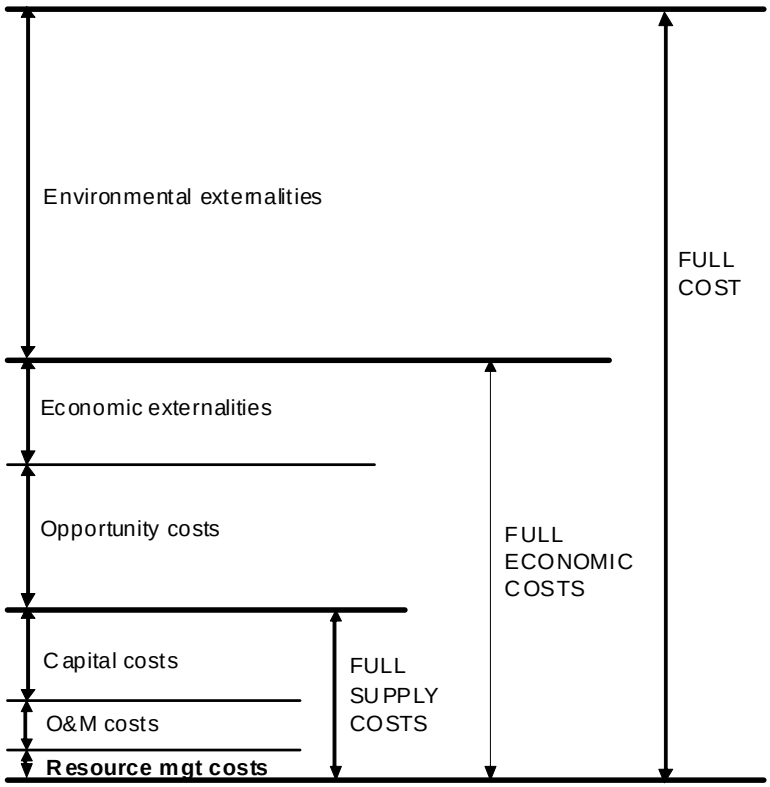
China – UK, WRDMAP
Integrated Water Resources Management Document Series

Thematic Paper 5.3: Water Resource Fees

May 2010



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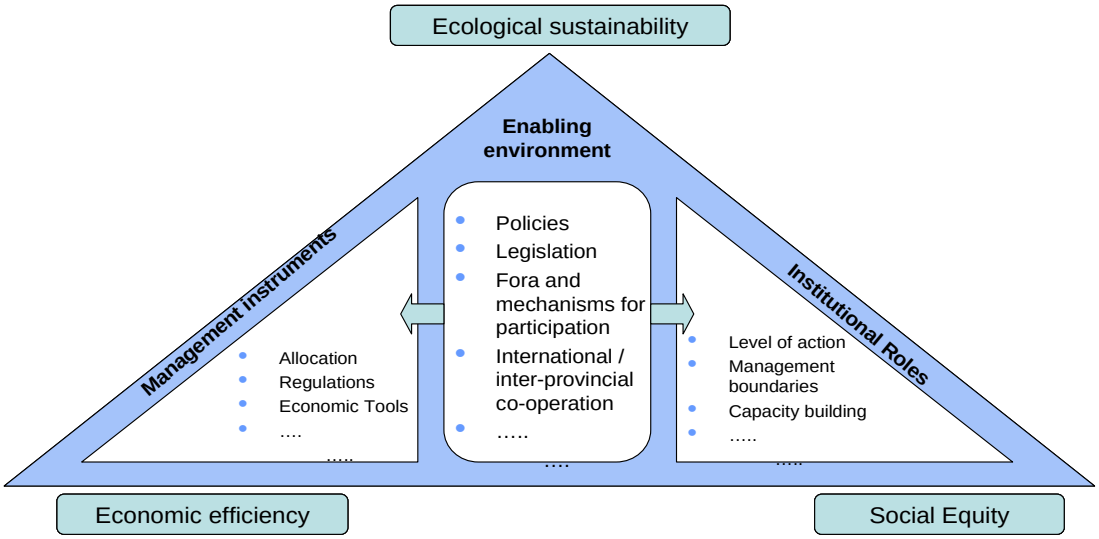
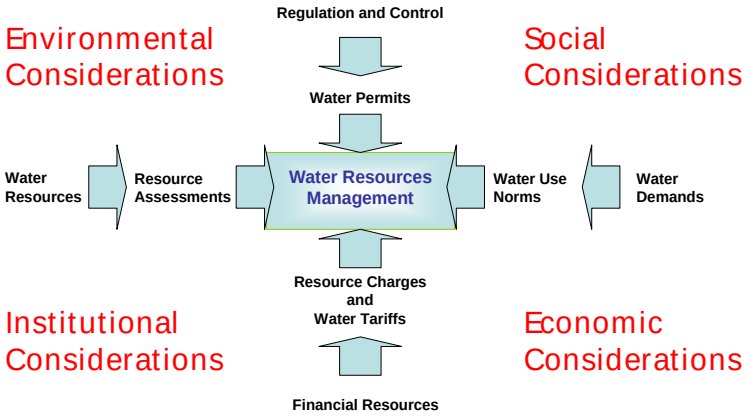
Integrated Water Resources Management (IWRM)

(Based on Global Water Partnership)



Driving Elements of Integrated Water Resources Management



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Summary: This document outlines the purpose and management arrangements for water resource fees (WRFs).

WRFs are collected in order to finance water resource management and related activities. There are generally a small part of the total costs, so have little or no direct impact on demand. Their main purpose is to ensure that water resource management activities are fully financed. They can only be introduced once there is a system of abstraction permits in place.

WRFs are adequately provided for in national policies and regulations, but these are not yet translated into provincial regulations in all cases.

There are significant practical difficulties in setting and collecting the fees, which this document attempts to address, on the basis of experience from other countries but applied to the Chinese context. These issues include:

- Identification of costs to be recovered
- Structure of fees to ensure that the economic value of water in its various uses is understood by users
- Collection and management arrangements

In the longer term, it can be expected that WRFs will be increased to cover environmental and economic externalities, but this will take time.

The Ministry of Water Resources have supported the Water Resources Demand Management Assistance Project (WRDMAP) to develop this series to support WRD/WAB at provincial, municipal and county levels in their efforts to achieve sustainable water use.

1. Introduction

1.1 What are water resource fees?

Water resource fees (WRFs) are an important part of integrated water resources management (IWRM) in many countries. Their main purpose is usually for financing some part of the cost of water resources management, particularly the costs of managing water abstraction permit systems.

IWRM involves a range of management instruments, as described in Overview Documents OV1 'IWRM' and OV2 'Water Demand Management'. WRFs are part of the 'economic instruments' described in those documents. It should be stressed here that they are only a part of the overall approach for IWRM or of water demand management. They are only even a small part of the economic instruments aspect of IWRM, but they have been found from international experience to be invaluable for ensuring adequate finance for key aspects of water resource management.

1.2 Economic instruments for water resource management

Introduction

Traditionally, water has been managed informally or by top-down government control, but the need to bring in economic and market-based approaches has been recognised for many years. This need has been prominent since the Dublin Principles were agreed at the International Conference on

Water and the Environment in Dublin, 1992. One of the four principles states:

> "*water has an economic value in all its competing uses and should be recognized as an economic good*".

Managing water in a way which recognises this economic value involves the use of *economic instruments.* WRFs are a part of these economic instruments in general, but they are only a small part.

There are several aspects of the use of economic instruments, including:

- Recovering costs of water resource management;
- Cost recovery for water service delivery (urban water supply, irrigation, etc)
- Influencing demand directly through the price of water;
- Setting economic policies, subsidies and support systems in ways which will promote water saving or improved water management;
- Using cost-effectiveness and economic analyses for optimising the allocations to various water uses;
- Use of discharge and effluent permits and associated charges; and
- Use of tradable abstraction permits.

WRFs relate to the first of these bullet points – recovery of the costs of management of the resource itself and thereby ensuring that the organisations responsible for this are adequately financed. The cost of supplying water to the user from the source is much greater (usually at least ten times greater[1]), but these supply costs are recovered through separate service charges. The WRF has little direct impact on demand, but the fee can be valuable for influencing the perceptions of the value of water.

The wider aspects of economic instruments for water demand management are not described here, but are outlined in Overview Document OV2: Water Demand Management. This Thematic Paper just considers the water resource fees, covering the concepts, methods of application, impacts and limitations.

The concept of water resource fees

Water resource fees are intended to recover part of the costs of water, so it is important to identify which components of the full cost of water are or could be covered by resource fees[2].

The full cost of water is illustrated in Figure 1, and includes several elements:

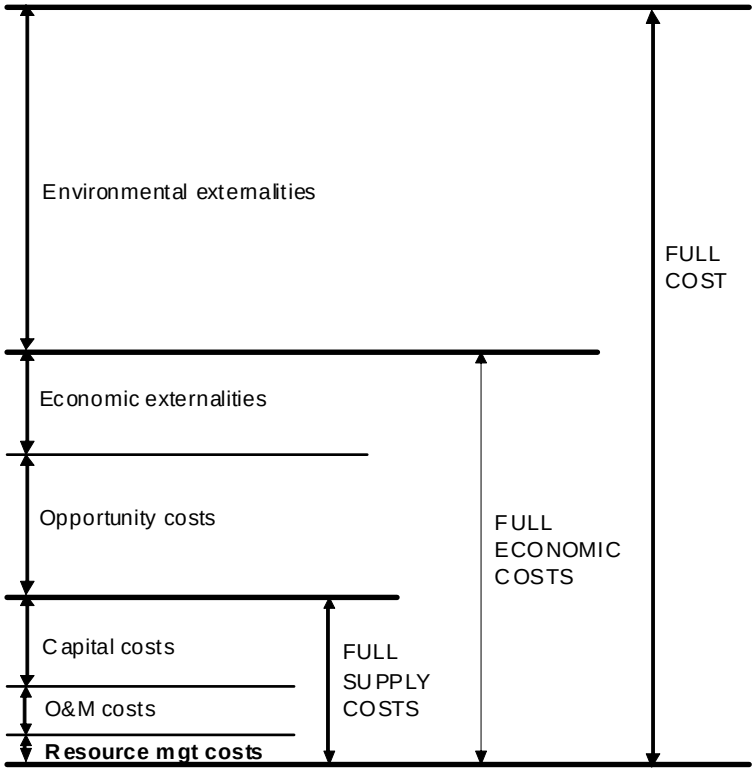
- The administration and other **costs of water resource management** – this relates to the cost of monitoring the resource, administering and auditing permits and so on.

[1] typically 1-2% of the cost of urban water and 5-10% of the cost of agricultural water, although this varies considerably

[2] In some countries the terms water abstraction charges, or water resource charges are used. In this paper, the term Water Resource Fee is used throughout

- The **capital and O&M cost** of the infrastructure, including all costs associated with the organisation responsible for delivery of water to the end-users.
- The **opportunity cost** of water, which addresses the fact that by consuming water, the user is depriving another user of the water. If that other user has a higher value for the water, then the opportunity cost is the difference between the actual value of water consumed and the potential value if water resources were allocated to the most valuable uses. This cost is only zero if there is no alternative use of water.
- **Economic externalities**, which may be positive if return flows recharge aquifers and thus reduce costs for other users, or negative if they pollute sources used by downstream users which need to be treated before they can be used. These are distinct from environmental externalities because they cause increased production or consumption costs to downstream users. Over-production of an output using water in one location may adversely impact on markets for the same product elsewhere, but conversely increased production may also increase downstream industrial opportunities.
- **Environmental externalities** occur if a use causes adverse impacts on public health or ecosystem. These are difficult to quantify, but the economic costs of remediation will give a lower bound estimate

Figure 1: Major components of the total costs of water



Most of these costs are not covered by charges at present (in any country). The WRF at present usually just covers the first element. The service delivery costs are distinct and relate to the costs incurred by the WSC or irrigation service provider. These cover the capital and O&M cost of the infrastructure, etc. In some places additional environmental taxes or charges are levied, but this is rare. In the future, WRFs may be increased to cover all or part of the externalities in some countries.

If the externalities and opportunity cost were charged to the user, the cost would rise by a large amount and might well influence demand. In this case the WRF would need to be increased by a large percentage – probably by several orders of magnitude. The political ramifications would be very great, and no country has yet attempted this: water is thus generally an under-priced commodity. There are indications that some countries beginning to address this issue (see section 1.4), but this is still at a very early stage. Even quantification of these other costs is rarely done (see section 3.2 for an example).

Even with the limited objective of recovering administrative costs of WRM, which are just a small part of the full supply cost, WRFs are confined largely to a few high and middle income countries. Many countries in Europe and several in South America apply WRFs, but Japan, Australia (except the capital territory) and most states in the USA do not. China is unusual amongst middle-income countries in having a highly developed system of water resource fees.

The WRF is normally paid by the permit holder, and is thus a cost which the service provider needs to include in the charges to the end-user. The WRF is normally invisible to the end-user who is just concerned with the total cost that he has to pay. The WRF is only paid directly by the end-user in those cases where the end-user is the same individual or organisation as the license-holder.

Distinction between water resources fees and water service charges

As indicated in the preceding section, WRFs at present relate to the administrative cost of the resource at the point of abstraction. This cost is a small (usually very small) part of the total supply cost to the end-user. Where WRFs are charged, they are paid by the permit holder to the regulatory agency and included in the charges paid by the end-user.

In the urban sector, the Water Supply Company (WSC) pays the resource fee to the organisation responsible for WRM, and it becomes the costs which the WSC passes on to the end-users in the form of urban water tariffs (UWT). These also include the much larger costs for abstraction, treatment and distribution through a network of pipes, and other management costs, which account for the majority of the UWT. In England, for example the abstraction charge (payable to the Environment Agency) averages less than 2% of the cost of urban water. If the WRF were increased to cover some externalities (as it has been in Denmark, for example), this would be paid by the WSC to the water

resource manager and added to the tariff paid by the end-users.

The situation with surface irrigation is slightly different in many countries as it is managed by the same organisation as the water resource and it is rare for a WRF to be charged for irrigation use. The irrigation service charge (ISC) ostensibly covers all costs of the resource and of supplying water to the users, but the breakdown of the costs is not usually made explicit. In practice, political limitations on the magnitude of ISCs mean that the ISC usually only covers part of the O&M costs of the canal system. Other costs, including the resource cost, are generally not recovered, and are thus an implicit subsidy to the irrigation sector which leads to a financial deficit both for water resource management and for irrigation service delivery. Thus there is no clear distinction between WRF and ISC in this situation.

There is generally only one WAP for a surface irrigation district. This is held, in China, by the Water Management Division (WMD). This is a subsidiary organisation of the WAB which is responsible for issuing and managing the permit, and hence uses the funds collected through the WRF. If the WRF were charged, one part of the water administration would be liable for paying the fee to another part of the same organisation.

Even though this fee would be passed on to the end-users, it is essentially an internal transaction. This differs from the normal case where another agency – a WSC or industry pays the WRF to the WAB, resulting in a net financial flow to the WAB. This is presumably one reason why WRFs are not charged for surface irrigation. The transaction costs of identifying the water resource management costs separately from the infrastructure management costs, recovering these through the WRF and accounting for these separately (and differently from other elements of the ISC) would be very high. This is typical of many developing countries where the irrigation management and regulatory organisations are part of the same departments.

Surface irrigation in Europe is linked to a complex system of river development. Identifying the resource management costs is again not easy, given the varied historical nature of the development and the extensive range of infrastructure (dams and transfer channels) which have been built for source development. There is no consistent basis for identifying resource costs, nor any conceptually simple basis for charging water resource fees for surface irrigation. This may account for the surprisingly rare application of such charges in Europe. Although Denmark and the Netherlands levy environmental taxes for agricultural water use, these are not related to water resource management activities or costs

Irrigation in England is different in that water is abstracted directly by individual users who hold abstraction permits and can be charged WRFs in exactly the same way as other abstractors.

Typical arrangements for management of abstraction permits and WRFs are presented in Table1.

Table 1:Water resource fees and water supply tariffs in China

Category of use	License issuer	Infrastructure manager	Water resource fee	Water supply tariff	Other charges
Urban and industrial	WAB or equivalent	WSC	WRF paid by WSC to license issuer	UWT, including WRF and other supply costs paid by users to WSC	
Surface water irrigation	WAB or equivalent	WAB, delegated to WMD	Not usually charged	ISC paid by user to WMD, to cover O&M costs, resulting in implicit subsidy of water resource and all other costs	
Groundwater irrigation	WAB or equivalent	WUA, well operator or village	WRF paid by well operator or users to WAB / WMD	ISC may be payable to WAB / WMD (in China, but not usually elsewhere)	Well O&M costs managed by well operator and users

Link between WRFs and water abstraction permits

The primary requirement for WRFs is that they should cover the costs of managing the abstraction permits. The abstraction permit system is a primary tool for water resource management and a system of fees (abstraction charges) should mean that it can be fully financed. The details of the costs covered vary from country to country, but it is widely recognised that the fee should also cover some of the broader costs of water resource management or related infrastructure. In a few cases, the cost of some infrastructure (eg inter-basin transfers) for source development is reflected in the level of fees (although not fully recovered).

WRF charges are thus introduced to finance and reinforce administrative measures such as abstraction licensing. They are intimately linked with abstraction licensing because an effective WRF charging system can only be operated if there is a register of abstractors. There is no sense in attempting to introduce WRFs unless there is an effective system of abstraction licensing.

In the UK there is a comprehensive licensing system, combined with a system of fees to cover all the costs associated with this system – including resource assessment and monitoring as well as administration. All abstractors in the UK taking more than 20 m^3/day are required to have a license. These licenses are issued by the Environment Agency on the basis of an assessment of how much water can be abstracted from water bodies without damaging the environment, as required by the EU water framework directive.

This is assessed through catchment abstraction Management Strategies (CAMS) for every catchment in England and Wales. These provide a consistent and structured approach to local water resources management, recognising the reasonable needs of abstractors and of the environment. The Anglian Region of the EA has some 5,400 licensed abstractions which are recorded on National

Abstractors Licensing Database (NALD). This database forms the basis of the WRF charging system.

Most of the staff are involved in the abstraction licensing system and related water resource matters, and the incremental cost of introducing WRF charging where there is already an effective abstraction licensing system in operation can thus be expected to be very low (less than 2% of the cost of managing permits). Much the most demanding and time-consuming part of the exercise is establishing and operating the licensing system.

Once the licensing system is set up, it is relatively easy and inexpensive to introduce WRF charging, using the register of licensed abstractors as the basis. It is the license system rather than the fee which is central to demand management in UK. This is important, since the WRF needs to generate sufficient income to cover the cost of WRM without a large proportion being consumed in collection costs for the fee itself.

This system be effectively computerised, including data management, contact with licensees, determination of fees payable, billing and receipting. Although the licensing system is central, the fees are still structured in a way which makes the demand management objectives explicit – these include allowance for inter-basin transfers, source quality, seasonal issues, return flows, etc).

1.3 Water resource fee system in China

National regulations

WRFs have been charged in China since the 1980s. These differed from fees in other countries in that they did not initially aim to recover administrative costs. They were introduced to check the over-exploitation of water resources by industrial and institutional water users with self-provided water abstraction facilities. Shanxi Province issued a regulation for this in 1982, and other regions soon followed. The 1988 Water Law provided for WRF to be charged to urban units drawing groundwater, and other users if decided by the relevant Provincial government.

The 2002 Water Law provided that all agencies and individuals who abstract water directly from rivers, lakes or aquifers should have a license and pay water resources fee. This was followed in 2006 up by State Council Decree No. 460 (SCD 460) - *Regulation for Water Drawing Permit and Collection and Management of Water Resources Fee*, and in 2008 by the Ministry of Water Resources (MWR) Document 79 - *Measures for Water Resources Fee Collection, Use and Management.*

The system is thus well-developed and China has taken WRF far further than many developing countries and some developed countries.

State Council Decree 460 and its implications

Key features of SCD 460 are that:

- In order to draw water, any unit or individual shall apply for a water drawing permit and pay water resources fee…*[Article 2]*
- Implementation of the water drawing permit system must accord with comprehensive water resources plans, comprehensive river basin plans… *[Article 6]*
- Water users shall pay water resources fee, and pay fees at a progressively increasing rate if the amount of water drawn exceeds the planned amount or quota. The rate of water resources fee shall be formulated by the department of price administration jointly with the departments of finance and water administration at the same level. [*Article 28*]
- The rate of water resources fee shall:
  - Promote rational development, utilization, conservation and protection of water resources, both surface water and groundwater and avoid groundwater over-abstraction;
  - Suit the conditions of local water resources and the level of local economic and social development;
  - Take full account of the difference between different industries and sectors. [*Article 29*]
- Measures shall be taken to promote agricultural water use efficiency and develop water saving agriculture. The rate of water resources fee for agricultural production shall be lower than those for other purposes, and the rate of water resources fee for use by grain crops shall be lower than those for use by cash crops. [*Article 30*]
- The amount of water resources fee to be collected shall be determined in the light of the actual amount of water drawing. [*Article 32*]
- For the amount of agricultural water drawing not above the established limit, it is not necessary to pay water resources fee. [*Article 33*]
- The collected water resources fee shall be paid to the central and local treasuries, [*Article 35*].

It is clear from the above quotations from SCD460 that many actions are defined which '***shall'*** be taken. These are not all easy to achieve – for example, promoting rational use of water resources, suiting local levels of development, taking account of differences between sectors, promoting water saving agriculture, etc will all require considerable care and sophisticated analysis in setting the fee level and in providing support in parallel with the introduction of the new systems for water resource management.

These regulations stipulate that WRF is based on the volume actually abstracted, and not on the licensed volume. This requires good flow measurement facilities and means that the final amount of WRF cannot be assessed by the licensing authority until after the

water has been used. This differs from the situation in the UK and some other countries where the charge is based on the licensed volume.

The situation is further complicated by the requirement to increase the fee rate progressively for use above the planned amount (quota). This has two important implications: it suggests that it is allowed to pay extra WRF instead of complying with the permit restrictions (ie to abstract at an unsustainable rate from a water resources point of view); and it complicates assessing the amount of WRF due which in turn makes the budget of the regulatory organisation rather uncertain.

In the case of agricultural water use, SCD 460 indicates that the WRF is only payable for use above the limit. This has not yet been adopted widely, but where it has been (eg in Beijing) this rate is set at high level in order to give the end-user an incentive to comply with the limit. However, this means that the WRF is highly uncertain, complicated to assess, and could lead to even greater unpredict-ability in the budgets for the regulatory authority.

MWR Document 79 and its implications

MWR Document 79 includes detailed provisions for most aspects of WRFs. These include stipulations on the scope of water resources fee collection, methods of calculation and collection of water resources, authority for water resources fee collection, procedures for reporting on and verification of amount of water abstraction, installation of water abstraction metering instrument, delivery of notice on water resources fee payment, sharing proportions of collected water resources between the central and local authorities and the procedures of payment to treasury, bills for water resources collection, scope for the use of collected water resources fee, and administrative authority and their duties of supervision and service, etc.

The WAP holder or water abstractor is responsible for paying the fee regardless of who the permit holders subsequently supply water to for use, i.e., WUAs, village committees, individual water users, etc. Document 79 requires volumetric measuring of water from the source by the permit holder or abstractor, and installation of a workable measuring device at that location. Whether the permit holder can or cannot recover part or all of the WRF from water users as part of the water charges for the service of supplying water is not addressed specifically in the document, but these types of fees are invariably and correctly passed onto users.

Collection of WRFs is a very demanding task, as there are a large number of license holders. The process is made even more complex by the requirement to collect WRFs every month based on volume of water abstracted / diverted to the permit holder (Article 12). This may be simplified by Provincial regulations (for example in Gansu, WRFs are to be collected seasonally rather than monthly).

Collection of WRFs on a monthly basis is practicable for urban and industrial users, but would be very onerous in the case of agricultural

users. Where WRFs are only payable for actual use above the permitted volume (eg in Hebei) it is only possible for this to be collected annually in arrears.

The use of funds collected as WRF and paid into the respective revenue departments is explained in Document 79 as follows: (WRF funds) "*are earmarked for water resources saving, protection and management and may also be used for rational development of water resources*" [article 21]. Through the involvement of the finance, price administration and water bureaus and development and reform commissions at provincial and local levels, these funds are intended to be identifiable and verifiable, and their uses carefully checked.

Document 79 goes on to state the specific uses for the WRF, which are:

- *"water resources survey, assessment, planning, allocation and formulation of relevant standards;*
- *supervision and implementation of water abstraction permit system and water resource allotment;*
- *protection and management of rivers, lakes, reservoirs and water source areas;*
- *development of water resource management information system and collection and publicity of water resource information;*
- *establishment of the system of water saving policies, regulations and standards, scientific researches and development and extension of new technologies and products;*
- *subsidizing the funds of water saving demonstration projects and the interest rate for loan-financed extension and application pilot projects*
- *subsidizing emergency handling of water resource accidents;*
- *dissemination on and awards for water resource saving and protection;*
- *rational development of water resources"*. [Article 21]

This is a large and ambitious list: these tasks go beyond the administration of the permit system to cover some aspects of economic and environmental externalities, or measures to encourage water savings which in turn would reduce the externalities.

Many of these tasks are part of normal responsibilities of the WABs, which makes it difficult to earmark the funds for specific activities. There needs to be a clear definition of the specific activities which are to be supported from the WRF – this is important for ensuring financial efficiency and for transparency and accountability of the use of WRFs. This in turn will influence willingness to pay and political acceptability of the fees. It can be anticipated that fees will need to be increased since it appears that the magnitude of WRFs at present is too low to cover all of these activities in full.

WRFs in China – some conceptual considerations

There is still much debate in China on the structure of the WRF, even though the water resources fee

system has been implemented for many years and is well-defined in legislation as described above There is still no consensus on the detailed nature or composition of the water resources fee; and the existing laws and regulations do not clearly provide for this issue.

SCD 460 brings together several different objectives for the WRF, but puts the emphasis on resource management costs and protecting the different interests of the users, rather than consideration of wider economic or environmental objectives.

In addition to the specific activities listed in MWR Document 79, it is often regarded that the fee should cover rent payable to the state for the intrinsic value of the resource in its natural state which has a value which varies with the scarcity of the resource.. Many theoretical studies have been carried out on this issue, using a range of methods, such as rent theories, marginal utility theories, existence value theories, etc, water resources

In China, water resources are owned by the state, and it is widely believed that a purchase price for water resources should be paid for the development and use of water resources. However, none of the methods for calculating the appropriate value is fully accepted, and all have some theoretical problems and difficulties in application. The methods are complex and difficult for non-specialists to understand – which makes it hard to convince politicians and other stakeholders to accept and implement any charges calculated from them.

Provincial regulations

Responsibilities for WRF management are largely delegated to provincial and lower levels, and thus there are (or need to be) provincial regulations. Not all provinces have issued these regulations, or updated them after SCD 460 was issued. The status of these is summarised in Table 2

There may also be differences between national and provincial guidelines. For example Article 33 of SCD 460 states that it is not necessary to pay water resources fee for agricultural water use unless it exceeds the norms. This differs from current practice in Gansu, for example, where local regulations require collection of water resources fee for all agricultural use of groundwater (although not surface water). This requirement to pay WRF for agricultural use of groundwater is in accordance with Decision No.4/2003 of People's Government of Gansu Province which was issued in 2003 in advance of SCD 460 (2006) and the Management Measures for Water Resource Fee Collection (MWR document 79 – 2008).

A summary of the current status of WRFs in China is presented in Table 2.

Table 2. Status of water resource fee collection in China

Province	Region	Water Resource Fee collected for			
		Power	Agriculture	Rural household use	Other uses
Regulation issued after SCD 460					
Qinghai	Arid / semi-arid	Yes	to be provided separately	Not for abstraction less than 100 m^3/month	
Guizhou	Humid	Yes	Not mentioned	Not for abstraction less than 100 m^3/month	
Guangxi	Humid	Yes	Postponed	Not	Not for govt. instits, social orgs, garrison, schools and med services; postponed for navigation
Liaoning	Semi-humid	Yes	Postponed	Postponed, and not for abstraction less than 1000 m^3/year	
Zhejiang	Humid	Yes	Yes	Not	
Fujian	Humid	Yes	Yes, but the rate will be publicized separately	Not for less than 3000 m^3/yr surface water, 1000 m^3/yr of groundwater	
Regulation issued before SCD 460					
Gansu	Arid / semi-arid	Postponed	Only for groundwater	Not	Not for abstraction by welfare enterprises for disabled and abstraction less than 2000 m^3/year
Jilin	Semi-humid	Yes	Postponed for planting and animal husbandry by farmers	Postponed for abstraction for farmers' domestic use	
Henan	Semi-humid	Yes	Not for less than 3000 m^3/yr surface water; 1000 m^3/yr of groundwater*	Not	Not for less than 1000 m^3/year (excl. commercial use by business) and for groundwater returned after used for closed recycling.
Shandong	Semi-humid	Yes	Postponed	Postponed	

Source WRDMAP studies

Despite a broad similarity in approaches between Provinces, there are considerable differences in detail – this is evident from a review of fees in 11 Provinces (Table 3), which indicates large differences in the charges. Gansu is the only province which charges WRF for normal use for agriculture. Some provinces charge WRF for use above the allowable limit. Charges for industry range from 0.02 to 0.80 Y/m3 depending on source and location. Charges for urban use are generally similar but may be slightly higher or lower. Use for power generation (which is non-consumptive) is generally much less.

Table 3: Magnitude of water resource fees in China

	Year	Industry (yuan/m³)		Urban domestic use (yuan/m³)		Water supply plant (yuan/m³)		Hydropower use (yuan/kWh)		Thermal power cooling (yuan/m³)	
		Surface water	Ground-water	Surface water	Ground-water	Surface water	Ground-water	Surface water	Ground-water	Surface water	Ground-water
Qinghai	2005	0.03-0.08	0.06-0.16	0.02-0.06	0.04-0.12				0.002		
Guizhou	2007	0.06	0.12	0.04	0.08	0.04	0.08	0.004-0.015	0.007-0.015	0.01-0.02	0.02-0.04
Guangxi	1992	0.02	0.03	0.03	0.04				0.001-0.003		
Liaoning	2002	0.10	0.35-0.55	0.25	0.2-0.4	0.1	0.2-0.4				
Zhejiang	2004	0.10	Conf.1.20 Uncon 0.40	0.1	Conf.1.20 Uncon 0.40	0.08	Conf 1.20 Uncon 0.40		0.01 Pumped storage 0.002		
Fujian	2007	0.07-0.08	0.25	0.05-0.06	0.25		0.15		0.008		
Gansu	2003	0.10-0.15	0.15-0.20	0.10-0.20	0.15-0.30				0.003-0.005		
Jilin	2004	0.10-0.15	0.02-0.30	0.05-0.10	0.10-0.15	0.055	0.055		0.0005-0.001	0.05-0.07	0.10-0.15
Shanxi	2005	0.15-0.20	0.20-0.45	0.15-0.20	0.20-0.45		0.1		0.003		
Henan	2005	0.25	0.40-1.30	0.25	0.4-1.3	0.15 (dom) - 0.25 (oth)			0.002		
Shandong	2002	0.20-0.35	0.45-0.80	0.20-0.35	0.45-0.80						

1.4 Water resource fees – an international overview

General experience

Some international examples of the use of water abstraction charges are presented in Table 4. In most cases, WRFs are low in comparison to other costs of water and there are varying degrees of complexity and differences in the arrangements for assessment, collection and use of fees. However, the focus is almost always on cost recovery for abstraction permit management rather than directly for demand management. Agricultural users are generally exempt. Denmark and Israel report that fee levels have an impact on consumption of water, but fees in most other countries are too low to influence demand. The WRF for domestic use in Denmark is now a very high proportion of the total water charge payable by users.

Table 4: Water abstraction charges in Europe

Country	**Observations**
Denmark	▪ High water tax on domestic use ($0.70/m³), contributed to large increase in water bill ▪ WRF resulted in 50% increase in household water bills ▪ Total water consumption reduced by 13%
France	▪ Revenue used for pre-determined water management costs; ▪ Charges vary between 'Agencies'; ▪ For SW part of the charge is based on consumption; ▪ Charge is too low to affect water user behaviour
Germany	▪ Revenue used for research and pollution abatement infrastructure; ▪ Charges vary with quality of water resource;

Country	Observations
	▪ Some water users are exempted; ▪ Charge is again too low to affect behaviour in usage
Israel	▪ Revenue input to government treasury; ▪ Progressive charges with 40% premium for summer usage (or where demands are high); ▪ Charge levels reportedly reduced water usage per unit area by 40%!
Netherlands	▪ Revenue used for investment in treatment plants; ▪ Water companies pay full charge, other users pay 50% of the charge, whilst small abstractors 0%; ▪ Fee reductions if groundwater recharge takes place; ▪ Little impact on water usage behaviour
Spain	▪ Revenue only covers 15% of the cost of water management. ▪ However, it is still believed that it influences water usage.
England and Wales	▪ Revenue covers the cost of the regulatory agency ▪ Fees structured according to the impact the use has on the resource, even though the level is very low
Australia	▪ Principle of cost recovery accepted, but WRF not charged to cover specific costs of water resource management
Brazil	▪ WRFs introduced after Water Law reform in 1997 ▪ Public perception that water is not free ▪ Many institutional constraints to WRFs ▪ Earmarking of revenues is important
Jordan	▪ Imposing WRFs for agriculture water use above the permit volume has largely stopped this excess abstraction, which was previously done for water trading

Experience in England and Wales

The United Kingdom has recently reviewed, strengthened and simplified the WAP system and associated abstraction charges. The pattern of water use in the UK is different from many countries, given the environmental and economic conditions. This can be seen from the proportions of water used for the various purposes. These are:

- Electricity supply industry –54%
- Public water supply – 29%
- Other industry – 11%
- Fish farming – 5%

- Agriculture - 1%

Water resource fees are calculated on the basis of a standard unit charge (SUC), but adjusted to take account of a number of factors – source, season, 'loss factor' (ie how much of the abstracted volume is actually consumed) etc. The standard charges vary by region, this is not in relation to water scarcity but to the costs that need to be recovered and they reflect the different operational characteristics of each region. The regional variation in standard charges is presented in Table 5.

In addition to the SUC, which essentially covers costs of resource management, environmental improvement compensation unit charges (EIUC) have been applied since 2008. These cover compensation payments for old water abstraction licences which were granted in perpetuity but now need to be rescinded. A combination of historic decisions and changes in environmental standards mean that a proportion of the 20,000 abstraction licences are now considered to be unsustainable. These will be revoked by 2020. The increase in total fee (ie the sum of the SUC and EIUC) is limited to 10% per year, although the increase was limited to 5% in 2009 because of wider economic conditions.

Table 5. Standard Unit Charges (SUC) and Environmental Improvement Unit Charge (EIUC) in 2009/10 (£/1000m3) *(£1 = Y11 in 2009)*

Region	SUC	EIUC*
Anglia	26.08	2.07
Midlands	14.88	0.99
Northumbria	25.62	0.00
Yorkshire	11.46	0.00
North West	13.22	1.46
Southern	18.75	1.90
South West/Wessex	19.71	1.46
Thames	13.84	1.24
EA Wales	13.68	0.00

* These are the charges applicable to a water undertaker, different charges may be applicable to other users (in some cases less – 0.76 in North West and 0.83 in Thames – and in other cases more - 2.57 in South West, , 0.61 in Yorkshire, 1.15 in Wales)

As noted above, these standard charges are adjusted to take account of several factors which are considered important for efficient water resource management.

An important distinction is made between abstraction and consumption since, depending on the type of use, a proportion of the amount abstracted returns to the source. The return flows cannot easily be measured, so the EA applies proxy measures – 'loss factors'. Drip/spray irrigation is regarded as high 'loss' (loss factor 1.0, ie virtually all consumed with negligible return to the water body), surface irrigation as medium loss use, urban water supply as medium loss (loss factor 0.6), power generation as very low loss (loss factor 0.003 – virtually all water is returned). It is interesting to note that the very small loss factor for

power generation means that virtually no fee is paid by this user, which abstracts the majority of water.

The combination of usage percentages by different users and the relevant loss factors indicates the following approximate distribution of WRFs by user (Table 6).

There are also seasonal factors, with charges increased for a summer-only abstraction permit (by a factor of 1.6) and reduced (by 0.16) for winter-only permits. The final adjustment in the calculation is a source factor: the fee is increased by a factor of three if the source is supported by an inter-basin transfer.

The resulting average WRFs paid by water supply companies are presented in Table 7. As can be seen from this table, these fees are small compared to the total cost of delivering water to the consumer.

Table 6: Proportion of water use and WRF assessed, by type of use

Use	% of total use	% of total WRF
Electricity / power	54%	0%
Public water supply	29%	60%
Industry	11%	20%
Agriculture/fish	6%	20%

Table 7. Comparison of WRF and urban WSC charge in UK

Region	**Average WRF (p/m3)**	**WSC charge**	**WRF/WSC %**
Anglian	1.66	79	2.1
Midlands	0.98	50-74	1.3-2.0
Northumbria/Yorkshire	0.70-1.75	45-59	1.2-3.9
Northwest	0.93		
Southern	1.28	42-98	1.3-3.0
South-western	1.36		
Thames	0.93		
Welsh	0.84	64-82	1.0-1.3

Experience in Australia

Australia has a very different setting, being extremely arid and with a large irrigated agriculture sector. The difference in usage pattern between UK and Australia is presented in Figure 2. But despite the extreme environment, water resource fees are not as yet seen as a key element of demand management. The majority of water use in Australia is for agriculture, but WRFs are currently only applied in the capital territory (ACT) – an essentially urban area– and are part of a package to be used with demand management measures including public education, water saving devices and water reuse strategies.

Globally, it is (for political reasons) very difficult to charge WRFs for agriculture, and Australia is no exception to this observation.

Water use in Australia is increasing, particularly for agriculture (Figure 3), and thus demand management is an important priority. However, fees are not yet seen as a way of achieving this.

Figure 2 Comparison of water use patterns in UK and Australia

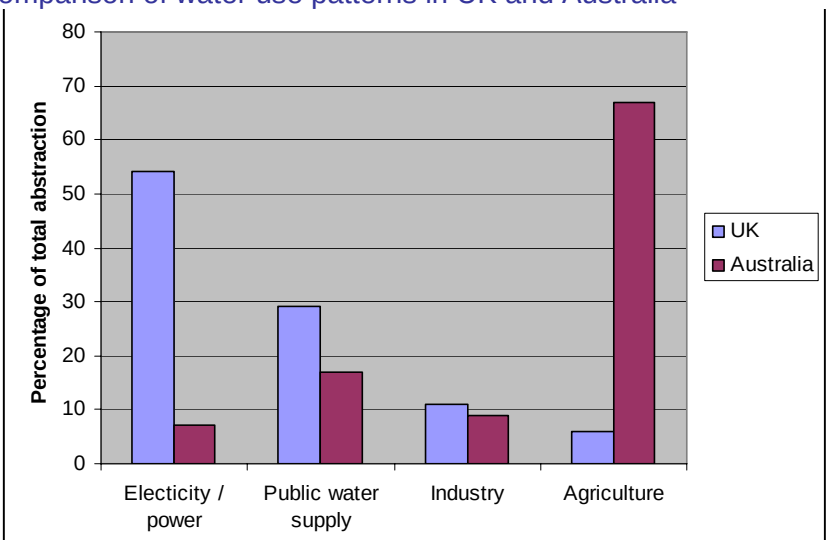
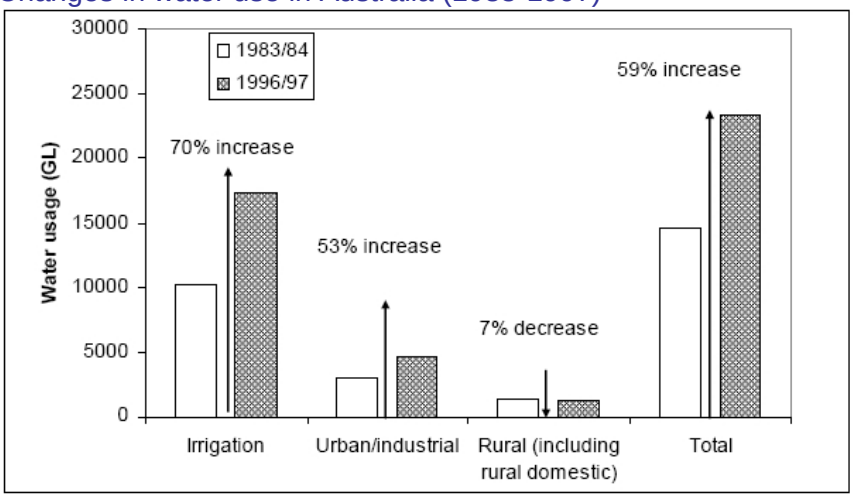


Figure 3. Changes in water use in Australia (1983-1997)



Experience in Brazil

Brazil introduced WRFs as part of a wholesale reform of its water resource management system following the 1997 Water Law. A key component of the reforms is the introduction of bulk water charges (*cobrancas*; i.e. water abstraction charges). This involves a crucial change in the public perception of water in Brazil as a free good, and it has met with varying degrees of resistance and success. The bulk water charges per m^3 are given in Table 8. In practice two thirds of receipts came from the water supply sector and one third from industry. Participation from agriculture and the small-hydropower sector was "largely symbolic". All the revenue raised was spent in the basin, 30% on institutional interventions and the rest on erosion control projects and municipal wastewater plants. This is summarised in Table 8.

Table 8 Bulk Water Charges in the Paraiba do Sul Basin, Brazil

User group	Reals per m^3	US cents per m^3
Municipal water supply	0.02	4.60
Industry and mining	0.02	4.60
Agriculture and livestock - charges not to exceed 0.5% of production costs	0.0005	0.11
Aquaculture; charges not to exceed 0.5% of production costs	0.0004	0.09
Hydropower generation	75% of energy output value	-

As in the UK and Germany, the purpose of the fees is to cover costs for water resource management, and to finance some improvements in infrastructure. The purpose is not to influence demand directly. The fees have, however, had an important impact on public perception of the value of water and thus may indirectly influence water use.

Other Experiences from South America

A major review for Latin America by the Inter-American Development Bank of the use of economic instruments (EIs) including WRFs identified five main types of challenges and constraints:

- Institutional and administrative challenges, including cooperation between different administrative bodies, the advantages and disadvantages of decentralisation, and the inadequate involvement of stakeholders.
- Human resource constraints;
- Financial challenges (budgetary constraints): for example, inadequate funds may be available to introduce the necessary metering of water consumption.
- Lack of data, on hydrology, meteorology, water quality, water use and its efficiency, and other important parameters.
- Social challenges: e.g. possible adverse impacts of WRFs on the incomes of the poor.

The factors identified for the successful implementation of economic instruments were found to be:

- Capacity building, to develop the necessary institutional and management capacity.
- Spatial organisation (river basin management)
- Decentralisation and integration. The need for a decentralised system, with regional or river basin institutions managing the licensing and WRF charging.
- Charging the full costs
- Cross-subsidisation (e.g. to assist low income groups), if necessary.
- Public education programmes, for awareness raising and other WRM-related purposes.
- Earmarking of revenues
- Transparency

Experience in Jordan

In Jordan, all wells were licensed in 1998 (following a 10 year field survey to cover all 2,449 wells - 1,830 irrigation, 450 municipal supply and 169 industrial). Fees (US$0.37/$m^3$) were charged to all users apart from irrigation, and industrial users were advised to install water saving and recycling devices. These industrial plants succeeded in saving around 10% of water use and found the devices worth the investment. Fees are not normally applied for irrigation use in Jordan, but all irrigation wells were metered to check their compliance with permits, and were charged at the standard rate for any water for use above the limit defined in the permit. This did not restrict valid irrigation use, but did discourage illicit trading and was enforced by threat of closure of the well.

1.5 Comparison of permit and fee system in China with other countries

Fees should support (and finance) other water resource management measures (permits, allocations, environmental targets, awareness programmes etc) which need to be introduced at the same time, so they need to be structured in a way which supports these broad objectives. These relate to local details of water resource sustainability, regional industrial development and socio-economic development, etc. The complexity of the charging system needs to be balanced against the purpose. The very large number of permits and users in many parts of China compared to the revenue collected through WRFs suggests that a relatively simple system should be adopted.

Comparative figures for Mexico, England and the Shiyang River Basin in Gansu indicate the need for simplicity in China:

- Mexico (1,970,000 km^2, 110 million population)
    - 344,000 permits
    - Average volume per permit 220,000 m3/year.
    - Revenue from fees $650m (Y0.1 per m3) - about 80% of agency revenue
    - *Revenue per permit = Y15,000*
- United Kingdom (130,000 km^2, 51 million population)
    - 23,000 abstraction permits.
    - Total revenue from WRF £125m – 99% of agency revenue

  - *Revenue per permit = Y80,000*

- Shiyang River Basin (Gansu) (41,000 km^2, 2.3 million population)
  - 20,000 groundwater permits (approx)
  - Typical volume per permit 60,000 m3/year.
  - WRF = Y0.01 /m3. Total revenue from WRF should be about Y10m if all users pay, which would just cover direct costs
  - *Revenue per permit = Y500*

It should be clear from the above that there are a large number of small permits in China. This creates a large administrative burden for managing permits and for collecting fees. There is a risk that the transaction costs of collecting WRFs from so many permit holders will absorb a large proportion of the total revenue, leaving insufficient for effective water resource management. This might be acceptable if demand management was the primary objective, but it would still be very difficult to convince poor people of the reasons for collecting fees and this might lead to political pressure to abolish fees for agricultural use.

Data from other countries as well as China (Table 9) indicates that most countries differentiate WRFs by source (surface or groundwater) and abstractor category (domestic, industrial, agriculture, other – particularly power generation). Rates do vary considerably, but indicative comparisons are given in the table below. Figures for China are in the same general range as for the other countries cited – slightly lower than Brazil, rather higher than South Africa.

Table 9. Water resource fees in different countries (US cents/m3)

Country	Surface water (SW)	Ground--water (GW)	Abstractor category			
			Water supply	Industry	Agriculture	Other (power)
Danish water supply tax			87.5	Exempt	Exempt	
Dutch GW tax			17.0	13.0	Exempt	12.0
Germany SW			5.0	5.0	0.5	5.0
Czech Republic	Variable	5.0				
Hungary	0.6-4.0	0.6-4.0	Different charges for different user categories			
Poland	2.8	8.4				
Slovakia	52	2- 52	2.0	52.0	?	?
England & Wales	2.1-5.0	2.1-5.0	Same basic charges for all user categories,			
Brazil - Pariba dol Sul,			4.60	4.60	0.11	0.09
Canada (Quebec)	1.0	1.0				
South Africa (varies by river basin)						
- Median			0.19	0.19	0.12	0.07
- Minimum			0.06	0.06	0.04	0.04
- Maximum			0.46	0.46	0.18	0.11
China (varies by province)						
- Median	0.7	2.9	2.9	2.1	generally exempt	0.1
- Minimum	0.01	0.3	0.3	0.3		0.01
- Maximum (unconf aquifer)	5.0	7.9	6.4	7.9		2.1
- Maximum (confined aq.)		18.5	18.5	18.5		

1.6 Awareness and understanding of the WRF system

Comparison of the situation in China with that in England

Water Resource Fees are an important topic in China, and are a focus of much attention. Although SCD460 indicates they are primarily required for financing the water resource management system, they are widely perceived to be more important for their potential direct impact in reducing demand for water.

There is also much theoretical debate as to what fee is appropriate to be paid to the state by a water user in recompense for state ownership of the resource. Internationally, this is not regarded as important but is briefly discussed in section 3 of this paper.

The role of WRFs in financing water resources management does not appear to be as widely understood or recognised as it should be, nor are the fees used in a way that would make this linkage apparent (either to the users or to the WABs). Water resource management costs are covered by the existing water administration (which is staffed by civil servants and paid for by the government) without specific relation to the WRFs, despite the reference in MWR Document 79 to earmarking). The concept of targeted cost recovery for a bureau (or section of bureau) is new and is not fully recognised.

There has been some awareness-raising regarding the fees, but in general there is little public awareness of the basis for setting fees, or involvement in the process. This is very different from the situation in England Wales, where the role of WRFs for cost recovery is well-understood. There is a quasi-independent body – the Environment Agency – which is responsible for licensing and for water resource management more generally. It is widely understood and recognised that this needs to be self-financing from fees: both the costs and the income of the EA are publicly audited and available for inspection by the public.

The EA held an extensive three-stage period of consultation (in 2000-2007) regarding abstraction charges, following the introduction of the EU water framework directive. This was to obtain public opinions on:

- recovery of costs associated with environmental improvement, including compensation for changing the terms of existing licences to reduce the environmental effect;
- innovative charges to encourage efficient water use (incentives, such as differential charges, time-limited licences, and basing charges on actual rather than license volume);
- changes to charging arrangements needed to comply with the Water Act 2003.

This led to simplifications to the permit and financing system, and has resulted in broad acceptance of and compliance with the system.

This also led to the introduction of EIUC in 2008 and a limitation on

the rate of increase in total unit charges to 10% per year.

1.7 Conclusions from overview

Water resources fees are one form of economic instrument for IWRM. They are used to recover part of the costs of water, although they usually just cover the costs of managing the resource. The full intrinsic value of water is normally one or two orders of magnitude greater than this and is rarely recovered through user charges. The costs of service delivery for urban or agricultural use are met through separate water tariffs. WRFs are gradually being increased in some countries, to reflect the increasing scarcity of water and growing concerns over the environment.

China has a relatively well advanced system compared to many countries, and it is well provided for in legislation and regulations. The fees are comparable in magnitude to others countries that do make such charges. A key feature of WRFs in China is that they are levied on actual consumption rather than permit volume, even though they are ostensibly for cost recovery which can more simply and reliably be achieved by charging on the basis of permit volume. This is presumably because they are also intended to have a direct influence on demand. However, this objective can also be achieved with WRFs based on permit volume by encouraging users to reduce the volume that they request when applying for a permit.

Many countries do not levy WRFs, as it can be politically difficult to do so, and there are many institutional challenges to be resolved when they are introduced. However, there is a growing trend to charge WRFs and, even though they are generally much less than the full cost of water, they can be structured in a way which gives appropriate signals about the value of water at different times or locations and they can encourage conservation of water.

2 Purpose of Water Resource Fees

2.1 Introduction

As indicated earlier, there are several purposes for WRF. The need for cost recovery of the costs of water resources management should be pre-eminent among them (see section 2.2). Direct influence on demand should not be regarded as the primary purpose of the WRF, for reasons outlined in section 2.3. However, collection of the WRF should provide funds to implement measures which will facilitate introduction of demand management – for example, administrative measures, education and awareness programmes, demonstration projects – as well as ensure that normal water resource management activities (resource assessment and monitoring, permit management etc) are fully financed. In addition, funds from the WRF may be used to finance environmental improvement projects.

The purpose of WRFs in China is clearly stated in MWR Document 79 (section1.3). These are ambitious objectives and potentially

very expensive. It may not be possible to cover all from WRFs initially. They may need to be introduced incrementally, and care is needed to ensure that they suit the local level of social and economic development (as required by SCD 460)

If these purposes are indeed to be the target of WRF usage, then the individual activities should be identified and costed. There should then be a process of annual review and reporting to assess what proportion of the costs for each activity can be met from the WRF.

2.2 Cost recovery for water resource management

Practice in England

The UK is typical of many countries in basing its abstraction charges primarily on cost recovery for WAP management, rather than on directly promoting environmental sustainability – although the environment is a key driver for abstraction permit management. The abstraction charges are used to finance other measures which will protect the environment. The Environment Agency makes an annual charge for the abstraction of water to cover the costs of managing water abstractions and regulating abstractions.

In effect the fee is the total costs of management divided by the total volume licensed, but it is not applied uniformly to all users (but takes account of the impact of the use on the resource and variations in management costs, as indicated in section 1.4). The fee for a license holder is calculated on the basis of the impact that licence might have on water resources. The level of the fee is small, but it still varies according to the type of use, to give a small encouragement to be economical in use of water in particular situations.

Water users pay a fee according to the amount of water that they are licensed to consume (ie abstraction minus return flows). In total, however, the fees paid by all users meet the full costs of managing the water resource. Both the fees and costs are audited and accessible to the public: the simplicity and transparency of the UK system means that compliance is almost universal and complaints are few.

Irrigation is a small use in UK and water for this is abstracted directly from the source by the user. The different factors applied for WRFs in the UK give a small incentive to abstract water in winter (and store on-farm) rather than in summer and to be efficient in water use. The WRF is about 7-10% of the total cost of water for agriculture in UK, so the difference in fee between summer and winter usage is significant. Although on-farm storage is primarily needed to provide a buffer against summer droughts, the small incentive given through the WRF weighting factors has prompted some farmers to take action to build reservoirs. There would be strong resistance to increasing the fee to the extent need to cover environmental externalities (ie by perhaps a factor of 10 or probably much more), although it can be expected that environmental charges will be introduced and gradually increased, in the medium term. There is much discussion on this topic nowadays in the context of

increased stress on water resources due to climate change.

This differs from the situation in Mediterranean countries where large public-sector irrigation schemes are common. ISCs are charged to meet O&M cost recovery. There is a small element of the ISC which covers the WRF, but it is a very small proportion and it is not explicit. According to a World Bank water pricing seminar, the total costs have contributed to the reduction of public financing at least with respect to water resource management (as well as to operation and maintenance costs of irrigation schemes). The fees are, in total, set to cover O&M costs: they are usually` too low to influence demand.

2.3 Influence on water demand

WRFs are a small proportion of the total cost of water, and thus even large percentage adjustments to the WRF may not affect the total cost sufficiently to influence demand. The converse, of course is also true: increases to the WRF needed to meet cost recovery objectives (for the water resources monitoring and management system) can be made without increasing the total cost to the user by a large proportion.

In neither case does the WRF usually give any direct signal or incentive to the license-holder to save water although it can be structured in a way which gives an indication of the relative value of alternative sources (eg through the source factor in the UK). There is only a potential direct incentive in the cases where the user abstracts water directly from the source – where the user is the license holder.

Although WRFs can in themselves be expected to have a relatively small (or even zero) direct impact on demand, many people consider that WRFs should have a substantial impact. This section reviews the impact of prices in general and WRFs in particular on demand.

Water users respond to the total price of water, including the resource charge, delivery and other costs. This total cost of water does influence demand if it is set at a high enough level (such as that prevailing in the UK for domestic use) The resource charge, *per se,* will only have an impact on demand if it raises the total cost to a sufficiently high level. At present the resource charge is usually very small (typically less than 10% of the total cost, usually much less).

It is not yet considered acceptable even in the UK to charge a water resource fee which is high enough to influence behaviour by agricultural users: a separate fee would be needed and this has not progressed further. The fee is known to be for cost recovery purposes and there is no legal or practical basis for increasing it for environmental purposes. It has been estimated that significant reductions in water use could be achieved only with increases in rates of £0.50 (Y5) or more per m^3 – a 10-15-fold increase. This would be politically very contentious and, as only 1% of total water use is for agriculture, the introduction of such a fee is still a relatively low priority (although it may be gradually introduced in the medium to long-

term). Even with the introduction of the EIUC in England, the annual rate of increase in abstraction unit charges has been capped at 10% per year until 2020, which will not increase the total WRF to a level which will influence demand significantly.

Australia faces an extreme water shortage, but it has been concluded that abstraction charges need to be used in conjunction with other demand management measures, including public education, water saving devices and appropriate water reuse strategies – they have not introduced fees as a measure for influencing demand. They are in fact only applied in the Capital Territory, a largely urban environment, and not in the most water-sensitive areas.

Apart from the low value of the WRF vis-à-vis the total cost, a further reason why the WRF is in itself a weak demand management tool is that it is paid by the license holder rather than the user – who simply passes it on the user. The user does not necessarily recognise the WRF element of the total charge – although the linkage should become obvious if it were increased significantly. There is only a potential direct incentive in the cases where the user abstracts water directly from the source – where the user is the license holder. This applies mainly to two groups at opposite ends of the scale - some large industrial users and some farmers from small tubewells. In other cases, the WRF does not give the license holder any incentive, and the incentive to the user is both indirect and miniscule.

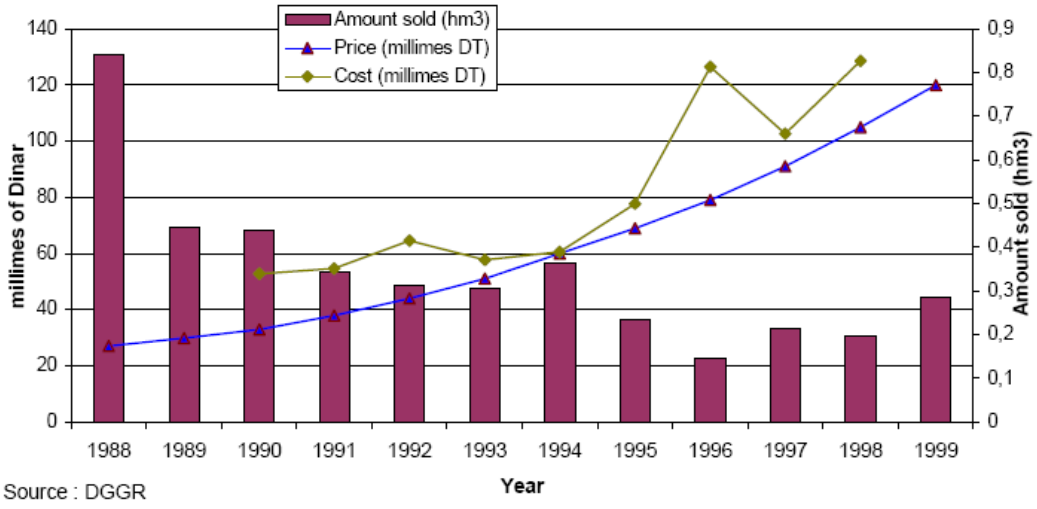
Elasticity of demand

The impact of prices in general can be assessed by consideration of price elasticity of demand.

The elasticity of demand refers to the impact on demand that will be caused by a change in total price. This elasticity can only be calculated in relation to the total price, of which the WRF is currently only a very small proportion. This elasticity can be calculated from theory, but is not always easy to observe in practice since prices are not usually changed in isolation from other measures to influence demand and thus although there may be an observed relationship between price and demand (see Figure 4, for example), this is usually not a causal relationship. Prices are generally increased at the same time as other administrative restrictions are imposed and in order to ensure adequate cost recovery, unit prices need to increase as the volume consumed decreases. Furthermore, irrigation systems are generally designed for supply management [3], and farmers may not be able to respond to price signals.

[3] Modern irrigation schemes are increasingly designed for demand management are more expensive, for various reasons, but it can be difficult and expensive to convert existing infrastructure from supply management to demand management

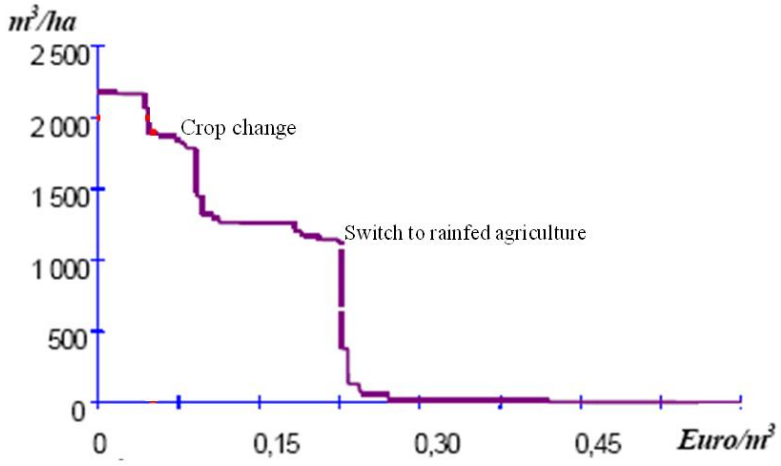
Figure 4. Changes in irrigation water use and price in Tunisia



Although there can be impact on demand even in agriculture at high total prices, it is not a simple gradual response of reducing demand as prices increase. Instead there are likely to be a series of step changes as the price triggers major decisions by the farmers: whether to invest in irrigation technology (a long term decision), which crops to grow (a seasonal decision), and how much water to apply to growing crops (a short term decision). Typically, elasticity is low, but the following example (Figure 5) from the Charente region in France indicates a significant drop in water use at a price of €0.05/m^3, (Y0.5/m^3), dropping to zero at a price at around €0.25/m^3 (Y0.25/m^3).

This had a substantial impact on farmer income, which was politically unacceptable and discontinued. In other more water-stressed regions, it may be necessary to raise prices to the extent needed to stimulate some of these step changes, but it will be necessary to provide alternative support to farmers so that they can cope with less water.

Figure 5. Price elasticity of water in Charente, France



Source: Anne Chohin-Kuper et al, *op ci*

Conclusions

At current levels, the WRF is thus a weak tool for influencing demand. Very large increases in WRF would need to be introduced before the total cost increases enough to influence water use significantly. A WRF which is currently less than 10% of the total water cost would need to be increased, so that the ***total*** cost of water is doubled: this would requite an increase in WRFs by a factor of 10 or more. If applied to agriculture, this could have major repercussions in the wider economy and could not be introduced in isolation. This has been done in Denmark, but this is very rare. It is more practicable in the urban sector.

The primary method for influence demand should thus be administrative regulation (ie a permit system), but WRFs and other methods should be used to support this by ensuring adequate finance to administer the permits.

2.4 Environmental protection

Three aspects of environmental protection are implied by the objectives of WRFs as defined in MWR Document 79:

- Reduced abstractions from rivers and water bodies
- Improved quality of return flows
- Specific environmental enhancement measures, such as urban green spaces

The sections above indicate that the WRF is likely to support (and finance) administrative measures for reducing abstractions and reallocating between sectors, which will in turn enable greater environmental flows and restoration of groundwater levels. Although there would be a direct impact if WRFs fees were increased to a high enough level, such that the total cost of water had a influence on demand, this is unlikely in the short term. Fees might also be used to influence seasonality of abstractions, or location and type of source, but this too is likely to be achieved in an indirect manner by stimulating knowledge and supporting other measures.

However, it is worthwhile to consider increasing the WRF by even a modest amount in order to cover more than the basic WAP management. This will enable some elements of environmental protection and enhancement can be financed. This was the reason[4] for the introduction of the Environmental Improvement Charge (EIUC) in England, where it is currently set at about 10% of the abstraction charge. In some other countries, such as Germany, this revenue is used to construct infrastructure for abatement of pollution

Natural environmental use cannot pay a fee, so the total cost of management needs to be fully recovered from all other users. Thus, in effect, direct users of water are also paying a small fee to maintain the residual environmental flows in the river system – this is explicitly identified in England in the form of the EIUC. Other environmental uses – such as

[4] More specifically it was levied to compensate holders of perpetual licenses which need to be revoked to protect environmentally sensitive sites

urban environmental enhancement – can be paid for by the relevant municipal authorities through the water supply tariff.

2.5 Social equity

Some provisions for social equity can in theory be incorporated in WRFs, through differential fees according to use type and location, and socio-economic conditions. One of the main provisions, in many countries, is for reduced or zero charges for agriculture, since farmers are generally from poorer sections of the community. This is not true of all countries – and thus in England, where farmers are relatively well-off, the abstraction charge is calculated on the same basis for agriculture as for other users.

Urban Water Tariffs often set in ways which attempt to protect the interests of the poor. This may be through measures such as rising block tariffs, but is not specifically related to the WRF which is effectively uniform across all users within an area covered by a permit.

Social equity objectives are primarily met by ensuring that water is allocated in a way which meets the social objectives. This should be built into the water permit and allocation management system. Thus ensuring that water resource management authorities are adequately financed and able to undertake all the activities listed as objectives in MWR Document 79 is important. This should help them in meeting the social objectives, but there is no direct link between WRFs and social equity.

2.6 Conclusion

Cost recovery, to cover the costs of administering the permit system and gradually other aspects of water resource management, is the most practical objective for WRFs. This is:

- easy to justify to water users and is generally accepted by them - any attempts to raise charges to reflect the assumed economic value of water or the downstream environmental costs are likely to meet strong resistance. This resistance will only be broken down when there is a greater acceptance of the need to reduce water use, and more accountability in the calculation and use of fees. It will only possible when income levels are sufficiently high that livelihoods can be maintained (or diversified) even with higher water charges.
- easy to manage, requiring little more data than that needed for the effective abstraction licensing and monitoring system which is a pre-requisite for a cost recovery-based WRF.
- can still be a useful tool for encouraging abstractors to improve their water use efficiency, by creating an awareness of the value of water.

3 Structure of Fees

3.1 Introduction

Where WRFs are applied – whether in China or elsewhere - there are usually different rates for different uses, taking account of the different consumptive uses and

hence different impacts on the resource. For reasons of affordability or political acceptability, charges for agricultural abstractions are often low or even zero. Industrial and urban users are charged at much higher rates although these vary considerably by location. These differences are recognised in SCD460, which states that the WRF should take account of the difference between industries and sectors, conditions of water resources, status of rural economic development and the need to promote agricultural water saving, and so on.

However, the costs to be recovered need to be determined before the fee structure can be decided. There are various components to be covered, as reflected in the objectives summarised in MWR Document 79.

3.2 Total cost of water and recovery mechanism

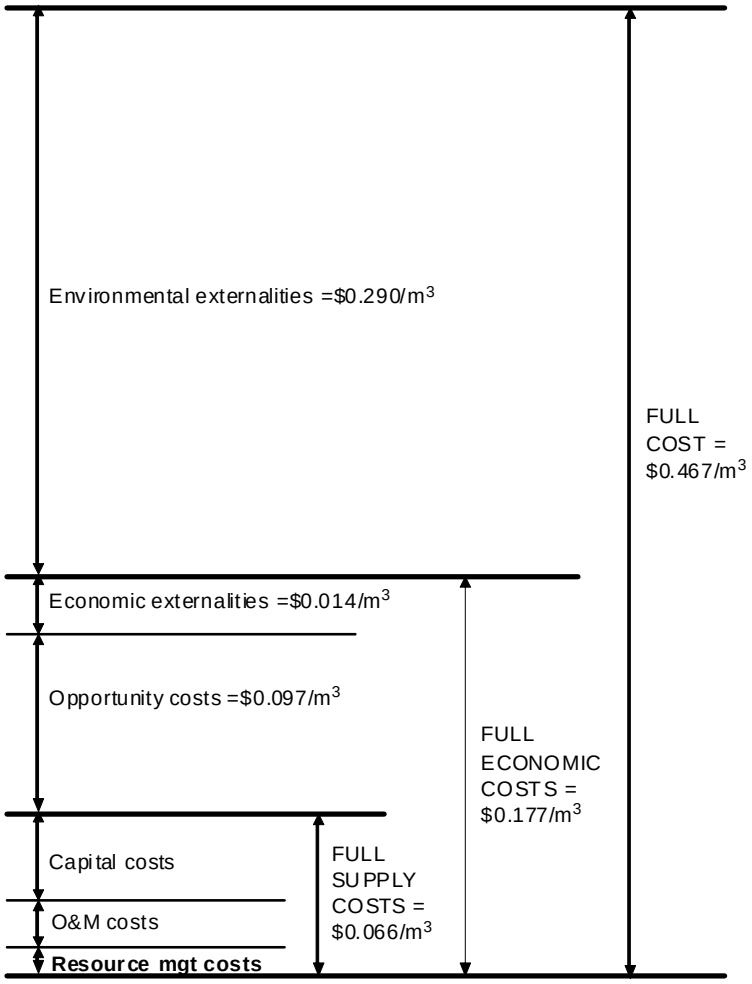
Categories of costs

The true cost of water, is much more than simply the cost of abstracting water from the river. There are many components of cost, some direct (such as the cost of pipes or canals), others indirect or hidden (such as opportunity costs relating to the value of activities which cannot be done because the water is used for an alternative purpose). Some costs can be quantified accurately and easily, others are more difficult to calculate. These may be subjective and difficult to explain clearly to people who are not professional economists – the methodology may even be contested by economists..

The main costs were illustrated in Figure 1. As noted earlier, in most countries where water resources fee is collected, the primary purpose of the fee is to recover the cost of water resources management. O&M and capital costs are met from irrigation service charges or water supply charges, and other economic and environmental costs are usually ignored. There are also some countries where there are measures in place to minimise opportunity costs through water allocation, and to recover economic and environmental externalities to varying degrees. This is either through an enhanced water resources fee, or through separate ‘eco-taxes’ or other measures.

It is difficult to estimate all of the ‘other costs’ (externalities and opportunity costs). For example, in the Subarnarekha Basin in India for both urban and industrial uses, the full cost is seven times the full supply cost (Rogers et al, 1998). This is largely because of environmental externalities in urban settings (in places where irrigation is dominant, environmental externalities are likely to be lower but opportunity costs much higher). Figure 6 is only approximately to scale, but it highlights the magnitude of the externalities in comparison with the supply cost. It is not quite to scale as it still overstates the resource management costs – which are the main costs to be recovered through the WRF, but are too small to be represented to scale on this figure.

Figure 6: Components of the full cost of water in Subarnarekha Basin, India



All of these costs need to be met in some way or another. Some are met directly through fees and charges; others are ignored in the charging system but are covered indirectly, by implicit or explicit subsidies. Typical arrangements are presented in Table 10.

Table 10: Typical cost recovery arrangements for water resources systems

Component of cost	Cost recovery mechanism		
	Urban/Industrial	Agricultural (surface water)	Agricultural (ground water)
Environmental externalities	ignored	ignored	ignored
Economic externalities	ignored	ignored	ignored
Opportunity cost	ignored	ignored	ignored
Resource management cost	Water Resource Fee	Not charged	Water Resource Fee (but usually not charged)
Cost of water delivery infrastructure	Water supply tariff, set by WSC	Partly by ISC, partly implicit subsidy	Well owner
O&M of water delivery infrastructure	Water supply tariff, set by WSC	Irrigation service charge	Partly by ISC, partly by owner

Although the externalities and opportunity costs have traditionally been ignored, many countries are now taking them into account in various ways. The opportunity costs can be reduced by allocating water in economically more efficient ways – to industry rather than agriculture. Often, a fairly small switch in allocation is sufficient to reduce the opportunity cost significantly since, even though the productivity in industry is much higher, the demand is less and can be met in full with a small transfer of water. In the past such reallocation has been done through administrative systems, but increasingly water markets are being used – for example in California where water is transferred from agriculture to urban areas. Water markets, however, a not easy to manage and have not yet been as successful as hoped. They are used on a limited scale in China, and it can be expected that their importance will increase. There are currently restrictions on the price at which can be traded (eg three times the WRF in Zhangye) which limit the attractiveness of such transactions at present. These approaches are discussed further in Overview Document OV2 'Water Demand Management'.

Externalities are increasingly being addressed through fees and environmental taxes. Some are addressed by requiring users to improve, for example, waste water quality. Other externalities are tackled through measures such as environmental taxes which can be used to finance ecosystem remediation. These approaches are still very limited in scale and scope, and mainly applied to urban and industrial settings. They can, however, be expected to be an increasing focus of attention: an important first step is to identify and quantify them (even if only approximately) so that appropriate measures can be gradually introduced. It is likely that some aspects will be covered in future through enhanced WRFs

Components of water resource management costs

In general there is a clear distinction between the costs of managing the resource, and in providing and managing the infrastructure to deliver water from the source to the use, but sometimes the boundaries between costs to be recovered in different ways can, however, be slightly blurred.

In theory, water resources management costs can be calculated from the direct cost of staff, equipment and facilities needed for management, although it may be difficult at present to identify these staff, activities and costs precisely, and to distinguish them clearly from other work of the Water Bureaus. In the early stages of introducing a WRF system, it may be regarded that salaries should continue to covered by regular budgets (and excluded from the WRF calculation). The WRF should then be confined to covering any specific additional costs that are required – such as transport, facilities or equipment. Despite this difficulty, it is important to attempt to quantify these costs, as described below (section 3.5), and in the long run all costs should be recovered.

The costs of some infrastructure for water resource development (WRD) - dams and inter-basin transfers - may be reflected in the water resource management costs and covered by the WRF. In most cases, the actual cost of these is covered separately by irrigation or water supply tariffs, or separately from government funds. South Africa makes a clear distinction made between the two, with separate published schedules of water resource fees for WRM and WRD. The fees for WRD are much greater than for WRM – typically by a factor of at least five, and even this is only sufficient to give an indicator of value rather than recovery of actual costs. Similarly in England, the source factor allows for the WRF to be increased by a factor of three if it is supported by an inter-basin transfer.

This is a sound approach as the costs of water resource-related infrastructure such as dams and inter-basin transfer works are often not uniquely identified with any particular water supply scheme but supply several different users each with their own abstraction licenses. However, cost recovery even for O&M costs is not usually possible in this way – certainly not for mega-projects such as the South-North Transfer in China. Even smaller transfer schemes, such as the Yellow-Hongshui transfer in Gansu, are difficult to finance in this way (see Box A).

Box A – WRFs and inter-basin transfers in the Shiyang River Basin, Gansu

The Shiyang River Basin is a highly water-stressed basin. One irrigation district at the downstream of the basin is partially supplied from inter-basin transfers, but these are currently managed and financed in different ways.

- Maintenance of the Yellow - Hong Shui inter-basin transfer is recovered via irrigation service charges from the users of that water, under the responsibility of the County WAB.
- By contrast O&M of the new Xiying-Caiqi transfer channel is intended to be managed by the river basin bureau (SRBMB) with the management costs covered from the WRF from the river basin as a whole. This cost is likely to be high compared to the total value of WRFs – suggesting consideration of the need for differential WRFs (see section 3.3) since most users will not benefit from this canal.

A further complication in this case is that WRF is charged for groundwater use but not for surface water irrigation. The transfer is, obviously, of surface water, but it contributes to recharge of the aquifer which is mostly derived from seepage losses from surface irrigation. Most farmers use both sources and aquifer recharge, and thus although they only pay WRF on groundwater use, this is indirectly derived from the surface irrigation supplies and hence the inter-basin transfers. The small number who only use surface water are thus subsidised by those who use groundwater (but they are probably still at a relative disadvantage since groundwater is a much more convenient source).

Setting fees is, however, not a purely technical and financial process in China or in other countries. Political and other factors are often significant. SCD 460 provides that the rate of water resources fee shall be defined by the price authority jointly with the finance and water authorities of the provincial government.

For example the new EIUC in England was proposed by the Environment Agency and calculated to meet specific financial requirements, and agreed through an extensive consultation programme. Yet ultimately it was reduced by the time it received Ministerial approval because of the adverse overall economic environment which made the full charge politically unacceptable.

3.3 Differential charging

Factors which may be considered

Water resource fees need to meet certain cost recovery objectives, but they do not have to be collected absolutely uniformly from all users: charges may vary for different users or situations in order to encourage or discourage certain users, or to protect livelihoods of vulnerable people.

Internationally, fees may differ, for example, according to:

- Season, with higher charges in the season of lower water availability.
- Degree of consumptive use of each type of water use, with charges being reduced for those uses with high return flows.
- Quality of the water abstracted, with a lower charge for brackish water than for fresh water.
- Location of the abstraction, with higher charges where the stress on the available water resource is greatest.
- Category of water user, with agricultural users often charged less or exempted.
- Type of source, with different rates for surface and groundwater, or for water transferred from other catchments
- Volume of use compared to a standard or norm, with rising block charges for those using more than the norm.

There is scope for differential charging in China, and the applicability of the various factors is briefly considered here. The need to apply adjustment factors in practice in any location should take account of the requirement for a simple system, and the magnitude of the impact that they will have .on water resource management and financing.

Regional variations

There are often big differences in the conditions of water resources and the level of economic development between provinces and even between areas within one province, thus differential rates of water resources fee may be applied for different areas within a province. This is provided for in SCD460, and it is possible to make allowance for differences in both economic status and in water resources

Source

It has been suggested that in China, protection needs to be focused on groundwater, particularly deep groundwater, and that groundwater should not be used if there is surface water available for use. This is because surface water cycles are rapid, whereas groundwater has a relatively low rate of renewal and the replenishment of deep groundwater takes a long time. Over-abstraction of such groundwater may cause many ecological and geo-environmental problems. More stringent restrictions on permits should be applied in this case, but these may be supported by a higher rate of water resources fee to highlight the relative scarcity and sensitivity of the resource as a small incentive to discourage its use.

In other places, there is a close hydrological linkage between surface water and groundwater, and thus permit conditions should reflect this and the fee should be the same.

Abstraction permits should not normally be issued for groundwater use in areas within the scope of the public water supply network, but if such use is allowed the rate of WRF for should be higher than for areas outside the scope of the network. This is to encourage the use of the public water supply network, rather than direct individual groundwater usage.

Season

Both precipitation and water demand in China is highly seasonal. There may be scope to increase use of water resources in the flood season in some locations; this could be encouraged by different rates of water resources fee in each season. For example, the permit might specify a total annual volume, but with different fees for abstraction during the wet and dry seasons. This approach is adopted in the UK, with a seasonality factor of 0.16 in winter and 1.6 in summer – ie WRFs in summer are 10 times greater than in winter – and has resulted in some farmers constructing more on-farm storage. The fee thud encourages the private sector to invest in drought management.

Sector

In setting the rate of water resources fee, consideration needs also to be given to the difference between industries or sectors, which have greatly varying ability to pay the WRF. Most industries have a much greater output per unit of water used and thus can afford a much higher water resources fee than agriculture. Some industries have a much greater consumptive use that others - thermal and hydropower consume little water but influence water resource availability or quality for others. Therefore, the difference between industries or sectors needs to be considered.

As an economic instrument for the control of development and use of water resources, the water resource fee system needs to be consistent with the national industry policies. The rate of water resources for industries promoted by the state needs to be lower than that for industries restricted by the state; that for agriculture needs to be lower than that for other industries; and that for the tertiary

industries such as car washing, bathing and catering needs to be higher than that for other industries.

Reuse of waste water

The WRF should be higher for high quality water and lower for reclaimed wastewater, as an indicator which should promote efficiency in the use of water resources.

Volume of use

The rate of water resources fee can be tiered, or split into two parts. One part is the basic rate of water resources fee, applicable for the amount of water abstraction specified in the permit; the other is the higher rate for water abstraction above the permit volume. This rising block rate structure makes payment of water resources fee increase with the amount of water abstraction. In theory this will encourage water abstractors to save water, but this will only happen if the WRF is increased substantially above its present level for the second 'tier' since the water resource fee is a small proportion of the total cost of water.

Application of a rising block structure for water price may also reduce adverse impacts on poor people. The water price of the first block may be subsidized or even free (in the case of agriculture) in order to meet the essential needs of poor people, with those for other blocks reflecting the true economic cost of water. However, this will only be effective if other elements of the total cost are structured in the same way.

The use of a tiered WRF, however, requires good volumetric measurement and reporting, as well as careful consideration of how it relates to permit conditions

3.4 Agricultural water resource fees

The question of whether to charge WRFs on agricultural use is particularly important as this is the main use of water in China, both in terms of total volume and number of permit holders. It is also the lowest value use if expressed in terms of economic value of output per unit water consumed. But it is critical for the livelihoods of vast numbers of the rural population who are amongst the poorest and most vulnerable section of society. In addition, agriculture is essential for national food security. Water resource fees are needed to finance sustainable management of a critical input to agriculture, not to create a financial burden on the rural poor. They are part of a package of measures. In the long run, the true value of water should be reflected in food prices, but this is a global issue which is outside the scope of water resources management.

SCD 460 provides that for water for agricultural production, water resources fee shall be paid

> "*for the amount of agricultural water abstraction above the limit established by the provincial authority, and for the amount of agricultural water abstraction* ***not above the established limit, it is not necessary to pay water resources fee***".

The meaning of 'limit' is not clearly defined in SCD 460, but should

logically be the amount defined in the abstraction permit and presumably the permit holder should identify the individuals responsible and charge them accordingly. This is complicated in theory by the subsequent provision that the WRF for grain crops should be less than that for cash crops. However, this does not yet appear to be widely applied and would be very complicated to administer unless all users under a permit grow the same category of crops. The system has, however, been introduced in Beijing (see Table 11).

Table 11. Current levels of agricultural water resource fee (Y/m^3)

Province	Surface Water	Groundwater
Beijing	No	0.08 for grain (for water above 220m^3/mu for wheat/corn, 50% of water for paddy and above 80 m^3/mu for other grain) 0.16 for other crops (above 360 m^3/mu for vegetable, above 150 m^3/mu for fruit)
Gansu	No	0.01 (all water)
Henan	Only above 3,000 m^3/mu	Only above 1,000 m^3/mu
Zhejiang		0.02 (above norm)

The decree goes on to state further details about agricultural water resource fees: the rate "*shall be defined according to the features of agricultural water use, the conditions of water resources, rural economic development and the need for promoting agricultural water saving; the rate of water resources fee shall be lower than those for other water uses, and the rate of water resources fee for grain crops shall be lower than that of cash crops.*" In general, however, the fee will be zero, since the design and management of infrastructure means that farmers will rarely be physically able to take more than the norm (large-scale irrigation systems are generally designed for supply management, and it is usually only groundwater irrigation which can respond fully to demand). There is a risk that this will give the regulatory agency an incentive to encourage overuse, and thus there will need to be assured funding arrangements which do not rely purely on collection of WRFs. The incentives for the agency should be based on its achievement in water saving rather than water sales.

Inequity within a permit area may result in some farmers exceeding

their share of the allocated volume and other farmers receiving less than they should. It would not be practicable or sensible to try to charge WRFs formally to individuals to resolve such equity issues, since the measurements at this level are not sufficiently accurate to make this possible. However, the WUA would still need to determine which individuals should pay how much of the surcharge. This is quite easy in the case of individual tubewells, but would be very difficult for large-scale surface irrigation In the case of large irrigation districts, the WMD would need to determine which WUAs should be surcharged. This will an academic issue until WRFs are charged for large-scale irrigation, and the inevitable complexity suggests that it would not be worthwhile.

SCD 460 does, however, state that the steps and scope of agricultural water resources fee collection shall be determined by the provincial authority. Some provinces do collect fees for agricultural use. Gansu, for example, collects agricultural WRF from groundwater users but not surface water users. It does, however, enable some farmers or WUAs to question the legality of the charge which appears to be in contradiction with national legislation and thus can be contested. In other provinces new legislation has been issued to support SCD 460 which allow for agricultural water resources fee to be collected for use above the norm - those include Beijing and Zhejiang.

Nevertheless, irrigation accounts for over 60% of total water abstraction. It is considered important by many that unless some water resources fee is charged, water users will not appreciate the true value of water and hence be reluctant to adopt water saving techniques. This will, however, only be effective if improved facilities for flow measurement are installed, and if the infrastructure is managed in a way which enables farmers to choose how much water they will receive (and pay for).

Since SCD 460 requires that agricultural WRFs should only be chargeable for use in excess of the norms, care is needed in setting agricultural water use limits or norms (see AN 1.8 Agricultural water use norms). These norms should take account of the realities of the current situation - the management level and techniques for water saving achievable in the next 3-5 years. WRFs would need periodic revision as technologies and socio-economic conditions develop. It should also be noted that norms are also currently used to set permit volumes (on the basis of aggregate norms for a certain cropping pattern and area), thus farmers should only be able to exceed norms in one area if they use less in another (within the permit command area). These issues make the process of assessing fees and enforcing permits quite complex.

In other countries, permit volumes are derived from water resource availability, and fees assessed on the basis of permit volumes (see Thematic Paper 4.1 ‘Abstraction Licensing Systems’). This avoids most of the administrative complications of the system in

SCD460 without reducing the incentive to save water.

In Beijing's regulation on agricultural water resources fee, the agricultural water use limits have been defined to ensure decreasing agricultural water use from 2003 to 2005 taking consideration of water uses and output benefit of different agricultural production activities, and the water use limits can be achieved with ordinary water saving technologies and can basically meet the needs of crop planting. Thus, the water users will only pay water resources fee above this limit and by paying attention to water saving they can meet their basic needs for production water without incurring any WRFs – this is intended to stimulate water saving. However, the incentive is only for the farmers – there would be a perverse incentive if the WAB had to rely on these fees for their income. They would have to implement a complex WRF system and the more successful they were, the less their income would be. However in practice their income is secured from central funding rather from WRFs.

It may be necessary to give farmers other incentives to improve irrigation and agriculture, without undermining the requirements of environmentally sound water resource management. This should be done by measures such as direct support or subsidies to grow certain crops, or other social protection measures rather than by implicit subsidies through artificially low water charges or fees which do not cover the management costs. There is also a need for awareness and information programmes, demonstrations of new crops and techniques, and so on. These should be supported by funds raised through WRFs, and presumably other sources as well.

For example, in Hebei Province, the WRFs have been increased considerably in order to establish a water saving fund from the additional income from higher water charge. This is augmented further by a government subsidy. Money from this fund is directly granted as subsidy to farmers according to the area of farmland. If farmers save water, they avoid paying the much higher WRF, but they can also benefit from fund which is derived from all WRFs from all users plus the government subsidy. This mechanism is reported to have promoted water saving among farmers. However, it requires accurate measurements, good data quality and careful management.

Setting fees for rural water users is a sensitive issue and involves the price bureau as well as the water administration. The affordability of fees – even of the WRF is an important issue (see below).

3.5 Calculation of costs to be covered by the WRF

Background

The long-term goal of water price reform is full cost recovery, as defined in Figure 1. In the case of WRFs, this relates to recovery of costs for abstraction permit management, other aspects of water resource management, and possibly (in the longer term) other environmental costs, in accordance with MWR Document 79.

It is necessary to handle rate setting of water resources fee, water charge and wastewater treatment fee via an overall arrangement according to the principles of economic efficiency, social equity and sustainability, by first focusing on recovering the financial cost of water supply (i.e., O&M and capital charges), then moving forward to water resources management and later other economic and environmental components of the costs. Guidance on cost recovery of engineering elements is provided separately (Advisory Note 5.2 'Formulation of Irrigation Service Chargers for Surface Water Irrigation Schemes' and Advisory Note 5.4 'Tariff Setting for Small to Medium Size Water Supply Company'); this document focuses just on water resources fees.

The rate of water resources fee should be set by the price administrative authority with the finance and water administrative authorities at the provincial level and reported to the relevant national authorities for record purposes. The rate of water resources fee for water abstraction works directly under the management of central government or covering more than province, for which water abstraction is approved by a river basin authority shall be set by the relevant national authorities.

Water resource management costs

Water resources management includes a range of tasks, including water resources monitoring and planning, management of water abstraction permit and water resources fee, water environmental protection and management, water saving management, water and soil conservation, water resources regulation, information management, legislation enforcement, etc.

The required rate of water resources fee may be assessed by calculating the expenditures on various water resources management, and dividing these by the total volume of water abstracted. Ideally the costs of each component should be identified and quantified separately, so that the build-up of the WRF can be seen as more tasks are included (Table 12): this is likely to be difficult since many of the tasks cannot be isolated, but approximate estimates can be made.

Table 12: Build-up of water resource fee

	Staff costs	Direct expenditure (transport, equipment stationery, etc)
Administration of WAP & WRF		
Water resources monitoring		
Water resources planning		
Water environment protection		
Water saving demonstrations		
Water saving publicity		
Water resources regulation		
WR information management		
Water legislation enforcement		

Affordability of water resource fee

An actual rate of water resources fee needs to take account of the affordability of water users and water use sectors. This affordability analysis needs to take account of the total cost of water. Although this document focuses on WRF, the affordability and willingness to pay calculations need to take account of all costs including water supply charge, water resources fee and wastewater treatment fee, and any other payments required. Although the WRF is less that 10% of the total cost of water at present, it might appear that affordability of WRF is not an issue. However, this is not always the case – particularly for agriculture.

For affordability of domestic water prices, the World Bank considers that a total water charge of 3-5% of household expenditure is realistic and feasible for average urban residents. This is consistent with the Report on Urban Water Shortage (Ministry of Construction, 1995) which found that 2.5-3% of average family income is appropriate for urban residents in China. A WRF which is around 2% of the total cost is clearly very small in comparison with acceptable range in total costs, and thus questions of affordability of WRF should not arise.

For the analysis of affordability for industrial water price, the methods often applied include the industrial water demand price elasticity method, the enterprise cost indicator analysis method, the sector competitive strength indicator method, the water price affordability indicator method, etc. Industrial water charges have been considered in a study on the water price of the South to North Water Transfer Project; 1.5% of the industrial output value is taken as the criterion for the average industrial water charge. In the case of industrial water use, the WRF may be a relatively high proportion of the total water cost and thus may be significant for some types of industry.

Many studies have been done internationally and in China on the affordability of agricultural water price. Water is a significant input cost, and typical range of acceptable levels of fees have been found to be as in Table 13. Since WRFs may be as much as 10% of the total cost, this can be a significant cost for poor farmers. These acceptable ranges can be expressed in various ways – as a percentage of gross revenue (eg crop value), as a percentage of the costs incurred in producing this crop, or as a percentage of the net revenue (the crop value minus the production costs).

Table 13: Total water fees – typical examples

	Acceptable range
Water cost as % gross revenue	5-12%
Water cost as % production cost	10-20%
Water costs as % net revenue	8-18%

Agriculture is a marginal activity for most people – few can subsist entirely from it. There is a challenge to set prices at a level which will give farmers an incentive to manage water well, yet not drive them out of agriculture by making an already poorly-remunerated occupation even less viable. There needs to be a combination of charges to cover the costs of irrigation management, and other support measures to protect farmers.

The cost of water, relative to production cost and agricultural income in Wuwei, Gansu is presented below to give an indication of the affordability of agricultural water resources fees. This is a relatively poor area, with a low proportion of cash crops and hence affordability is low in comparison to other parts of China.

In the context of land holdings of 2.5 mu/capita, it can be seen that these fees are very significant – WRF alone would reduce the net income of a wheat farmer by over 2%.

Table 14: WRFs, total costs and value of groundwater in Wuwei

Item	Maize for seed	Maize	Wheat	Typical international values
Total output value (Y/mu)	850	986	620	
Production cost (Y/mu) (excluding water and labour)	494	379	397	
Net revenue (Y/mu)	356	607	223	
Water resource fees (Y/mu)	**4.8**	**4.8**	**4.8**	
Irrigation management fees	9.0	0.0	9.0	
Other water costs	60	60	60	
Total cost of water	**74**	**74**	**74**	
Water as % gross revenue	9%	8%	12%	5-12%
Water as % production cost	15%	20%	19%	10-20%
Water as % net revenue	21%	12%	33%	8-18%
WRF as % gross revenue	**0.6%**	**0.5%**	**0.8%**	
WRF as % production cost	**1.0%**	**1.3%**	**1.2%**	
WRF as % net revenue	**1.3%**	**0.8%**	**2.2%**	

Note: data from reports prepared for WRDMAP in 2007

Willingness to Pay

Willingness to pay is quite distinct from ability to pay, and this will ultimately be reflected in the political acceptability of WRFs. Users in general may accept the need to pay for service, ie water delivery. But, they may well be much more reluctant to pay for the cost managing the resource (the costs of monitoring, modeling, planning, administering permits etc) – particularly if this is done by

Government staff who already seen to be fully employed. It may thus appear to be a duplicate charge. This makes it important to identify the tasks, and what aspects of them are covered from WRFs.

Further increases in WRFs to pay for matters related to environmental sustainability are likely to have even lower acceptability. Even in the UK which is highly environmentally-aware, the environmental component of WRF was reduced in 2009 because of adverse economic conditions. The introduction of charges to cover environmental externalities of water use will depend on a much greater awareness of the issues around sustainability.

3.6 Conclusions regarding the structure of fees

Water resource management costs are typically a very small proportion of the full cost of water taking its environmental value into account. These costs are typically 2% of the full cost, although the proportion may be much greater in those places where water is abstracted directly by the user (such as farmers in UK, or major industries elsewhere).

Charges may take account of several different factors, such as source type, season, sector the water is used in, and return flows(magnitude, quality and location). Charges will vary according to these factors. WRFs are rarely charged to agricultural users, but they are charged in some countries (such as UK). WRFs are applied to agricultural users in a few provinces in China, although generally only for use of water above a certain limit, which makes it complex to calculate and collect them.

Whatever basis is adopted for the structure of fees, the magnitude of WRFs need to be calculated on the basis of actual costs and then assessed to confirm ability to pay for each category of user.

4 Collection and Use of Fees

4.1 Institutional arrangements

In order to guarantee effective implementation of the water resources fee system, the relevant authorities of government at all levels need to supervise the collection and use of water resources fee well. This includes:

- the water abstraction permit supervision authority supervising the payment of water resources fee by water abstraction units or individuals;
- higher level authority supervising the collection activities of water resources fee by lower level authorities;
- finance, price, supervision and audit authorities supervising the collection and use of water resources fee by water administrative authorities.
- Ensuring that administrative authorities and water abstraction permit holders receive social supervision.

The link between the water resources fee system and the water abstraction permit management system is important: improving WAP management is a

precondition for effective implementation of the water resources fee system. At present, many water abstraction authorities in China have problems of inadequate staffing and perhaps weak technical capacity or resources to implement the WAP system: capacity building and training of staff is needed to improve understanding of the regulations, the WAP system, and WRF management methods. Improvements to flow measurement and data management systems are also needed, since WRFs are based on actual water use in China (under current regulations).

Advocacy and awareness

Advocacy and education is needed to improve the public understanding of water resources issues and water legislation. It is necessary to make the public, particularly water users, understand China's basic situation of water scarcity and the nature and purpose of the water resources fee system. This will improve the consciousness of water abstraction units or individuals to pay water resources fee and the awareness of participating in water resources supervision and management and contributing to the coordinated development of resources, environment, economy and society. The relevant advocacy and education activities may be combined with those of the World Water Day, China Water Week, National Urban Water-saving Publicity Week, World Environment Day, etc.

It is necessary to establish transparent procedures related to WRFs, so that the system is understood by and accountable to the public. It is necessary to abide by the Regulation on Information Publication by Government in China and release relevant information to the society, on the:

- basis for and the rate of water resources fee,
- determination of water use norms/limits,
- amount of collected water resources fee,
- planned and actual expenditure of collected water resources fee, etc,

In setting the rate of water resources fee or making importance decisions about it, the public right to know and stakeholder participation need to be ensured. The opinions of interest groups of various kinds need to be presented and there should be public hearing in the light of the Price Law.

4.2 Methods of collection

Constraints

In recent years, with the implementation of rural tax reform and the cancellation of agricultural tax, the collection of water charge in rural areas is becoming increasingly difficult as all of these taxes and charges used to be collected together. Some local governments with high financial capacity provide reduction or exemption of agricultural water charge by providing subsidy to water supply agencies. Under this situation, the addition of agricultural water resources fee may be difficult.

In addition, fees are payable in China according to the actual rather than licensed volume, and thus water needs to be metered at the point of abstraction. This should not be a problem for surface irrigation where one permit covers an entire irrigation district and at least this much measurement is needed for effective irrigation management. It should also not be a problem for urban or industrial supplies which can each be metered.

Groundwater agricultural water use is the most difficult. Each tubewell needs to be monitored accurately so that total use, and use above the limit can be calculated. This is not generally possible at present, and most well operators can, at best, estimate use by time and pump capacity. Until flow meters are installed, charging WRFs on the basis of actual rather than permit volume is likely to be a complication which is not justified by the accuracy of measurement.

Approach

The procedures and scope of water resources fee collection for water abstraction is determined by the provincial government. Water resources fee shall be collected by water administrative authorities at and above the county level according to the authority for water abstraction permit approval. For water abstraction approved by a river basin authority, water resources fee should be collected by the provincial water administrative authority, under which jurisdiction the water intake works is located.

The agencies for water resources fee collection are water administrative authorities at various levels, but they shall receive supervision and examination by the administrative authorities for finance, price and audit and water administrative authorities at upper levels.

SCD 460 provides for over-arching procedures for the collection and use of water resources fee, covering the timing for water abstraction units or individuals to report amount of water abstraction and pay water resources fee to water administrative authority, the proportions for the sharing of water resources fee collected at local levels between the central and local treasuries, budget management of water resources fee, uses of water resources fee, ways for the formulation and review of revenue and expenditure budget of water resources fee, etc.

The payment schedule in many countries and as laid down in SCD460 is monthly, but this would be unwieldy for agricultural fees which are best paid on an annual basis in arrears. This is to reduce the administrative workload, and because the volume in excess of the limit cannot be known until the end of the season.

Agricultural water resource fees – combined collection with ISCs

WRFs are just part of the total fees which farmers ultimately have to pay – in practice both resource fees and service charges are all paid to the same office (the water management station), for onward transmission to the County treasury. It makes sense for them all to be paid together, and this is normal practice.

Box B: Agricultural Water Resource Fees in Gansu

In parts of Gansu, for example, agricultural groundwater users pay two fees, a basic fee of 5Y/mu, a management fee of 3Y/mu, the WRF of 0.01 Y/m^3 and a fee for the WUA of 1Y/mu . Although logically these are all different fees for different purposes, they are regarded effectively as taxes rather than as fees for distinct aspects of the services delivered. Since the quota was 480 m^3/mu in 2007, users paid Y13.8/mu in total. The entire sum was collected by the WUA for the WMS, and the 'WUA fee' should be returned to the WUA for its operation and management. This was regarded by the WAB as compensation for the WUA for helping WMS to improve the rate of water fee collection.

In addition to the fees payable to the government, the users also have to pay electricity local (production group) costs. These are typically Y60/mu (Y52 for electricity, Y7 for WUG staff, and Y1 for maintenance, based on Wutong production group 3 in 2006).

These fees cover a range of activities, including water resources management costs, some aspects of which are done by WUAs.

Source WRDMAP studies in Wuwei

Since the WRF is intended to cover the cost of water resource management, it is necessary to determine who is responsible for each activity and what costs they incur. Although the license may be issued at county, municipality or river basin level, many tasks are delegated to lower levels – for example as shown on Figure 7 and tabulated in Table 15. For each organisation, there is a need for funds from the WRF collected to cover staff costs, transport, stationery, and other specialised tasks as needed (eg IC card equipment), etc. The actual collection inevitably needs to be undertaken by the lowest level organisations – the WUA and WMS, and a large part of the costs are incurred by them.

Figure 7. Organisations involved in agricultural WRF collection

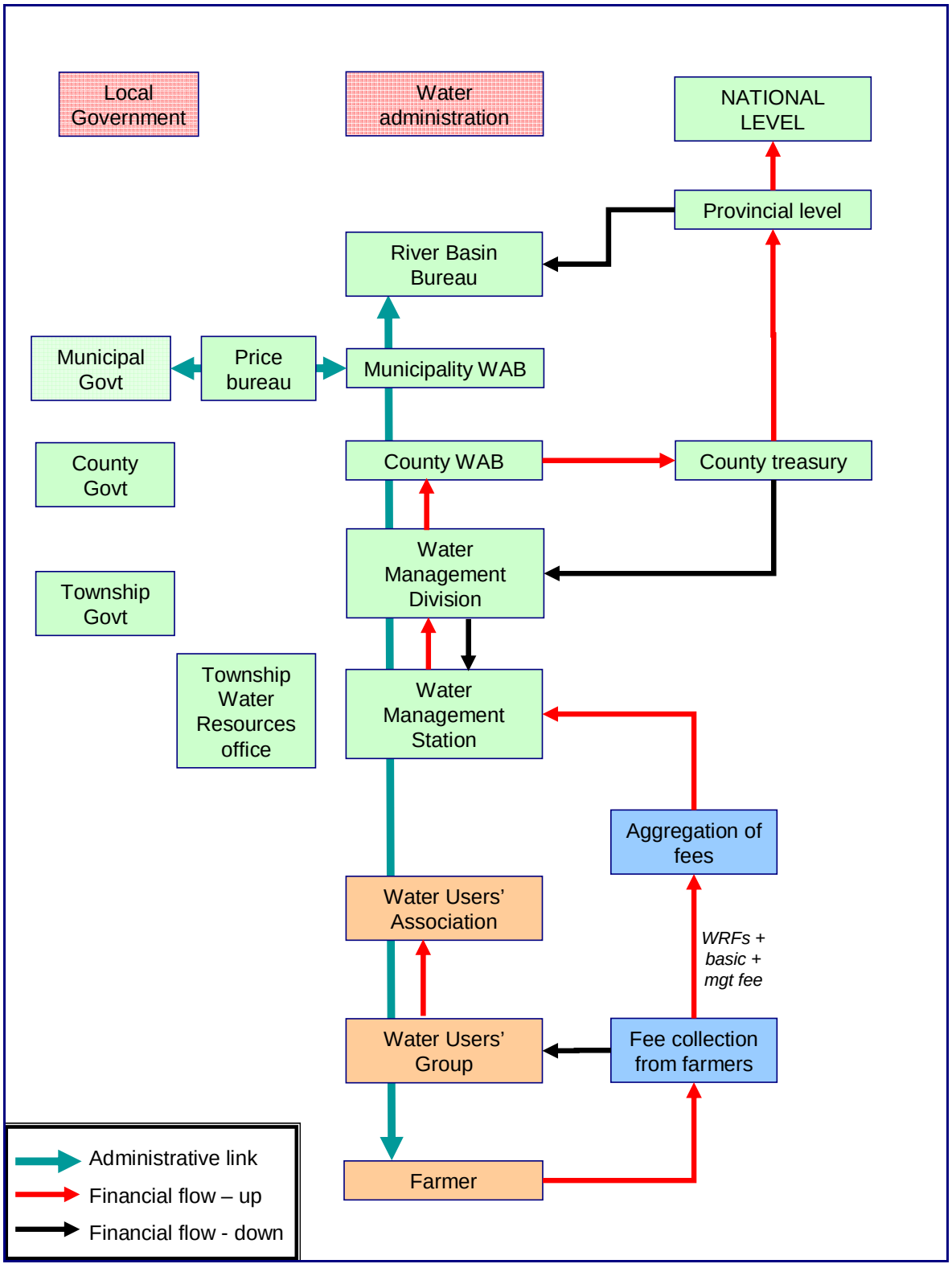


Table 15: Allocation of tasks for WRF collection and WRM in agricultural areas

Organisation	Task (indicative – not complete list)
Village/WUA	▪ water resources allocation within permit area ▪ aspects of permit issuance and monitoring ▪ water rights, and issuance and monitoring of household certificates (HWRC) where applicable ▪ IC card management, or alternative procedures for ensuring compliance with permits ▪ Water resources and related fee collection
Water management station	▪ all day-to-day supervision and management of the WAP system and related procedures, in conjunction with the township water resources office. ▪ Support to WUA in their activities related to WRM
County WAB	▪ Evaluate, approve WAP applications ▪ manage permits to ensure compliance, monitor actual abstractions ▪ inform annual allocation plans to the WMDs and permit holders ▪ implement changed allocations in case of emergency (eg. drought) if necessary, and inform permit holder ▪ develop local norms for water use, as necessary ▪ disseminate information on water-saving technology.
Municipality/ river basin bureau	▪ review, evaluate permit application, issue WAPs ▪ prepare/inform annual allocation plans to the county WAB ▪ inform SRBMB of emergency provisions (eg. drought) if necessary ▪ develop norms for water use ▪ disseminate information on water-saving technology. ▪ evaluate and approve applications for permits, taking ▪ design implement measures for emergency (eg. drought) ▪ Monitor water use and groundwater response ▪ Audit permits and annual allocations

4.3 International experience with collecting water resource fees

General

A key question when designing WRFs is whether they should be based on licensed abstractions or actual abstractions. If the objective is cost recovery, charges based on licensed abstractions are the simplest and most efficient. Such fees give no incentive to use less water, but as noted earlier the incentive effect would inevitably be very weak even if based on actual volume. The incentive is really

provided in the processing of setting the WAP volume, and the WRF merely supports this. However, fees even calculated on this basis should still convince people of the value of water and hence influence them to use less. Internationally it is most common to charge on the basis of licensed volumes (e.g. in UK, South Africa and Canada), but some charge on the basis of actual abstractions (e.g. Hungary, Italy, Mexico and The Netherlands) – there is no consistent pattern. A hybrid system is allowed for irrigation in UK in places where daily metering by the abstractor is possible. In this case, 50% of the change is based on permit volume and 50% on actual volume.

If the WRF charging objective is just to recover the budgeted costs of water resource management, there are sound reasons for adopting the simpler and less costly option of basing the charges on licensed volumes. It is still necessary to meter abstractions to ensure compliance with the permit, but the data management and administration associated with WRFs can be simplified. This would reduce the risk that the process of fee collection would absorb much of the fee collected (especially in those parts of China where there are large numbers of very small permits).

For any organisation to operated, it needs a sound knowledge of its income and hence budget at the start of the year. Basing WRF on permit volumes guarantees this. If it is based on actual volumes, the budget will vary and will not be known until the end of the year – and it will be lower during droughts when their costs may actually be higher.

United Kingdom

In the UK, Anglian Region has some 5,400 licensed abstractions who are all required to record their abstractions (76% have meters). They are billed once per year, in March, with payment due within 28 days. There are no specific penalties for late payment or non-payment, and most problems relate to over-abstraction rather than non-payment of WRFs. The Anglian Region employs the equivalent of 0.5 person for WRF management as compared to about 40 employed for abstraction licensing and related water resource matters. Once the institutional and technical capacity to operate an abstraction licensing system is in place, that capacity should be adequate to ensure a high WRF collection efficiency. Water resource fee billing is based on a national database. The WRF revenues received for each Region are paid into its Water Resources Account.

In most countries the WRF revenues are earmarked for water resource management. In fact, the need to generate funds for water resource management and development is often used as a major justification for the introduction of WRF charges. This is true for UK, and for 11 of 15 countries reviewed by OECD. In Brazil the Federal Water Resources Law of 1999 stipulates that not more than 7.5% of the WRF revenues can be transferred for use outside the river basin in which they were raised. France has a policy that '*water should only finance water matters'*.

Earmarking of WRF revenues is highly desirable, not only to promote the acceptance of WRFs amongst the water users but also as a way to help ensure an adequate level of expenditure on WRM and WRD. Establishment of separate accounts for the management of WRF revenues, as in the UK is a good way of reinforcing the earmarking principle – otherwise it is difficult to identify the relationship between fees and administration costs.

Brazil

Experience with the successful introduction of the Paraiba do Sul River Basin WRF charging system in Brazil is of interest from the practical viewpoint. This system was reportedly introduced "with relative ease". Key factors behind this success were reported to be:

- The flexible, participatory and transparent approach adopted by the authorities concerned. Instead of the traditional top-down approach, there were lengthy and open consultations and negotiations with the key stakeholders and the design of the system was adapted to meet several of the water users' key demands. These included the need for all the WRF funds raised to be re-invested within the basin (i.e. 100% earmarking) and the insistence of the industry sector that all permit holders (and hence all water users) should be charged, albeit at different rates. Both these demands were acceded to.
- The system of WRF charges adopted was kept as simple and low-risk as possible.
- The high level of technical knowledge and capacity in the basin and in the national water agency involved.
- Users' awareness of the issues involved increased their receptiveness to the idea of WRFs.
- Attractive financial inducements, such as the first committees to charge WRFs would earn matching funds from a national water pollution reduction programme.

The main problem mentioned with regard to the operation of the Paraiba do Sul River Basin WRF system was that the process of identifying and incorporating all water users (i.e. the inventory and licensing process) is not yet complete and illegal water use occurs. This is a common problem in many countries, and is likely to be equally true in China. It underscores the need to have a sound WAP system in place first. This is a fundamental prerequisite for WRFs.

4.4 Sharing funds between different organisations

Overview

SCD 460 stipulates that 10% of the water resources fee shall be sent to the central treasury. The 90% at local level shall be shared between governmental organizations in the water sector within the province according to the proportions determined by the provincial authority. There may be differences between provinces, giving consideration to the needs of water resources management, saving and protection at various levels and

to mobilizing the enthusiasm of local levels for water resources management.

The water resources fee should mainly be used for the conservation, protection and management of water resources, but may also be used for the rational development of water resources. The latter requires a huge amount of funding compared to the total value of WRF income, and is thus normally paid from Government funds. Thus the use of WRF for "*rational development of water resources*" should be interpreted as a subsidy for early stage preparatory work for the water resources development

Both domestic and international experience shows the importance of designating the WRF collected for use for water resources management. Problems often arise if this principle is not followed. In some economically undeveloped areas, water resources fee has reportedly often been used for other purposes, because of financial difficulties, creating difficulties for water resources management.

Auditing needs to be done to ensure that the fees are correctly collected and used. The auditing agency needs to intensify its audit of the use and management of water resources fee to ensure that it is used correctly for the rational development, use, conservation, protection and management of water resources. The audit should be publicly accessible so that all users can see what the WRF is used for and how it is accounted for.

Sharing of WRFs between organisations – example from Gansu

As noted above, there are many differences in the use of fees in various parts of China. This information is based on the situation in Wuwei Municipality in Gansu Province. The fees for groundwater abstraction for irrigation are 0.01 Yuan/m^3 in this region. The fees for urban or industrial use are about 10-30 times greater (Y0.1-0.3/m^3 depending slightly on type of use and location).

The collection arrangements are laid down in local regulations as follows:

- Abstractions for agricultural irrigation of less than one million m^3 per year; this covers all agricultural wells in the case study villages which are typically less than 100,000 m^3/yr (250 m^3/day). The fees are collected by **County WAB** of which 80% is retained by the county finance bureau; 90% of the balance goes to the city and the remainder to the province.
- Abstractions for industrial and urban domestic use of 1 to 5 million m^3, and groundwater abstractions for agricultural irrigation (including well fields) of more than one million m^3 per year. The fees are collected by **Municipality WAB** and paid to city finance bureau who pass on 10% to province finance bureau. Collection may alternatively be delegated to the county who then retain 30% and share the balance as above (90% to city, 10% to province).

Paid to the finance bureau but retained for 'water affairs'

- Fees for industrial and urban domestic abstractions greater than 5 million m^3 per year, and abstractions for large-scale hydroelectric power generation are collected by the **Provincial** authorities

This is illustrated in Figure 8 below. As indicated earlier, many tasks of WRM are devolved to lower level organisations. Part of the WRM needs to be shared out amongst them according to the responsibilities of each organisation and the amount that need to cover their costs of WRM. This is partially reflected in Figure 8, but part of the fees indicated in this figure need to be further transferred to others. For example, in Minqin in Gansu the county WAB transfer a portion of the WRF revenue to WUAs in recognition of their role in water resource management. However, the WAP/WRF system is complex and does result a relatively small amount of money being shared between many organisations.

4.5 Conclusions regarding collection and use of WRFs

It is relatively easy to design a logical system of WRFs, as described in Sections 2 and 3, but this is of little value unless it can be collected and managed efficiently. The management arrangements need to be planned at the same time. These include:

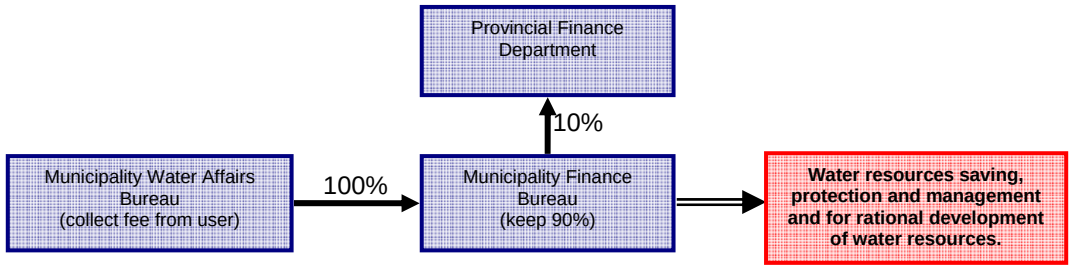
- Institutional arrangements, staff responsibilities, logistical arrangements, and supervision
- Methods of collection –
- On basis of actual or license flows,
- Frequency of collection (annual, seasonal or monthly)
- Public awareness of the purpose, arrangements for collection, and use of fees.

International experience suggests that simplicity and transparency of arrangements is most important, and that there should strong awareness and acceptance of the arrangements (usually following on from consultation or participation in the design of the fees). They may be supported by additional incentives, such as matching funds depending on the percentage collection rate.

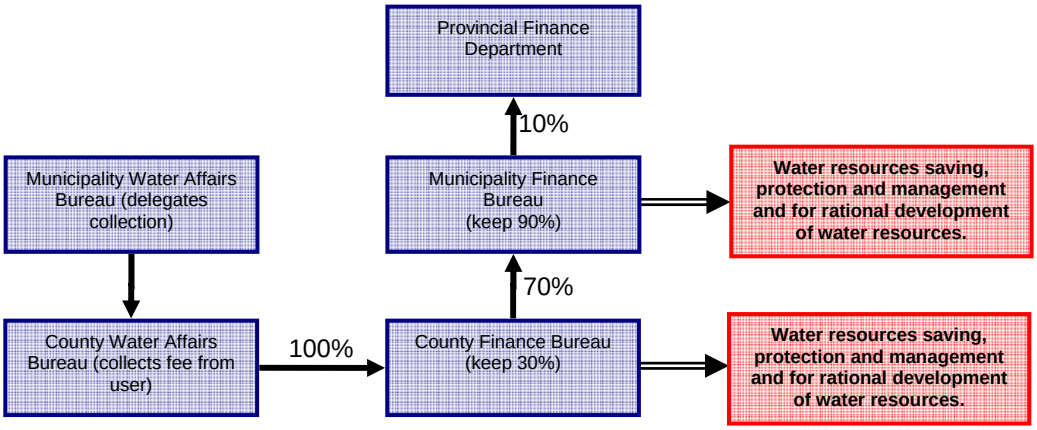
WRFs are generally more complex than in many countries, requiring collection from a large number of bodies and relying on actual measurements rather permit volumes. This should encourage greater water saving, but the increased cost and complexity of management arrangements may outweigh the theoretical benefits since the fees can only be set at levels which are too low to influence demand directly.

Figure 8: Utilisation of WRFs

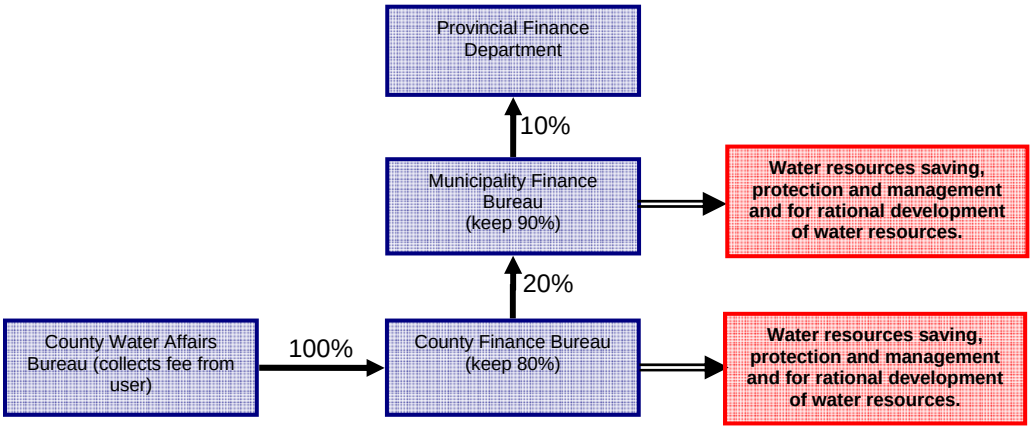
Municipality Water Resources Bureau collects water resources fee directly from users (for permits for 1 – 5 million m^3/yr):



Municipality Water Resources Bureau delegates collection of water resources fee to county WAB (for permits for 1 – 5 million m3/yr):



County Water Resources Bureau responsible for collection of water resources fee (for permits for less than 1 million m^3/yr):



5 Impact of WRFs

5.1 Water resource management

It should be clear from the above that the main impact of WRFs should be on ensuring that water resource management is well-financed and thus can be done well and effectively. This will include ensuring that there are sufficient funds and staff to enable accurate assessment and monitoring of water resources, timely issuance of permits, auditing of permits, accurate allocation of water in accordance with agreed objectives, and so on.

These tasks are generally done by WABs at various levels, which are already staffed and paid from government funds. To some extent WABs and WMDs are dependent on user fees for their income, but staff salaries are generally assured from central funding. This raises the question of what the funds will be used for. The workload will increase for some activities, but it is likely that this will be done by reallocating staff responsibilities rather than recruiting new staff.

In most countries, such central funding is usually scarce and inadequate even to cover the recurrent costs (transport, stationery, etc) let alone staff costs. However, the concept of identifying these costs and recovering them directly from user fees is very difficult to introduce. The situation is different in the UK where the WAP system is managed by the Environment Agency which is quasi-independent and required to be financially self-sufficient. This makes the financial arrangements for WRFs transparent and straightforward. Analogous arrangements exist in many European countries but do not occur in China or most countries with large areas of irrigation.

5.2 Social impact

The social impact of WRFs is very small, although the fees should be used to finance some measures which will assist in meeting social objectives. A fully-financed water resource management system should be beneficial, as better water management should result in better access to water for the poor, although this depends on the objectives agreed. There should be adequate stakeholder participation in WRM to ensure that social objectives are incorporated and complied with.

The level of WRF is theoretically an important social consideration, but as it is just a few percent of total water cost at present, the value of the WRF itself is usually insignificant. This would only become significant if the WRF was increased to the extent that it influences demand (or makes agriculture unviable), but this is unlikely to be acceptable to the Price Bureau in the short term.

5.3 Environmental impact

A better financed water management system should enable a positive impact on the environment as the management authority will be able to monitor conditions, quantify requirements and ensure that these are allowed for in the water allocation and in conditions of abstraction permits. The extent to which this is due to

activities financed from the WRF and that due to normal activities will depend on the structure and use of the fees.

In the longer term, greater environmental improvements should be possible, if environmental externalities can be covered from increases WRFs.

6 Conclusions and Recommendations

Conclusions

The water resource fee system is an important part of IWRM, but it needs to be regarded in this wider context and implemented in conjunction with other measures, to ensure that the objectives are realistic and achievable. Key conclusions are that:

- Water resources fees are an important element of integrated water resources management, but they are just one part and need to be closely linked with many other activities to be effective – particularly the abstraction permit system – and they need to be set up in a sound institutional environment. Expectations that WRFs can, on their own, stimulate better allocation of or reduced use of water are unrealistic.
- WRFs can however raise sufficient funds to finance improved standards of WRM – including resource assessment and monitoring, water abstraction permit systems, and so on. These costs need to be evaluated accurately, so that the appropriate level of WRF can be calculated. There may be political adjustment of the fee for different users, but any decisions on this need to be taken in the context of the actual specific cost of WRM tasks.
- WRFs can increase awareness of the value of water and hence stimulate some activities for water saving but they will have little direct impact on water demand. The structure of the fees can give some indicator of relative water from different sources or for different uses.
- There needs to be an active programme of consultation and awareness-raising regarding the fees and the way they are used; consulting widely before introducing and fixing the fee level; and stimulating participation in all processes related to collection and management of fees.
- Fees will only achieve this if their purpose is clearly defined and understood, and they are managed in a transparent way. Water service charges and resource fees need to be clearly distinguished and understood, even if they are sometimes combined in the payments made by the user. WRFs are normally paid by the permit holder, but will be passed on to the user.
- WRFs are part of total financing arrangements for water – it is the total the cost of supply and not the WRF which provides the signal to the user. The WRF is typically in the range 1-10% of the total cost, so a large increase in WRF is needed to influence demand. WRFs for urban water supplies are generally at the low end of this

range (1-2%), and for irrigation if charged are at the high end (5-10%). WRFs for industrial use are very variable, depending on whether they use municipal supplies or abstract water directly from the source.

- Many organizations are involved in WRM and all of their costs need to be covered – the responsibilities and costs need to be carefully defined and agreed. The fees collected through WRF need to be shared out amongst them (and with the state, which has a 10% share defined in SCD460) – this may require further regulations at the local level.
- Differential charging may be appropriate (according to category of use, status of user, location, source etc) but needs to be kept simple otherwise the cost of collection may absorb most or even all of the fee collected. Complicated systems are usually not worthwhile, unless they can be structured to influence user behaviour, whilst still ensuring that overall all costs are covered. The system should be transparent and clearly understood by the public; the amount collected should be published along with the uses of the funds.
- Use of fees for cost recovery potentially contradicts the objective for demand reduction, if revenue of the regulatory agency is reduced as water use decreases. This is one reason for basing fees on permit volumes rather than actual volumes.
- Collection of fees on the basis of permit volumes is much simpler than on the basis of actual volumes. In theory it still gives an incentive to save water as it will encourage users to apply for a smaller permit volume. Annual collection is also much simpler than monthly collection. Seasonal collection can be a useful compromise, since the availability of water may vary strongly between seasons.

Recommendations

- Water resource fees should only be used in combination with a full range of IWRM management instruments. In particular, they should only be used where there is a fully functioning abstraction permit system in place.
- Water Resource Fees should be used primarily to recover costs of water resource management. They should be structured in a way which:
- Gives some indication of the relative value of water from different sources or for different purposes,
- Is simple and efficient to assess and calculate,
- Is easy for water users and other stakeholders to understand,
- Ensures a predictable budget for the WABs.
- Specific activities and costs to be recovered from WRFs should be identified.
- Any additional funding from other sources which are available for these activities should be explicitly identified. The combination of funds from WRFs and regular government

budgets should be planned so that they give incentives to WABs to encourage water saving without compromising their budgets.

- Responsibilities for the various activities should be defined, so that inefficient internal transactions can be avoided. These might include one part of a WAB paying WRF to another part of the same bureau.
- Incentives for both users and regulatory agencies need to be designed so that they encourage water saving. The risk of perverse incentives to some organisations should be assessed carefully.
- Basing the fees on permit volumes can still give users an incentive to be economical in the use of water, whilst being simple to manage.
- Annual collection is the simplest arrangement, although seasonal collection may be appropriate if there are large variations in availability and uses of water between seasons. Monthly collection is very labour intensive, time-consuming and costly.
- Fees should be audited, with information on costs and revenue made publicly available.
- Publicity campaigns will be needed to ensure awareness of the purpose and basis of the fees, and to foster an environmentally-aware society willing to pay greater fees to ensure sustainability.
- In the medium term, fees should be increased to cover increasing proportions of economic and environmental externalities, but this may need to be part of a wider programme in order to protect livelihoods.

Document Reference Sheet

Glossary:

WRF	Water Resource Fee
ISC	Irrigation Service Charge
EI	Economic Instrument
WAB	Water Affairs Bureau
WSC	Water Supply Company

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Where to find more information on IWRM – recommended websites:

Ministry of Water Resources: www.mwr.gov.cn

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