot of water out there. Don't see any real losers … More efficiency is going to help and people understand that".*

4.3.2 System 2 – Central pool method

Delivery Agents

The delivery agents interviewed were more polarised in their views about the central pool method than about the improved pair-wise trading. For many, a regulated market-based approach was seen as a rational way of allocating water resources:

"It might well be a way of using the water resources more intelligently and therefore making sure that all users of water in the catchment were better provided for including the environment. It would need to be an intelligent system.... it couldn't be purely commercially based." Delivery Agent 6.

The benefits of this system were seen as increasing the number of potential trades through all buyers and sellers trading in one place, the flexibility that would facilitate more temporary and short-term trades and making it possible for water to find its value with the result that the value of water could be more effectively factored in to decision-making.

However, one interviewee felt that it was difficult to understand how the system would work and that the description provided painted "too rosy a picture". This interviewee was keen to see a system which would cut out the need for costly and time-consuming contract drafting processes, but could not see how the central pool system could avoid the need for contracts.

Another issue raised by those who were less enthusiastic about a central pool methodology was the way that this system would link up with regulatory processes. They appeared to feel that the link with regulation would be weaker and this might encourage people to 'cheat' the system by taking a bit more water than they had bought:

"Policing it and the credibility of a pooled system could be difficult in terms of making sure everybody stuck to their agreement." Delivery Agent 5.

Concerns were expressed about the impact of this system on smaller businesses. One delivery agent felt that:

"It would be easy for large companies to outbid small farmers as they have such different scales of business, large agri-businesses will pay whatever is required. Small growers (e.g. potato growers) would not have the margin to pay; the challenge therefore would be to make the market fair."

Finally, a number of interviewees felt that in both systems, there was a risk that less savvy abstractors might find themselves at a disadvantage, for example in terms of having the time to trade on a weekly or even daily basis or because they had more difficulty in keeping up to date with information about the trades: if they missed a trade, they might find themselves without water and this could have very damaging effects on their business.

Abstractors

The abstractors were generally interested in the central pool approach in part as it was the more radical alternative to the current system. The main benefits of the central pool expressed by abstractors were:

- Potentially more flexibility in the system, i.e. abstractors would be better able to respond quickly to changing needs and conditions;
- Greater transparency about what was happening and what the prices were.

Concerns were voiced regarding:

- The belief that a new industry of both brokers and speculators would emerge and would take money out of the system to the detriment of abstractors;
- Uncertainty as to whether the central pool would give sufficient certainty to support long-term planning something that was viewed as crucial by farmers;
- There was significant scepticism about the ability of the method to accurately allow for the complexity of abstractors uses and hydrogeology, i.e. could the system be accurate enough to ensure that there was enough water in the system where it was required;
- Those concerns and issues which had been raised about the current system were again reiterated.

The role of the Environment Agency in this method was not consistently agreed upon with some seeing a role for them as brokers with others doubting that they would have sufficient resources to fill the role. At the same time one abstractor said that they felt it would require considerable resources (time and effort) to be an active trader in the central pool method (to update your needs and offers and keep abreast with trading), and that this might act as a barrier to its use.

In general there was some cautious interest for this method and for trading in general as expressed by the following quotes:

"1. Well, I think we're all keen on trading aren't we?

2. Up to a point.

3. If it can work. What would concern me is if the trading had an impact on my own business albeit it there wasn't water there when I wanted it because someone else had traded up through.

1. But I see that rivers that haven't got the flow you won't be able to trade on. Rivers, like for example, the river outside here [the River Ouse]*, what we're taking out of it is minor against what's in there. So, that's where the trading will work. You've got to restrict it to those types of rivers."* (Focus group 1)

"Well I like the central pool market, it just sounds more workable, especially for somebody like me who would need it now, I want something now, that is the trouble with my job and what I do, I'd need something now, not to wait six months' time because that time's gone." (Focus group 2).

In comparing the two the following quote summed up the view of one of the focus groups:

"With the central pool…. whereas a pair wise is fairly narrow in scope but then the central pool obviously has the complexities and probably the cost. I think that's what it boils down to." (Focus group 1).

Innovators

Generally the innovators interviewed were quite positive about and interested in the concept of a Central Pool method, for example:

"...firstly, if I didn't have to search for someone to trade with, that's good news. They just put two and two together. I don't have to write a complex contract so that's fine or wait long for approval so that's fine. It would be more flexible and cheaper. That's fine." Innovator 3.

"…it relies on people being honest and straightforward and, if you like, properly-controlled." Innovator 2.

In addition one innovator said that they could see useful ways in which such a system could help in the case of farming: firstly if a farmer upgraded their irrigation equipment to a system with a slightly larger functioning capacity, rather than renegotiating their entire licence they could just buy in a "top-up" to meet the extra demand; secondly, if towards the end of a growing season, in spite of planning abstractions as carefully as possible, as farmer finds him or herself "three of four days short" of water, they would be able to go to the market and literally buy-in the little bit of extra capacity they need. Greater flexibility was therefore seen as being a positive factor in the central pool method.

However, the same concern was raised regarding the role assumed to be played by the catchment regulator, and whether in practice the Environment Agency or another organisation would be willing and able to play this role. One idea related to this, raised by an innovator was that, in practice the Environment Agency knows who is and is not using their licences and could therefore be more proactive in facilitating trades by approaching people not using their licence and asking if they would like to trade.

One innovator was uncertain how the central pool method could work in practice, in particular what the starting point would be: *"Do you have some rights because you've*

had the licence for years? Or do you have to go and bid with new business for example? I don't know how it would work."

Another innovator raised another issue related to how the system would work, especially asking who would meet the cost of it, and about how the price of water would be set:

"Someone's going to have to set a price and we don't want a situation similar to sugar beet contracts … where you're a sugar beet grower and there's only one body (the NFU) that sets a price or agrees a price with the sugar beet factory. It only breeds a lot of disquiet in the industry really [there is a] *concern something similar could happen with water prices."*

This lack of clarity about the conditions for trading in general meant that all the interviewees struggled to see how it might operate and therefore to make clear statements about opportunities and barriers.

A further potential issue raised related to a web-based central pool system was that some potential buyers/sellers may simply not have the necessary equipment or knowledge to participate. Equally if the trading happens very quickly and unpredictably, one innovator expressed concern that someone might miss out on a trade critical to their business simply by being unavailable at the time (for example if they were dealing with an emergency in their business or a personal problem) or unaware that they needed to be taking action at that point.

Finally a central concern is that an open and free market place for water may ultimately push up the price of water and/or mean that new or wealthy businesses buy up the vast majority of rights leaving others unable to afford water, or with no rights to access water needed.

"I hope and pray that once we get into water trading the EA [Environment Agency] will restrict water companies coming in and buying. We've got to have agricultural trading for a particular volume of water. They can't come into our market because we're not allowed into theirs because we can't get into theirs and it's too expensive if we get water supplied by a water company to do agricultural horticultural work. It's too expensive" Innovator 3.

4.3.3 Overall views on current and innovative approaches

Most interviewees expressed general interest in an improved system. However, many also indicated that they had not had time to fully understand, discuss and digest the systems proposed or that the information provided was too sketchy to enable them to properly assess the options. Very few stakeholders rejected the idea of water trading for reasons of principle. Those who expressed doubts tended to focus their queries on the way in which the system would work and on how it would fit in with the new system of regulating water abstraction.

One abstractor indicated that whatever the system, success would largely come down to how easy the interface is to use: *"…it doesn't seem to make a huge amount of difference whether I'm selling to someone … on a pair wise basis or whether I'm selling it to someone who I'm not talking to directly* [central pool]*. The big thing for me is … how easy it is to do. And if it's going to take me 40 minutes and two 24 digit passwords and user names ... then I'm probably not going to do it."* Abstractor 3.

4.4 COMPARATIVE ANALYSIS

In this section comparisons across all three groups of stakeholders are drawn out across a number of key issues.

4.4.1 Efficacy of the current mechanisms for abstraction licensing

From the perspective of the delivery agents it was considered that the current water allocation system does not allow water to be allocated or managed efficiently, but rather it is just split up and licensed on a 'first come first served' basis. From the abstractors perspective there was little comment on how the current system functions but it was clear that there is a great variation in abstractors' situation and needs: licence terms and conditions vary; needs vary between farmers (different crops or production) and between types of abstractors (e.g. water supply, industry, leisure). However, it was clear that within the current system even when abstractors have enough water they do want to hold onto any unused licences in case they might need it elsewhere or for a different purpose. This may or may not be a function of the current system but it does raise the bigger issue of the perception of water as a commodity and how that perception may influence decisions to take part in water trading. This is discussed further in the discussion section.

For the innovators, their concern focussed on the growing demand for water and increasingly unpredictable nature of supply and a realisation of the unreliability of historical rainfall patterns. Whilst this was not a direct criticism of the current system, this thinking does lead to questions about what sort of system would be most efficient given these changes in water supply.

Responses to drought

In terms of responses to drought, the main delivery agent (i.e. the Environment Agency) has made efforts to assist abstractors in coping with the drought by:

- Applying the current system as flexibly as possible, to assist abstractors, particularly farmers, to manage their water resources more effectively;
- Providing information to abstractors on trends in water availability;
- Moving away from thinking in terms of summer and winter abstraction, to periods of high and low flows;
- Introducing mechanisms for more informal agreements between abstractors, such as dispensation letters.

Across all the abstractors, those who had on-site storage infrastructure were in a better position to manage the drought than those who did not, but most reported that they had studied or implemented actions. Responses to the drought by non-farming abstractors ranged from implementing water efficiency programmes to reducing or closing down some of their activities.

The interviews and focus groups took place when it had already started raining and the drought was pretty much over, so farmers were perhaps more upbeat about having been able to manage the drought. However, it is clear that most of them had also taken or considered a number of measures to reduce the impact of drought on their businesses by:

- Reducing consumption and increasing efficiency;
- Reducing the quality or quantity of production (e.g. not agreeing to as many irrigations of crops, reducing area planted);
- Introducing improvements such as wetting agents or night-time irrigation.

What also emerged was a difference between the larger farms that were tied into agreements with supermarkets and the smaller farms that had a diversity of outlets for their crops. The former expressed greater concern about the drought and its impacts which would be more serious than for those with smaller farms who gave the impression of being able to manage during the drought.

Perhaps what singled the innovators out was their use of collective methods for addressing problems, e.g. catchment level associations, setting up groups to create joint storage facilities; networking with regulators to keep abreast of developments and identify opportunities, e.g. for funding for shared storage. Further they were involved in lobbying and influencing policy making (especially to promote interests of farmers). What emerges is a range of responses to the drought with flexibility on the part of the delivery agents together with abstractors having a variety of options available to them in order to secure their water needs.

Urgency of problems facing water abstraction system

In terms of their views on the urgency of the problems facing the current system, the Environment Agency sees it as a problem waiting to happen rather than one that has actually arrived. Other delivery agents considered reorganisation of abstraction system as an opportunity for more holistic planning of catchments.

For the abstractors in the Upper Ouse and Bedford Ouse catchment water availability has not historically, and is not perceived currently, to be a major consideration, with the exception of some farmers. However, it is important to note that the research involved only people who already have abstraction licences and did not seek out people who are trying to obtain licences.

The innovators were possibly more conscious of the looming problem of water shortages than the majority of abstractors. However, some innovators felt that there is still water widely available: *"if there's water available you can go and apply for it yourself so why would you buy it?"*

Overall, the drive for reform of the system appears to be mainly from the delivery agents rather than from the abstractors but it should be noted that the research did not ask about issues with the current system directly.

4.4.2 Perceived barriers to effective water trading

In terms of barriers to effective water trading there were a number of issues that emerged across all three groups of stakeholder.

Size of market

Environment Agency staff argued that there were not enough trades taking place to create a dynamic market. Abstractors like to hold onto their licences and there is no incentive to sell them because the cost of retaining the licence by paying the existing annual licence is relatively low. The innovators talked about the need for a big enough market to make trading financially interesting, whilst the abstractors argued that there was little trading because there was little information about trading and few had much idea of what it would involve.

Understanding and expectations about how a market for water could work

Abstractors expressed a concern that under a new system they might be forced to trade. This was mentioned by the range of stakeholders, including an industrial abstractor. For the innovators there was a difficulty of understanding at what level trading will work across catchments given that water does not have the same value across the country; in some catchments (with less water) water is much more valuable than others. The innovators had a greater awareness of the issues for setting up a trading system, e.g. the fact that 'consumptive use' abstractors pay two tariffs (for licence/rights and for use). If a 'level playing field' were introduced, this might mean increased prices for farmers.

Social equity issues

This was discussed by all the stakeholders. Several delivery agents felt that trading would benefit bigger abstractors at the expense of smaller users. Larger abstractors (water companies and power companies) themselves recognized the potential that they could 'skew' the market just because the volume the use is so much greater than anyone else's, but also felt that trading could benefit the agricultural sector. The farmers felt that it would be the larger abstractors who would benefit from trading and could potentially squeeze out smaller interests.

4.4.3 Consideration of the two innovative approaches to trading

The details of the different views of improved pair-wise and the central pool method are discussed above. What was clear across the different stakeholders was that there is currently openness to discussions around trading with views not appearing to be polarised either way regards trading in general or towards one method above another.

What is useful to draw out are the factors that would influence abstractors' decisions about whether to enter the water market, either as a seller or a buyer. These are presented in the Table 4.2.

Table 4.2 Factors likely to affect willingness of abstractors to trade water

Factor	Buyer	Seller
Volume of water traded	For those needing large amounts of water, there would be little interest in making multiple purchases of small amounts.	Given the price of water, high volumes would be needed to be high to justify the costs involved in trading.
	Would need to be able to trade large volumes freely, not just occasionally or subject to restrictions.	
Price of water	Price needs to be lower than the fine for exceeding licence conditions.	Price would have to be high enough to justify the costs involved in trading.
	For abstractors with access to water from the mains supply, prices would need to be lower than that of mains water.	
Process for participating in trading		The process for providing information about available water surpluses and for completing transactions would have to be simple and quick, avoiding additional costs.

5. Discussion

Wider water management context and implications for trading

It is clear that the interrelationship between type of licence, use and timing creates a set of complex conditions in which water is managed. In the case of agricultural abstractors, these conditions are made more complex by the existence of different crops with their own requirements. Each abstractor has their own particular set of conditions which makes their situation different from others: abstractors are not a homogenous group, even at a local level or within a particular sector. This makes it very difficult to predict what the uptake of a new mechanism would be: it would be unwise to make assumptions about the behaviour of an 'abstractor group'. This may mark the difference between the characteristics of abstractors in England and Wales and abstractors in places like California and Australia.

This wider water management context also means that different abstractors are affected and respond to drought in a number of ways. In particular water storage is recognised by abstractors and delivery agents as an effective way of giving abstractors more flexibility to respond to low flow conditions. Despite this, barriers relating to planning permission, cost, land ownership and physical factors can limit the ability of abstractors to develop storage infrastructure.

Attitudes towards trading

Firstly, there was widespread variation in knowledge and awareness of water trading expressed across all types of stakeholders within this research. Entrenched views were not expressed: there was neither outright rejection nor committed support for increased trading in water or a new system to facilitate it. Even people who did not want to participate in the research when invited indicated that this was because they could not see its relevance (often because the quantities of water they used were "small"), not because they were opposed to it. This means that there exists a space currently to discuss these issues which is very important in taking the discussion forward.

However, as water trading is not an urgent issue for abstractors, none had a clear idea of what the price of water might be although many seemed to think that it was likely to be low. Perhaps because it appeared to have little relevance to their current concerns, several suggested that they would need to be paid more than 'a few hundred pounds' to be interested in getting involved. Differences between abstractors are further coloured by issues such as trust or scepticism about the willingness of other actors to participate in trading.

Equity issues and ring fencing

A number of interviewees from all three groups expressed concerns that water trading could create a situation where there would be "winners and losers". Several mentioned the potential problems that could beset small farmers who failed to buy water for their crops. These interviewees felt that the market would inevitably favour those with greater resources who would be in a position to pay more and use their knowledge to get more out of the system than the small abstractors and that this would be inequitable. Other interviewees had a more positive view of the market as an even-handed mechanism for distributing scarce resources.

The issue of ring fencing (i.e. whether trading could occur across different sectors) was raised by a number of the abstractors, in particular agricultural abstractors. These discussions brought up issues around symmetry of demand, for instance it was felt that within a particular catchment most farmers would have similar demand (as they grew similar crops) and supply (as water levels would be similar) and that therefore there would be limited demand for trading within the agricultural sector.

It was recognised that there might be a greater difference in water supply and demand between sectors and that therefore there would be greater demand for trading. However, the farmers made it clear that they felt that allowing trading between sectors would mean that water would flow to sectors that were better able to afford it, this was felt to mean that agriculture would lose out. However, the scale of abstraction meant that some interviewees were not convinced that water companies would be interested in the scale of water that others abstract (which is less than 3% of total abstraction licences in this catchment). These discussion points were made across the three trading schemes discussed.

Perceptions of water: water as a commodity or right?

While some abstractors use the language of commodities to talk about their water resources, referring to assets, pricing, volumes traded; others described talked about needing to be sure that they could get their water back if they agreed to trade it temporarily:

"...okay so you put water in ... what if you wanted to put that in for a temporary period of time, how do you ensure you are going to get it back?" Abstractor 2.

This suggests that they have a different perception of their abstraction licences. Potentially, these kinds of social or emotional understandings of the value of water could act as barriers to water abstractors becoming involved in a water market.

Trust and social capital

Currently, abstractors engage in a number of water management practices in order to ensure they have enough water at the right time and place for their businesses. This includes "informal" trading, between trusted sources at times of need. It will be important to understand the compatibility of formal trading with these informal processes and the extent to which other water management practices may be as important to pursue as trading in order to make efficient use of water.

Across this catchment, there is evidence of the existence of valuable social capital including:

- **Bonding capital** (i.e. close knit groups with support from family/friends) found in river-level farmers' associations such as the River Lark Abstractors' Group and in informal cooperation between farmers to share water;
- **Bridging capital** (i.e. wider networks, bringing people involved in different groups together providing access to wider resources) through associations like the NFU which facilitates coordination between farmers across the region and between regions;
- **Linking capital** (i.e. hierarchical networks between people in local areas and organisations with power and influence): innovators appear to provide links between farmer abstractors and regional or national delivery agents such as the Environment Agency or the IDBs.

Water management is a social process: abstractors make decisions based not only on what they have (e.g. conditions on licences, storage facilities) but also on their relations with other abstractors and with regulators. If a formal mechanism for managing water, such as a new trading mechanism, is introduced, it is possible that this could have an impact on bonds of trust. To take one recent example: to what extent would the greater development of a water trading mechanism affect abstractors' willingness to agree to a voluntary 20% reduction in groundwater abstraction?

It will be important to consider the potential impact of new mechanisms on social capital alongside the assessment of the feasibility and likely costs and benefits of these mechanisms.

Pricing of water: tipping points and commercial interest

An issue explored indirectly in the stakeholder interviews was what would need to change in order for licence trading to become more frequent. Considering the potential value of water is one aspect of this, and although no specific 'tipping points' (i.e. the point above which trading would become attractive) were mentioned by abstractors, it is clear that the price and thus potential revenue from trading has got to be sufficiently high to 'make it worth it'. The interviews thus suggest there may indeed be a 'tipping point' above which commercial interest would be aroused.

"In terms of the commerciality of it… I don't think it is something that we have necessarily seen as a huge commercial opportunity to us, but … depending on the pricing and everything else and how freely we were able to trade these volumes, it might become something that we see as of commercial interest to us". Abstractor 2.

"For us to get on board … we'd have to see the advantage and for a few hundred quid we are not going to be bothered ….it would have to be something that starts to generate a reasonable return to basically devote resources to it". Abstractor 2.

"One of the problems with a relatively small abstraction licence would be whether it's financially worth doing it. Because if you're only going to get 150 quid from it or something along those sorts of lines then it's not really worth the time of going through the whole system" Abstractor 3.

A further point raised relating to the economic value of water was that of current differences in unit prices paid in different sectors (for different water uses), for example: *"I think… they have done one study where raspberry growers… could pay up to £6 a tonne…for water and still be able to justify that financially because without it they could lose their whole crop. We pay about a sixth of that".* Abstractor 4.

Views of water as a commodity

As discussed above, there is clear recognition and awareness that water and its use has a value. Overall the stakeholders expressed the general view that water can be viewed as a commodity, or asset that is clearly valued (and therefore can be seen to have an economic value).

"I think there is an appeal in being able to trade water because as … it is an asset and it's a commodity that could be traded." Abstractor 3.

Furthermore some interest was expressed in the potential to benefit economically from a potentially improved market in water licence trading, for example one abstractor said that: *"yes, there is the potential of earning a few pounds. I'm just looking at it from an economic point of view there, but ... yes; there is a bit of potential there"* Abstractor 1.

Although this interest is clearly shown, another abstractor indicated a *"change of mindset"* was required in order to see licences as *"tradable assets"*. Abstractor 2.

One interesting insight expressed was that in a situation where additional abstraction was needed desperately for commercial reasons (e.g. to stop a crop failing), for trading to be effective the price would need to be lower than fine for exceeding an abstraction licence: *"…theoretically I guess it may be cheaper to trade and purchase more rights than it is to effectively exceed your own limits and pay a fine."* Abstractor 3.

6. Conclusions and implications for Phase 2

6.1 CONCLUSIONS

The main findings of the Phase 1 stakeholder engagement were as follows:

- There was a perception that the abstractors within the Upper Ouse and Bedford Ouse catchment are not "equal" and that abstraction licences issued since 2003 have more restrictions on them than licences issued prior to the 2003 Water Act.
- Under the current abstraction licensing system even when abstractors have sufficient water or no longer require an abstraction licence they tend to hold on to their abstraction licence because the annual renewal fees are low and they may have a need for it in the future.
- There is widespread lack of knowledge and awareness of water trading across all types of stakeholders. Among certain abstractor groups it was felt that there was little information available to them about the trading of water rights. As a result, the space exists to be able to discuss trading. We did not find entrenched views: there was neither outright rejection nor committed support for increased trading in water or a new system to facilitate it. Even people who did not want to participate in the research, when invited indicated that this was because they could not see its relevance (often because the quantities of water they used were "small"), not because they were opposed to it. This space is very important in taking the discussion forward.
- The interrelationship between type of licence, use and timing creates a set of complex conditions in which water is managed. In the case of agricultural abstractors, these conditions are made more complex by the existence of different crops with their own requirements. Each abstractor has their own particular set of conditions which makes their situation different from others: abstractors are not a homogenous group, even at a local level or within a particular sector. This makes it very difficult to predict what the uptake of a new mechanism would be: it would be unwise to make assumptions about the behaviour of an 'abstractor group'. This may mark the difference between the characteristics of abstractors in England and Wales and abstractors in places like California and Australia.
- It appears that compared to previous droughts (e.g. 1976) that the current regulator (i.e. the Environment Agency) works more closely and flexibly with certain abstractors regarding the abstractions that they can make.
- Differences between abstractors are further coloured by issues such as trust or scepticism about the willingness of other actors to participate in trading.
- Delivery Agents often stated that the current system of abstraction licensing is not sustainable and not able to deal with the challenge of allocating water resources in conditions of rising demand, increased water scarcity and uncertainty about future supplies.
- Currently, abstractors engage in a number of water management practices in order to ensure they have enough water at the right time and place for their businesses. This includes "informal" trading, between trusted sources at times of need. What will be important to understand is the compatibility of formal trading with these informal processes and the extent to which other water management practices may as important to pursue as trading in order to make efficient use of water.
- Across this catchment, there is evidence of the existence of valuable social capital[3]:

[3] Social capital (Putnam, 2000) can be defined as reciprocal relations of trust

  - Bonding capital (close knit groups with support from family/friends) found in river-level farmers' associations such as the River Lark Abstractors' Group and in informal cooperation between farmers to share water;
  - Bridging capital (wider networks, bringing people involved in different groups together providing access to wider resources) through associations like the NFU which facilitates coordination between farmers across the region and between regions;
  - Linking capital (hierarchical networks between people in local areas and organisations with power and influence); innovators appear to provide links between farmer abstractors and regional or national delivery agents such as the Environment Agency or the IDBs.

- The day-to-day water management practices of innovators appeared to differ little from stakeholders classified as abstractors. The main difference was that innovators played a broader role in water management over and above that related purely to their own businesses.
- The issue of ring fencing (i.e. the act of putting restrictions on an abstraction licence so that it can only be used for a particular purpose) was made by many abstractors. There was a perception that farmers would lose out to larger abstractors such as water companies and that owing to their relatively small size of agricultural abstraction that larger abstractors would not be willing to make small trades with farmers.
- Delivery agents did not perceive the current regulatory and institutional framework to be suited to the trading of water rights and that radical changes to these were needed to encourage trading to take place.

Water management is a social process: abstractors make decisions based not only on what they have (e.g. conditions on licences, storage facilities) but also on their relations with other abstractors and with regulators. If a formal mechanism for managing water, such as a new trading mechanism, is introduced, it is possible that this could have an impact on bonds of trust. To take one recent example: to what extent would the greater development of a water trading mechanism affect abstractors' willingness to agree to a voluntary 20% reduction in groundwater abstraction?

It will be important to consider the potential impact of new mechanisms on social capital alongside the assessment of the feasibility and likely costs and benefits of these mechanisms.

6.2 IMPLICATIONS OF FINDINGS FOR PHASE 2

From the stakeholder engagement there would appear to be an interest in the possibilities that water trading could bring to them. In Phase 2 two demonstration water trading system will be set up based on the Upper Ouse and Bedford Ouse CAMS area. The main objective will be to allow the stakeholders to judge how different trading operations could work and the nature of the trading systems. The objective is to allow the stakeholders to understand how future abstraction licence trading systems could work and to assess their views on it. This will be done by an initial workshop. A second workshop will be held where a fully interactive demonstration of the central pool method will be demonstrated.

7. Recommendations for further research

From Phase 1 of this research it is clear that that there is a number of other key issues that need to be researched in relation to water trading within an England and Wales context. These research issues include:

- Investigating the social equity implications of water trading within a catchment with a range of large and small abstractors.
- Investigating the institutional and governance issues that would need to be in place for an approach to trading to be effective, credible and trusted. What implications that would have for current institutions associated with water management both in terms of resources, technical capacity and costs.
- Research into the perception of both the value of abstraction licences amongst different abstractors and the value of water.
- Improving the understanding of the different social and cultural attitudes amongst different abstractors to the trading of water.
- Research is required to gauge the robustness and accuracy of current methods employed by Catchment Abstraction Management Strategies (CAMS) to assess water resources with catchments within a context where water trading takes place on a regular basis, because there is scepticism amongst certain abstractors as to whether hydrological and hydro-geological processes are represented accurately enough in CAMS to allow water trading to take place.
- Research is necessary to consider the monitoring requirements both in terms of hydrological and hydro-geological measurements, as well as methods to monitor actually abstractions effectively to allow trades to occur quickly (i.e. completed in a number of days rather than several months).
- There is a requirement to consider the transition arrangements that are needed to move from the current abstraction licensing system to a more sophisticated and less bureaucratic system in the future, and the time period and costs to put these arrangements in place.
- Water management decision making under uncertainty including examining the ways in which a wide range of abstractors make decisions about their water use, looking in more detail so as to understand the most effective ways of ensuring an efficient water allocation approach.
- The setting of hands off flows in rivers is important to the amount of water that is available to be abstracted from watercourses. There needs to be greater transparency in the way in which these flows are set and there is a need for research in this area that engages with stakeholders, because there is a perception by many stakeholders that the way in which environmental flows are set is not transparent.
- Work is needed to better understand the demand for water by businesses and individuals that currently have no abstraction licences (i.e. abstractors using less than 20 m^3 per day).
- In order to assess the impacts of a particular trading system it is necessary to research the economic, social and environmental outcomes that would occur if trading were not possible, or very limited trading continues to take place;
- In the future the trading of water rights may have to reflect supply characteristics like water quality. For example many industries' decision as to where they obtain their water from (e.g. public water suppliers, surface water sources and

groundwater sources) often depends on the quality of the supply. This is an area where further research is required;

- Water management for many abstraction licence holders is about managing their risk. There is a need for further research to gain a better understanding of how abstractors currently manage their risk and how would trading of abstraction licences under possible future reforms to the abstraction licensing system would affect this.
- The current abstraction licence regime fails to legally link catchment wide considerations to individual licensing arrangements (Young, 2012b). There is need to link licensing reform to robust Integrated Water Resources Management (IWRM). There is also a requirement for further research to details how accurate CAMS are and how they contribute effectively to IWRM. CAMS need to become the prime means for managing catchment-scale issues. More research is required to assess how more accurate hydrological assessments can be obtained of catchments in water stressed areas using readily available hydrological data and models.

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Appendix A Note on method for analysing interview and focus group material

Focus groups were recorded digitally and then transcribed. In addition to the facilitator in the focus group there was a note taker, providing a record of each focus group that combined the notes from the note taker and the transcript. The benefit of having notes taken at the time was to speed up reporting.

Interviews were recorded digitally and transcribed. Both focus group participants and interviewees were informed that none of the information or views obtained would be attributed, to ensure confidentiality.

The interview transcripts were used to populate an Excel analysis framework structured to facilitate cross-comparison in each area that views were sought (i.e. by discussion points in the focus groups, and groups of questions in the interview schedules). The question areas were examined for key issues and themes.

The analysis presented in Section 4 draws out the key findings in each area of research interest, based on the input obtained from engagement with the three categories of stakeholder. Overall and common learning points are also drawn out where appropriate.

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