International Water Pricing: An Overview and Historic and Modern Case Studies

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1. The value of water: An overview of major issues

As water resources have become increasingly scarce in the last few decades, the perception of water has changed. The debate over the treatment of water as an economic good has been a prevalent part of water resource management discussions in the literature as well as in real world negotiations, as can bee seen in media reports. The topic is quite complicated, and a general overview is difficult. However, the following review attempts to present a short summary of some of the main issues related to this topic.

2. The Dublin Statement and United Nations Agenda 21

The Dublin Statement, issued from the International Conference of Water and the Environment (ICWE) held in Dublin, Ireland, in January of 1992, was a primary catalyst of the debate over treatment of water as an economic good (ICWE, 1992). Resulting from the call from 500 participants from 100 nations for fundamental new approaches to the management of freshwater resources, the Dublin Statement included within it the principle that, "Water has an economic value in all its competing uses and should be recognized as an economic good" (ICWE, 1992, Guiding Principle No. 4). This was the first explicit recognition of water as an economic good, and this principle is often found quoted in literature that has ensued since its establishment.

Shortly thereafter, this same idea was adopted by the Plenary in Rio de Janeiro at the United Nations Conference on Environment & Development in June of 1992, with some additions to the statement. Agenda 21, emanating from that meeting states, "Integrated water resources management is based on the perception of water as an integral part of the ecosystem, a natural resource and a social and economic good, whose quantity and quality determine the nature of its utilization" (United Nations, 1992).

3. The many values of water

Water is not strictly limited to the status of an economic good. It is also a social good, and it has cultural and religious value as well. In *The World's Water*, Peter Gleick illustrates the characteristics of water outside of being an economic good (Gleick, 2003).

- *Water is a social good.* Access to clean water is vital to people. Water quality affects public health in the short and the long term. Water supply management for populations involves the building of large infrastructure. Such works are best handled with public oversight.
- *Water is an economic good.* Water is a scarce resource with value in competing uses. Allocation of water resources could be optimized to maximize benefits to society.
- *Water has ecological value*. Water is not only essential for humans, but also for all life. Changing the hydrology of ecosystems threatens populations of many species.
- *Water has religious, moral, and cultural value*. Water figures into cultural and religious identities as part of rituals and symbolism. Moral values may come into play with property rights issues, when people feel they morally have a right to water.

4. Globalization, privatization, and commodification of water

Globalization, privatization, and commodification of water are all relatively new phenomena in recent

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decades. Gleick, in *The New Economy of Water*, reviews how these have changed the way water has been treated (Gleick et al., 2002).

Commodification is the transformation of a formerly non-market good to a market good. While water has on a smaller scale had a market value in the past, with the issue of the Dublin Statement on water and changes in global markets, the commodification of water has increased (ICWE, 1992).

Globalization is the process of integrating markets internationally. The uneven distribution of water across the globe, coupled with newly opened global markets, has made water an item to be traded on the global scale. Water can be traded as a bulk good or as a value-added product as bottled water. Bottled water sales have been increasing noticeably in the last decade. As the case studies in this document show, water trade as a bulk quantity is also occurring.

Privatization of water involves transferring control of all or parts of water systems from public into private hands. Privatization of water resources has been promoted as a way to improve water systems. There is a belief that business control is more efficient than government control and that the private sector can mobile capital more quickly. There are also concerns about privatization. Among many risks of privatization that Gleick outlines, privatization may result in social inequities, public ownership of the water itself may be at risk, ecosystem impacts could be ignored, and water use efficiency and water quality may not be as valued.

5. Complexities in the economic behavior of water

The question whether or not water can actually be treated as a true economic good is debated. Looking at water resources from a big picture perspective, it appears that by treating water as an economic good, pricing will improve overall allocations and encourage sustainable use. Dinar and Subramanian state that on both individual and social levels, if price reflects the value of the resource, water use efficiency will improve (Dinar and Subramanian, 1997).

Some argue that water cannot be treated like other economic goods because of its unique characteristics. Savenije outlines several characteristics (Sidebar 1) of water that, together, illuminate how it is not an ordinary economic good (Savenije, 2001). These characteristics of water lead it to behave differently from ordinary economic goods. To be effective, water pricing schemes need to be able to handle these complexities.

6. Water as a human right

As a response to the Dublin Statement identifying water as an economic good, there has been much outcry about the need to treat water as a human right (Baillat, 2005). Because water is essential to life, and there are no substitutes for it, there is concern that treating it as an economic good will leave certain people without access to needed freshwater resources. Scanlon, Cassar, and Nemes provide a review of this topic that covers many of the arguments found in the literature (Scanlon et al., 2004). In their review of international laws, conventions, and judicial decisions, they find that the human right to water has not been clearly defined by international instruments. It is implicit in existing fundamental human rights laws, and explicitly included only in non-binding instruments.

Scanlon, Cassar, and Nemes describe reasons for explicitly recognizing water as a human right. Defining water as a human right would provide more protection to people and would obligate governments to ensure water to all people. A human right to water could help to set priorities for water policy and may help to focus attention to resolve conflicts over shared waters. It also could help to safeguard other human rights and environmental principles.

Table 1: Price ranges for various sectors and countries in the analysis (in 1996 US$).

	Minimum		Maximum	
Agriculture				
Fixed (per hectare per year or season)	0.164	Bottom of range for India; range based upon state and crop	213.64	Top of range for Taiwan
Variable (per cubic meter)	0.0001	Bottom of range for Spain	0.398	Top of range for Tanzania
Domestic				
Fixed (per household per year or month)	0.075	Bottom of range for Madagascar	1937	Top of range for Portugal
Variable (per cubic meter)	0.0004	Bottom of range for Spain	2.58	Top of range for France
Industry				
Fixed (per plant per year or month)	1.67	Bottom of range for Sudan	2,705	Top of range for Portugal
Variable (per cubic meter)	0.0004	Bottom of range for Spain	7.82	Australia

Note: Values from Dinar and Subramanian, 1997, pp. 7-8.

Sidebar 1
Unique characteristics of water

- Water is essential.
- Water is scarce.
- Water is fugitive, meaning that it is a flux, and its availability varies with time; it needs to be stored for certain uses.
- Water is a system; the hydrologic cycle is all connected, and interruption to one part will affect the rest.
- Water is bulky and not easily transportable; movement of water is in most cases too expensive to transport and still meet buyer’s willingness to pay.
- Water has no substitute; no other economic good can replace it.
- Water is not freely tradable; because of the combination of it being essential but too bulky to easily move, trade is difficult.
- Water is complex.
  - It is a public good that cannot be owned privately. The societal dependency is high.
  - Water is also bound by its location of origin and its natural conveyance system.
  - Water has high production and transaction costs.
  - The market for water is not homogeneous. Willingness to pay is different for different users.
  - There are macroeconomic interdependencies between water using activities.
  - There is a threat of market failure in water supply. Because of its bulk, economies of scale lead to monopolies in water services.
  - Water has a high merit value relating to our perceptions of beauty, wellbeing and health.

7. Actual pricing of water

Dinar and Subramanian present a picture of international water prices in 1997 (Dinar and Subramanian, 1997, pp. 6–8). While these figures are now somewhat dated, no similar more recent such compilation was found, and the information presented is still quite helpful in understanding international and regional water price variations and price variations between water use sectors. Water price ranges in agricultural, domestic, and industry sectors for 22 countries are listed. Below is a summary of the minimum and maximum values reported in their analysis (Table 1).

Dinar and Subramanian state that the fixed prices of water have variable denominators in different countries (year, area, crop, water velocity, etc.), which make those figures particularly hard to compare, whereas the variable prices are more easily compared. They also state that variable prices in agricultural and domestic sectors are fairly similar in all countries, while industrial prices vary more based upon the value of industry to different cultures and their inclusion of pollution costs in the price of industrial water.

8. Full Cost Recovery

The principle of Full Cost Recovery (FCR) by definition is the pricing of a good in such a way that the entire cost of that good is recovered. This is a valuable principle to review in a general discussion of the economics of water, as it illuminates the various costs associated with water use. Full Cost Recovery is considered an option for handling increasing water scarcity and all of its effects, including environmental and human effects. This principle is described in a review of water pricing in the European Union (EU) carried out by the European Environmental Bureau (EEB) (Roth, 2001). Full Cost Recovery would include consideration of all of the following:

- Operational and maintenance costs;
- Capital costs;
- Opportunity costs;
- Resource costs;
- Social costs;

- Environmental damage costs, and
- Long run marginal costs.

Integrating social and environmental costs in an FCR framework would involve making a certain quantity available to every person and employing the Polluter Pays Principle (PPP). The PPP, in which those creating pollution have to pay the entire environmental cost, internalizes those environmental damages, rather leaving environmental costs as externalities where the public ends up paying the cost (with health care bills or otherwise). This is often quite difficult to quantify.

The basic premise of FCR is that the representation of the true cost of water in all sectors will cause users to value water at its real cost and will help the allocate water to where it is most valued. The EEB recognizes that FCR is a lofty goal, and will be difficult to achieve fully. However, they list recommended elements to move toward it. These are as follows (Roth, 2001):

- Public awareness and participation;
- Full cost recovery must include environmental costs;
- Metering and pricing schemes for all sectors;
- Increasing block schedules, in which prices increase with larger volumes of water consumed;
- Seasonal variations;
- Earmarking of water charges;
- Minimizing fixed and minimum charges;
- Providing information to water users;
- Providing an understandable bill;
- Transparency, and
- A gradual transition to new pricing schemes.

9. Conclusion

Discussion of the value of water involves a great breadth of topics. Because it is the most essential component of life on the planet and it is also treated as a good in civilization's advanced trade regimes, analysis of water's role along the whole continuum from the rudimentary end to the technologically evolved end is necessary to appreciate its full role on this planet.

10. Case studies

A set of case studies was compiled to highlight characteristics of water pricing. Case studies of international water transfers and trades were sought, but certain domestic water pricing case studies where pricing is well defined were also included. Both historic and recent case studies are presented. As water pricing is a deeply complex issue and influenced by a wide array of factors ranging from local to global in scale, a clear and concise comparison from one case study to another is difficult. Rather, this summary of many real world scenarios, where costs/prices are at least partially stated, is provided to give the reader a perspective of the range of ways in which the price of water has been considered in water provisions to date.

10.1. Historical cases

The Transboundary Freshwater Dispute Database (TFDD) is a project of Oregon State University's Department of Geosciences that includes information on international freshwater treaties and water events as well as spatial information on international basins. The International Freshwater Treaties Database, a component of the TFDD, contains information on more than 400 international freshwater-related agreements, covering years 1820 to 2002 (TFDD, 2007). The database was searched to find historical cases that defined the value of water in water transfers. Queries were conducted for agreements with the criteria of water quantity as the principal issue area and capital as a linkage within the agreement. All information presented in this section is derived from the TFDD unless otherwise noted in the text.

Some agreements with stated price considerations define the value of raw water explicitly. Others tie the value of the water to irrigation or hydropower. In some cases, the value of the raw water is implied to be zero. There does not appear to be a consistent way of valuing water in these historic cases. Conversions to 2005 U.S. dollars were made for easier understanding of the price terms of agreements. Calculations do not represent a rigorous analysis and are intended to provide a general idea of modern day equivalent value.

10.1.1. Agreement: Amended terms of agreement between the British Government and the State of Jind, for regulating the supply of water for irrigation from the Western Jumna Canal

Basin: Indus
Date: September 16, 1892
Parties: Great Britain, State of Jind (a state in India)
Summary: The British Government agreed to supply the State of Jind with water from the Hansi Branch of the Western Jumna Canal through ten main distributaries. Gauges would be placed at each distributary, and the British were to be in charge of monitoring these.
Price considerations: The construction of the distributaries would be done at the cost of the British government, but when completed, it would be handed to the Jind State with the exception of some parts. The distributaries would be kept in repair by the Jind State, and a deduction from the annual charge would be made accordingly. In return for the irrigation water, the State of Jind agreed to pay the British Government an amount annually based on an area of 50,000 acres, and a rate per acre calculated as the average of similar rates in other British territories. The price for the water was set at 2.4 rupees (approximately US$17 in 2005 equivalent[3]) per acre, with deductions for maintenance, establishment savings, and fees to local agricultural supervisors. Prices are listed in the treaty as shown below (Table 2).

10.1.2. Agreement: Agreement between the British government and the Patiala state regarding the Sirsa Branch of the Western Jumna canal

Basin: Ganges
Date: August 29, 1893
Parties: Great Britain, State of Patiala (a Punjab state in India)
Summary: The British Government planned to build infrastructure to supply water from the Western Jumna Canal to British and Patiala territory. The British government was to have exclusive control of the project as it was built; 5 years after completion, control of Patiala distributaries would be transferred to the Patiala State.
Price considerations: The British and Patiala governments agreed to share the cost of infrastructure building and maintenance, with the British billing the Patiala for their portion of the infrastructure annually. After completion of the waterworks, the Patiala state would then also pay the British government an annual sum for the Jumna water based upon amount of land irrigated. The price of water per year agreed upon is shown in Table 3.

The estimated acreage was based on the amount of land irrigated during the year from the British Distributaries and the relative proportions of the supplies actually passed in the British and Patiala Distributaries during the same period. The Patiala State agreed to furnish the British government with half-

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[3] Rupee to pound 1892 exchange rate obtained from Catão and Solomou, Effective exchange rates and the classical gold standard adjustment, *American Economic Review*, (95)4:1259-1275, September 2005. Conversion of 1892 pounds to 2005 US Dollars by Officer and Williamson, Computing 'real value' over time with a conversion between U.K. Pounds and U.S. Dollars, 1830-2005, *MeasuringWorth.com*, August 2006.

yearly statements for each harvest with information regarding area irrigated, income derived, and working expenses related to the Patiala distributaries.

Each state was entitled to all revenue that would be assessed on account of irrigation or sales of water for other purposes in their own villages, regardless of whether the water was supplied from British or Patiala distributaries.

Table 2: Water Prices in the 1892 Amended terms of agreement between the British Government and the State of Jind, for regulating the supply of water for irrigation from the Western Jumna Canal.

Gross sum payable		Rs.
50,000 acres and Rs. 2.4 per acre		120,000
Deductions	Rs.	
(1) Maintenance and repairs	5,000	
(2) Establishment savings	3,500	
(3) Fees to Lambardars and Patwares	6,000	
		14,500
Net amount payable per annum		105,500 (2005 US$760,000)

Note: The cost of the raw water is tied to its irrigation value and is not stated explicitly.

10.1.3. Agreement: Final working agreement relative to the Sirhind Canal between Great Britain and Patiala, Jind and Nabha

Basin: Sirhind Canal
Date: February 24, 1904
Parties: Great Britain, State of Patiala, State of Jind, State of Nabha
Summary: Flow allocations from the Sirhind Canal were agreed to in the following proportions: Patiala, 83.6%; Nabba, 8.8%; Jind, 7.6%.
Price considerations: Costs for the establishment of infrastructure and management were to be borne in the same proportion as the flow allocations. In addition, charges for water supplied to British villages from the Patiala Branches were "not to exceed the charges which are livable under the schedule of rates in force on the British and Signatory States." Further language in the text of the agreement states that measurements of land irrigated would be made to determine rates. While these rates were not laid out explicitly in the agreement, they may be similar to rates found in earlier agreements between the British government and states within India.

Table 3: Water Prices in the 1893 Agreement between the British government and the Patiala state regarding the Sirsa Branch of the Western Jumna canal.

Estimated area in acres	Rate of seigniorage per acre	Value in 2005 US$[4]
<42,000	Nil	Nil
42,000 – 43,999	One anna[5]	1 anna = 1/16 rupee = 1893 £ 0.0042 = 2005 US$0.45
44,000 – 45,999	Two annas	US$0.90
46,000 – 47,999	Three annas	US$1.35
48,000	Four annas	US$1.80

10.1.4. Agreement: Convention regarding the water supply of Aden between Great Britain and the Sultan of Abdali

Basin: Aden (groundwater)
Date: April 11, 1910
Parties: Great Britain, Aden (Yemen)
Summary: The Sultan of Abdali, on behalf of himself and his heirs, agreed to grant the British Government sole use of a piece of land east of Wadi-As-Saghir in perpetuity for the purpose of developing a groundwater resource. The land allocated to developing the groundwater resource would be approximately 110 acres in area. The Sultan of Abdali agreed to guarantee no contamination of the wells, to provide facility to construct and maintain the works, and to safeguard the work and those working there. In return, the British Government agreed to pay a monthly rate in return.
Price considerations: Great Britain was to pay 3,000 rupees (approximately US$17,400 in 2005 equivalent6) per month. No quantity of water was specified for this fee. If the water was diminished due to damage by Subehis or Abdalis, a maximum amount of 15 rupees (2005 US$111) per 100,000 gallons would be paid. In addition, 1,000 rupees (2005 US$5800) would be paid to land-owners for land on which the wells were dug.

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[4] Rupee to pound 1893 exchange rate obtained from Catão and Solomou, Effective exchange rates and the classical gold standard adjustment, *American Economic Review*, (95)4:1259-1275, September 2005. Conversion of 1893 pounds to 2005 US Dollars by Officer and Williamson, Computing 'real value' over time with a conversion between U.K. Pounds and U.S. Dollars, 1830-2005, *MeasuringWorth.com*, August 2006.

[5] An anna is a former currency. One anna = 1/16 rupee.

[6] Rupee to pound 1910 exchange rate obtained from Catão and Solomou, Effective exchange rates and the classical gold standard adjustment, *American Economic Review*, (95)4:1259-1275, September 2005. Conversion of 1910 pounds to 2005 US Dollars by Officer and Williamson, Computing 'real value' over time with a conversion between U.K. Pounds and U.S. Dollars, 1830-2005, *MeasuringWorth.com*, August 2006.

10.1.5. Agreement: Exchange of notes between the United Kingdom and Italy respecting the regulation of the utilisation of the waters of the River Gash

Basin: Gash

Date: June 15, 1925

Parties: Great Britain, Italy

Summary: The governments of Great Britian and Italy approved of the agreement between the Governor of the Colony of Eritrea and the Acting Governor General of the Sudan regarding water from the Gash flowing from Eritrea into the Kassala province of the Sudan. Eritrea was allocated 65 million cubic meters of water (or a mean discharge of 15 cubic meters per second for 50 days) to irrigate the Tessenei plain, an area of approximately 20,000-25,000 hectares. In order to safeguard the interests of both Eritrea and Kassala in times of water shortage, the water was to be divided as follows:

> "Since it would not be for the practical advantage of either territory to divide the very small supplies, we would leave the first 5 cubic metres per second at the complete disposal of Tessenei. The division of the supply from 5 up to 20 cubic metres per second should be made in such proportionately progressive manner that, when 20 cubic meters per second is reached, the partition will be 10 cubic meters per second to each."

It was agreed that water in excess of 65 million cubic meters would flow to the Kassala province. Later on April 18, 1951, Eritrea and Sudan signed an agreement to reaffirm established water quantities, with Eritrea receiving a maximum of 65 million cubic meters. The new agreement was signed by Eritrea and Sudan as independent nations.

Price considerations: The Sudan Government agreed to pay the Government of Eritrea annually based upon profits from irrigated land. Sudan would pay 20% of the sum of profits made due to cultivation by irrigation in excess of £50,000 (approximately US$2.65 million in 2005 equivalent[7]). The yearly amount due would be calculated using the yearly statements of the Kassala Cotton Company.

10.1.6. Agreement: The Indus waters treaty 1960 between the Government of India, the Government of Pakistan and the International Bank for Reconstruction and Development

Basin: Indus

Date: September 19, 1960

Parties: India, Pakistan, International Bank for Reconstruction and Development

Summary: India and Pakistan signed this agreement regarding the use of different parts of the Indus River system. The water system is divided primarily into the "Eastern Rivers," including the Sutlej, the Beas, and the Ravi; and the "Western Rivers," including the Indus, the Jhelum, and the Chenab. All the waters of the Eastern Rivers were to be available for the unrestricted use of India, and Pakistan was to receive unrestricted use of the Western Rivers. India and Pakistan agreed to let all the waters allocated to the other party to flow freely.

Price considerations: Because the water from Western Rivers and other sources were designed to replace water that would have previously been provided by the Eastern Rivers to Pakistan, India agreed to make a fixed payment of £62,060,000 (approximately US$1.33 billion in 2005 equivalent8) toward the cost of infrastructure necessary to deliver Western Rivers water to Pakistan. This was to be paid in ten equal annual

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[7] Conversion of 1925 pounds to 2005 US Dollars by Officer and Williamson, Computing 'real value' over time with a conversion between U.K. Pounds and U.S. Dollars, 1830-2005, *MeasuringWorth.com*, August 2006.

[8] Conversion of 1960 pounds to 2005 US Dollars by Officer and Williamson, Computing 'real value' over time with a conversion between U.K. Pounds and U.S. Dollars, 1830-2005, *MeasuringWorth.com*, August 2006.

installments. A Transition Period of ten years in duration was outlined in which the replacement of Eastern River water with Western River water in Pakistan would be completed. If the Transition Period were extended, India would be repaid a portion of its payment. Volumes of water are not discussed, and costs agreed to in the treaty involve infrastructure building; the value of the water is implied to be zero.

10.1.7. Agreement: Exchange of notes constituting an agreement between the United States of America and Mexico concerning the loan of water of the Colorado River for irrigation of lands in the Mexicali Valley

Basin: Colorado
Date: August 24, 1966
Parties: United States, Mexico
Summary: In order to relieve a critical water shortage in the Mexicali Valley, the United States agreed to release an additional 40,535 acre-feet of water from the Colorado River beyond the annual allocation to Mexico (annual allocation determined in 1994 water treaty). The International Boundary and Water Commission was to agree to a schedule for water deliveries in the 1967 calendar year. In the case that runoff in the Colorado River Waters in the United States from April to July 1967 was expected to exceed 8.5 million acre-feet, the 40,535 acre-feet reserved for Mexico would be held for 3 years.
Price considerations: Mexico agreed to reimburse the United States at market value for any decrease in power generation at Hoover and/or Glen Canyon Power Plant that would be caused by the loss of power resulting from the release of the agreed 40,535 acre-feet. The value of the water is tied solely to its hydropower generation capabilities; the value of the raw water in this agreement is implied to be zero.

10.1.8. Agreement: Agreement between the Government of the Republic of South Africa and the Government of Portugal in regard to the first phase of development of the water resources of the Cunene River Basin

Basin: Cunene
Date: January 1, 1969
Parties: South Africa, Portugal
Summary: This agreement was designed to optimize utilization of the water resources of the Cunene River Basin, and aimed to achieve several benefits as follows:

- Regulation of the flow of the Cunene
- Improvement of hydroelectric power generation at Matala
- Irrigation and water supply for human and animal needs in the middle Cunene
- Water supply for human and animal needs in South West Africa and irrigation in Ovanboland
- Hydroelectric power at Ruacana
- The parties agreed to pursue four major works as follows:
- A dam at Gove for Cunene flow regulation
- A dam at Caluque for Cunene flow regulation
- A pumping scheme at Caluque from the Cunene for human and animal needs in South West Africa and irrigation in Ovanboland
- A hydroelectric power station at Ruacana for power in South West Africa

Price considerations: The costs for each work were allocated to the party who would benefit from them. The building of the Gove dam was the responsibility of the Portugese government. South Africa was to participate in the financing of the Gove dam in all parts related to flow regulation, and not hydroelectric power. Its financial obligations to Portugal were limited to R 8,125,000 (approximately US$39 million in

2005 equivalent[9]). The cost of construction of the works at Caluque was to be entirely the responsibility of South Africa, as they would be benefiting from the water. South Africa agreed to pay the Portugese government R 220,000 (2005 US$1.1 million) as compensation from the ground occupied by the Caluque dam. South Africa also agreed to be entirely responsible for the costs of construction and operation of the Ruacana power station, though they were granted use of Portugese territory occupied by the Ruacana works for free by the Portguese government. South Africa was, however, to pay the Portugese government a royalty based on the forecast of power generation at Ruacana. This was estimated to be the same cost as the payments for construction of the Gove dam.

No specific charge for raw water is stated in this agreement.

10.2. A special note on Turkey

In the last decade, Turkey has actively pursued becoming a leader in exporting water. It is the only Middle Eastern country with a substantial natural supply of water. It has massive water projects within its borders, such as the GAP, or Southeast Anatolia Project. It also has the Manavgat Water Supply Project, which it has hoped would become a hub for water exports to other countries in the region.

Turkey has sought to promote its water export vision as an instrument for peace in the Middle East (*Turkish Daily News*, 1999). It has held a plan of ultimately being able to harness much of the total supply of the Manavgat water, which is nearly 5 billion m^3 per year (Morris, 2000), and is reported to have discussed water exports with many countries, including Cyprus, Israel, Libya, Malta, Greece, and Jordan. Its vision has not yet been realized, some of which has been attributed to poor governance of water policy (*Turkish Daily News*, 2001).

10.2.1. Agreement: Agreement of Water Transportation to the Turkish Republic of Northern Cyprus from Turkey

Parties: Turkey, North Cyprus, Inbar Water Distribution Company
Date: Agreement signed on 2003, but water transport had been taking place since 1998
Issue: Transport of water from Manavgat River in Turkey to North Cyprus
Summary: North Cyprus has experienced decreased precipitation in the last few decades. Over-drafting of groundwater resources has led to saltwater intrusion in aquifers. The use of saline water for irrigation has resulted in the killing of citrus crops and made some water unsafe for drinking. One of the main solutions considered to the water shortage is the importation of water from Turkey.

In 1999, a Harvard Institute for International Development paper outlined the financial feasibility of importing 40,000 m^3 water by tankers per year from the Manavgat River in Turkey to North Cyprus (Biçak and Jenkins, 1999). Annual demand for water in North Cyprus is 106.6 million m^3, 82% of which is for agriculture. Safe yield from aquifers is about 74 million m^3, and rivers and dams can provide approximately 13 and 7 million m^3, respectively. Thus the water deficit of North Cyprus is approximately 12.5 million m^3 per year, and this deficit had been accommodated by over-pumping of the aquifers, leading to salt water intrusion.

Price considerations: Biçak and Jenkins (1999) lay out in detail the total estimated costs for all parts of water import by water tanker. The cost of transportation of the water is US$0.4/$m^3$. With infrastructure investment added to this figure, the cost is estimated as US$0.79/$m^3$. Leakage of 30% in the distribution system would

[9] South African Rand to US Dollar 1969 exchange rate obtained from Williamson, S.H. (2006). Exchange rate between the United States dollar and forty other countries, 1913-2005. EH.Net (supported by Economic History Association). Conversion of 1969 Rand to 2005 US Dollars by Officer and Williamson, Computing 'real value' over time with a conversion between U.K. Pounds and U.S. Dollars, 1830-2005, *MeasuringWorth.com*, August 2006.

increase total cost to US$1.13/$m^3$. None of these costs account for any charge for the raw water, but the authors estimate that Turkey would charge US$0.15/$m^3$.

In a paper presented at the Water for Life in the Middle East Conference in 2004, Mithat Rende, the head of the Department of Regional and Transboundary Waters in the Ministry of Foreign Affairs of Turkey, reviewed the history and outlook for water transfer from Turkey to North Cyprus (Rende, 2004). He stated that initially Turkey had signed an agreement in 1997 for transport via water bags, a technology out of Norway, with Nordic Water Supply, with a price of 55 cents per m^3. However, that technology failed (Morgan, 2002).

The current agreement for water transport is with an Israeli company to transport water via a "new technology" to Cyprus, the agreed cost of which would be 60 cents per m^3. In addition, the project of water transfer via pipeline to North Cyprus was approved by the Turkish government in 1998, and movement toward that goal is anticipated. Following this 2004 conference, the *Turkish Daily News* reported that a $9.5 billion deal had been signed to construct the 78-km pipeline (*Turkish Daily News*, 2005).

10.2.2. Agreement: Intergovernmental agreement between Turkey and Israel

Parties: Turkey, Israel
Date: March 2004
Issue: Transport of water from Manavgat River in Turkey to Israel
Summary: For several years, Israel and Turkey have discussed the option of water transport from Turkey's Manavgat River to Israel. Increasingly dry conditions in the late 1990s and early 2000s prompted Israel to more seriously pursue an agreement with Turkey. In August of 2002, Israel agreed to buy 50 million m^3 of water annually for 20 years. However, a price was not determined at that time. After a few years of negotiations, an agreement was signed in March 2004. Israel and Turkey agreed to a "water for arms" deal, in which Turkey would supply water to Israel, and Israel would provide certain hi-tech weapons to Turkey (*U.S. Water News Online*, 2002).

In April of 2006, movement forward on this water transport project halted. Both governments agreed it was not feasible, but hoped to return to it in the future (*U.S. Water News Online*, 2006). The reasons cited for such a decision were the rising price of oil and the privatization of the water treatment facilities on the Manavgat River, both of which have contributed to raising the price of the water transport project (*Turkish Daily News*, 2006).

Price considerations: While Israel and Turkey appeared to keep the price component of the negotiation mostly private, a few figures have been published. Citing Blanche (2001), Feehan (2001) states that Turkey was asking for US$0.23 per m^3 for the water, making overall cost to Israel US$0.55-0.60 per m^3. However, Israel was hoping to get a price of US$0.15 per m^3 for the water, with the overall price with tanker, etc., to be US$0.50-0.55 per m^3. The Washington Institute for Near East Studies states the estimated cost of water imported from Turkey to be around US$0.80 per m^3 (Washington Institute for Near East Studies, 2003). In all prices mentioned, it does appear that Turkey was planning to charge for the raw water.

10.3. Modern cases

Information on modern case studies was sought from a much broader array of resources. The following studies are summaries of various agreements or provisions of water transfers or allocations. The price considerations vary significantly from one study to the next, but represent an array of real world situations that illuminate how the cost of water is handled in different circumstances.

10.3.1. Agreement: Treaty on the Lesotho Highlands Water Project between the Government of the Republic of South Africa and the Government of Lesotho

Parties: Lesotho, South Africa
Date: October 24, 1986
Issue: Creation of massive works in Lesotho to transfer water from the Senqu/Orange *River to South Africa*
Summary: Lesotho, a small country bordered on all sides by South Africa, has a relative abundance of water compared to its population. Water of the Senqu/Orange basin is of high water quality. South Africa suffers from water shortages. The objectives of the Lesotho Highlands Water Project (LWHP) are to provide a high quality water source for South Africa and to create hydropower and revenue for Lesotho from the transfer of the water (Lesotho Highland Development Authority, 2006). The LHWP is a massive infrastructural undertaking that has many phases of development, and has involved many contractors to complete the work. When it is completed, it is estimated that 40% of the Senqu River flow will be transferred to South Africa, and 70 m^3/sec will be available (Baillat, 2005). Planning for the LWHP was completed in 1986. The start of Phase I happened in 1987, and contracts were first awarded in 1988. In the span of 1997-99, the Katse Dam was completed, water was delivered to South Africa, and hydropower was inaugurated (Trans-Caledon Tunnel Authority, 2006b). While serious problems with bribery by contractors have come to light in the last 3 years (*Africa News*, 2006; *Comtex News Network*, 2004; *Global News Wire*, 2003), the project is still seen as a successful needs-based water transfer.

Price considerations: In the Treaty on the Lesotho Highlands Water Project (Lesotho and South Africa, 1986), South Africa agrees to be financially responsible for implementation, operation, and maintenance of that part of the project relating to water delivery to South Africa (Lesotho and South Africa, 1986, Article 10(1)), while Lesotho agrees to be responsible for implementation, operation, and maintenance of the part of the project relating to the hydropower generation in the Kingdom of Lesotho (Lesotho and South Africa, 1986, Article 10(2)). Although the water is not explicitly priced, royalty payments are made by the government of South Africa to the government of Lesotho. The determination of royalty payments from South Africa to Lesotho is based mostly upon a comparison to an alternative project called the Orange-Vaal Transfer Scheme (OVTS), in which water from the Orange River in South Africa would have been transferred to the Vaal Dam. Cost analyses of the OVTS and the LWHP showed the LWHP to be a more cost-effective option. The payment of royalties is, at least in large part, recognition of this cost difference, with the estimated difference between the two projects being shared 44%:56%, South Africa and Lesotho respectively. The Trans-Caledon Tunnel Authority (TCTA), the South African agency managing the project, highlights on their website that “Africa does not pay for the water. Lesotho does receive a financial benefit but for different reasons” (TCTA, 2006a). Baillat, in a review of the LHWP, states that “For South African officials, water is not an international commodity” (Baillat, 2005, p. 14). However, *Africa News* reports that water is called “white gold” in Lesotho, and says it is the largest single source of foreign exchange (*Africa News*, 2004).

The royalty payments consist of both a fixed and variable component. The fixed component is based on the calculated difference between the estimated benefit of the OVTS project and the LHWP, and is paid monthly to Lesotho through the year 2045. The variable component will be paid in perpetuity as long as South Africa receives water. The calculation of this component relates to the difference in electricity, operation, and maintenance costs (Lesotho and South Africa, 1986, Article 12(10b-c)).

Water deliveries and royalty payments made from 1999-2005 are shown in Table 4. As of 2004, royalties made up about 6% of government revenue. In addition to royalty payments, hydropower revenues from 1998 to 2004 had contributed M297 million and substituted for electricity imports from South Africa (Healing, 2005).

Table 4: Water deliveries and royalty payments, 1999-2005.

Year	Water Delivered	Royalty Payments
1999-2000	540	M147
2000-2001	574	M158
2001-2002	584	M183
2002-2003	585	M206
2003-2004	687	M208
2004-2005	314	M102

Note: Deliveries are in million cubic meters, and royalty payments are in million Maluti. Figures from LHDA, 2004.

10.3.2. Agreements: Tebrau and Scudai Rivers Water Agreement and Johore River Water Agreement

Parties: Malaysia, Singapore
Date: 1961 and 1962 for each agreement, respectively
Issue: Transfer of water from Johore State of Malaysia to Singapore
Summary: Singapore is an island state that, while it receives a significant amount of rainfall, is water stressed due to its low per capita availability of water. To meet these supply shortfalls, Singapore imports water from neighboring Malaysia. Singapore receives approximately 40% of its raw water supply from the state of Johore in Malaysia through a pipeline (Onn, 2005). An original agreement between the Sultan of Johore and the Town of Singapore was signed in 1927 (Johore and Singapore City Council, 1927), when both Singapore and Malaysia were colonies of Britain. This initial agreement was succeeded by agreements in 1961 and 1962. Under the 1961 agreement, known as the "Tebrau and Scudai Water Agreement," Singapore could draw 86 million gallons of water per day (mgd) from the Tebrau and Skudai Rivers and the Pontian and Gunung Pulai Reservoirs. This agreement expires in 2011 (Johore and Singapore, 1961). Under the 1962 agreement, the "Johore River Water Agreement," Singapore can draw up to 250 mgd of water from the Johore River. This agreement expires in 2061 (Johore and Singapore, 1962). Both agreements were upheld in the 1965 Separation Agreement, in which both Singapore and Malaysia became separate independent countries (Malaysia and Singapore, 1965). In 1990, an agreement to draw additional water in excess of 250 mgd from the Johore River was signed, and expires in 2061 (Johore and Singapore, 1990). In addition to receiving raw water from Malaysia, Singapore also returns treated water to Malaysia. The terms of both the 1961 and 1962 agreements have provisions for review of water prices after 25 years (Johore and Singapore, 1961, section17; Johore and Singapore, 1962, section 14), and water price has been hotly debated in the last decade.
Price considerations: Under the 1927 agreement, Singapore paid nothing for raw water from Johore, but it was responsible for the cost of the infrastructure to transport, store, and treat the water. In both 1961 and 1962 agreements, Singapore pays Malaysia 3 sen (RM 0.03) for every 1000 gallons (4,546 m^3) drawn from the Johore state (Johore and Singapore, 1961, section 16(i); Johore and Singapore, 1962, section 13(1)). In return, Malaysia pays Singapore 50 sen (RM 0.50) for every 1000 gallons of treated water (Johore and

Singapore, 1961, section 16(ii); Johore and Singapore, 1962, section 13(2)). Singapore is responsible for the cost of infrastructure. Provisions of the agreements allow for prices to be modified according to the purchasing power of money and labor, power, and material costs for supplying water (Johore and Singapore, 1961, section 17; Johore and Singapore, 1962, section 14). Prices were not revised upon the first such opportunities in 1986 and 1987 for the 1961 and 1962 agreements, respectively (Onn, 2005).

In recent years, much argument about the price of the water has ensued between Singapore and Malaysia governments. Segal, in a master's thesis reviewing the water situation between Malaysia and Singapore, states that political tensions between the two states have existed since Singapore's independence, and the issue of water has been used as a bargaining tool. Ethnic tensions exist between the states lead to conflict. In addition, Malaysia's experience of water shortages and its uncertainty about its own future water needs make water negotiations difficult (Segal, 2004).

Malaysia wanted to raise the price of water to Singapore to 60 sen per 1000 gallons (Ng, 2001 and Yian, 2001 as cited in Segal, 2004). Singapore states that in September, 2001, it proposed to revise the current price to 45 sen per 1000 gallons and agreed to Malaysia's price of 60 sen per 1000 gallons for additional water to be supplied after current contracts expire (Singapore Ministry of Foreign Affairs, 2006). Despite these negotiations, a new agreement has not yet been reached. Singapore has also been developing plans for alternative freshwater resources including desalination and recycled water ("NEWater") (Onn, 2005).

10.3.3. Arrangement: Transport of water to various small island states

Parties: Various mainland states with small island nations

Date: Early 1980s to present

Issue: Provision of emergency supplementary freshwater supplies to small island states

Summary: The Pacific Islands Applied Geoscience Commission (SOPAC) categorizes island freshwater resources into conventional and nonconventional groups. Conventional resources include rainwater, surface water, and groundwater. Non-conventional resources require a greater level of technology to supply. These include desalination, importation, and the reuse of wastewater or the use of saline water for non-potable uses (SOPAC, 2006). Several Pacific island states have experienced water shortages using their own conventional, or naturally available, sources and have handled these shortages by the importation of water via tanker. Nauru, and island fully exploited for its phosphate deposits, received around 30 percent of its water as return cargo in ships returning from delivering phosphate exports (Jacobson and Hill, 1988; *This American Life*, 2003). Many other states are known to have received water in tankers in recent decades (UNESCO, 1991).

Price considerations: Island states have few cost-effective options for supplementing water supply beyond natural island resources. Unless located very near a mainland, imported bulk water can only practically be done by tanker. While the price of all these types of water transfers is not known precisely, both UNESCO and UNEP report prices of a few water imports by barge to island nations. Citing Meyer (1987), UNESCO states that transportation costs for water tankers are between US$1.50 to US$3.50 (1985 value) per m^3, depending on distance traveled and the size of the tanker. In addition, loading costs are between US$0.20 and 0.75 per m^3 and oil removal costs are between US$0.05 and 0.20 per m^3. For small island states, large tankers are often not practical because of port needs. In some cases, barges towed behind small ships are best. In the mid-1980s, the cost for transporting water from Dominica over distances of 100 to 100 km ranges from US$1.40 to 5.70 per m^3 for barges and US$1.60 to 3.30 per m^3 for ships between 20,000 and 80,000 dwt. UNEP specifically gives the cost of transporting water from Dominica to Antigua as US$20 per 1000 gallons (UNEP, 1998). Citing Brewster and Buros (1985), UNESCO also gives figures for transport from Puerto Rico to St. Thomas in the early 1980s. The cost of water transport via tanker and barges with capacities ranging from 3,800 to 11,500 dwt over the distance of 100 km was US$4.65 per m^3.

UNEP (1998) reports costs of transporting water in the Bahamas between Andros Island and New Providence as US$3.41 per 1000 gallons including fuel costs. When shore costs are included, the total cost is approximately US$5.41 per 1000 gallons. UNEP also states that economies of scale, when water is transported using larger tankers continuously over the long term, reduce the cost.

Though the development of water bags, known as "Medusa bags," as described in the case study of water transfer from Turkey to North Cyprus, were a very hopeful development for water importation to islands; that technology has not yet succeeded, as bags were shown to burst when in use (Morgan, 2002). As such, transportation by water tanker, as was available at the time these figures were reported, is still the most viable option. The technology of this type of water transfer has not likely changed much, and the prices stated in the 1987 study may not be dissimilar to those that would be expected for a similar transport in the current day.

10.3.4. Agreement: Dongjiang water supply agreement

Parties: China, Hong Kong
Date: April 2006
Issue: Transfer of water from Guangdong Province in China to Hong Kong
Summary: Hong Kong has received a significant portion of its freshwater supplies from the Guangdong Province of China since the 1960s. Agreements over the provisions of this water transfer have gone through much iteration. In 1989, an agreement between Hong Kong and Guangdong secured 690 million to 1.1 billion m^3 per year, increasing from 1995 to 2008. Dongjiang, or the East River, is the source of the water from the Guangdong Province that is supplied to Hong Kong. Transferred through a series of dams and open channels and a pipeline, it supplies over 70% of the total freshwater demand of Hong Kong (Hong Kong Water Supplies Department, 2006b).

A new water supply deal was signed in April of 2006. The new deal specifies an annual supply of 1.1 billion m^3 per year to Hong Kong, and allows for seasonal fluctuations, with Hong Kong alerting Guangdong authorities of demand. This should aid in minimizing overflow of reservoirs, which amounts to a large overall loss of water to Hong Kong (Ng, 2006).
Price: The price of water, which was specified as HK$3.085 per m^3 in the 1989 agreement, will remain at that price in the 2006 agreement. Because of rising prices on the mainland, it is considered a savings to Hong Kong to maintain the earlier rate. This is the price of the delivered raw water to Hong Kong, and includes costs of infrastructural resources and investment for projects done to protect water supplies and improve water quality (Ng, 2006). Hong Kong water users pay for water based on a tiered fee system, which is designed to subsidize lower volume users (Hong Kong Water Supplies Department, 2006a).

10.3.5. Legislation: Water Resources Protection Act of 1999 in Newfoundland and Labrador, similar legislation in other Canadian provinces

Parties: Canadian provinces
Date: Legislation in 1999 for Newfoundland and Labrador, late 1990s and early 2000s for other provinces
Issue: Canadian exports of bulk water
Summary: Bulk water exports from Canada have been considered, but public outcry about this issue has led provinces to pass legislation banning the bulk export of water. One such example is *The Water Resources Protection Act of 1999* (Newfoundland, 1999, ch. W-4.1), in which the Government of Newfoundland and Labrador prohibited bulk water removal. Debate on this topic did not end with the legislation, and the government commissioned a review of the current legal, trade, environmental and economic aspects of bulk water exports (Government of Newfoundland and Labrador, 2001).

In this particular situation, the definition of water as either an economic good or a non-economic good is pinnacle to the debate. It is as yet unclear how the prohibition of bulk water exports such as this fit into international trade agreement such as NAFTA and GATT trade provisions (refer to Baillat, 2005 and Gleick, 2003 for a detailed discussion on this topic).

Price considerations: As part of the government report on bulk water exports, an economic feasibility study was commissioned (Feehan, 2001). The main conclusions of the study as stated in the government report are as follows (Government of Newfoundland and Labrador, 2001):

- "Most bulk water export operations are capital intensive;
- Tanker transport costs, at moderate or high rates, make bulk water export uneconomic;
- At "low" tanker costs, a few bulk export operations might be commercially viable, if aimed at displacing desalinated water in the U.S. southeast. Profit margins, however, would likely be very thin;
- Rationalized U.S. water policies (such as eliminating subsidies for agriculture) or further improvements in desalinization techniques would eliminate any chance of a U.S. market;
- There might be some opportunities for the supply of bulk water to bottling plants located outside North America. Competition there would be stiff;
- The potential employment and royalty benefits of a bulk water export project are relatively small.
- Only a few sites, if any, would be commercially viable, and
- Alaskan bulk water ventures have been proposed over the past six or seven years, and there are still no exports.

Feehan's economic feasibility report includes figures for the direct use and marginal value of water as well as projected costs for transport by tanker. These figures are quite extensive and can be obtained from the original report. He summarizes his synthesis of all this cost data into what he calls a "back-of-the-envelope" overall cost estimate:

> "Assuming that relatively large tankers, 250,000 to 325,000 dwt, are used; that tanker day-rates tend to the middle and low ranges given in Table 6; and that the markets are about a 15-day return trip away; then the tanker costs would be US$1.25 to US$2.50 per m^3. Adding an allowance of US$0.10 to US$0.50 for non-tanker costs, gives US$1.35 to US$3.00 a cubic metre. Longer distances, delays due to weather or ice or technical conditions, or tight tanker markets could add substantially to those figures. On the other hand, a return to a slack tanker market, strategic location of a facility or the possibility of some partial back-haul cargo could perhaps result in a somewhat lower cost. For the remainder of this report, the estimates of US$1.35 to US$3.00 per m^3 is a reasonable point of reference for the cost of harvesting and shipping water from the province to Florida, Texas and the Caribbean" (Feehan, 2001).

In addition, he later states that there would also be environmental and public costs for exporting water, which he does not attempt to quantify.

Related issue: The legality of government prohibitions to bulk water exports are being challenged by Sun Belt Water, Inc., a company based out of California who in 1991 signed a contract for bulk water delivery from Canada to the American Southwest. Shortly thereafter, the government of British Columbia killed this contract with similar actions as outlined above by the Newfoundland and Labrador. In 1999, Sun Belt Water, Inc. filed a claim under Chapter 11 of the North American Free Trade Agreement to challenge the actions of the government of British Columbia (Sun Belt Water, Inc., 2006). This dispute is yet unresolved.

10.3.6. Directive: Directive 2000/60/EC of the European Parliament and of the Council (EU Water Framework Directive)

Parties: EU member countries
Date: October 23, 2000
Issue: Water resources management in EU member countries
Summary: In recognition of scarce water resources in European countries, the European Union put forth a Framework Directive in 2000 to outline provisions for water resource management in member countries. Article 9 of the Directive addresses recovery of costs for water. The full text of Article 9 is as follows (European Parliament and the Council of the European Union, 2000):

- Recovery of costs for water services
- Member States shall take account of the principle of recovery of the costs of water services, including environmental and resource costs, having regard to the economic analysis conducted according to Annex III, and in accordance in particular with the polluter pays principle.
- Member States shall ensure by 2010:
  - that water-pricing policies provide adequate incentives for users to use water resources efficiently, and thereby contribute to the environmental objectives of this Directive,
  - an adequate contribution of the different water uses, disaggregated into at least industry, households and agriculture, to the recovery of the costs of water services, based on the economic analysis conducted according to Annex III and taking account of the polluter pays principle.
- Member States may in so doing have regard to the social, environmental and economic effects of the recovery as well as the geographic and climatic conditions of the region or regions affected.
- Member States shall report in the river basin management plans on the planned steps towards implementing paragraph 1 which will contribute to achieving the environmental objectives of this Directive and on the contribution made by the various water uses to the recovery of the costs of water services.
- Nothing in this Article shall prevent the funding of particular preventive or remedial measures in order to achieve the objectives of this Directive.
- Member States shall not be in breach of this Directive if they decide in accordance with established practices not to apply the provisions of paragraph 1, second sentence, and for that purpose the relevant provisions of paragraph 2, for a given water-use activity, where this does not compromise the purposes and the achievement of the objectives of this Directive. Member States shall report the reasons for not fully applying paragraph 1, second sentence, in the river basin management plans").

Price considerations: While the EU Water Framework Directive does not specifically state full cost recovery as a requirement, it does state that cost recovery for "water services, including environmental and resource costs" be taken into account by member states (discussion of full cost recovery is included in the overview of the value of water). The European Environmental Bureau (EEB) wrote a report outlining how a pricing policy would need to be devised to meet the requirements of the Directive (Roth, 2001). In the report, costs that need to be recovered for full cost recovery to occur include the following:

- Operation and maintenance costs;
- Capital costs;
- Opportunity costs;
- Resource costs;
- Social costs;
- Environmental damage costs, and
- Long run marginal costs.

Roth states that, "Without making the full costs of water use clear to the users by integrating them into the water price, any water pricing policy is thus in breach with the main principles supposed to underlie EU environmental policy."

The study showed that the level of the water price in EU countries is generally lower than the cost recovery level. However, the pricing in most countries does play a role in achieving environmental goals. Pricing water appropriately will be different in all different sectors including household, industry, and agricultural sectors, each having a different set of influencing factors. In addition, influencing factors will vary on different scales and in different locations, all of which will need to be considered in pricing. EEB identifies several factors necessary to consider in an EU water pricing policy which include the following (Roth, 2001):

- Public awareness and participation;
- Full cost recovery that includes the costs for environmental damage;
- Metering and volumetric pricing schemes;
- Increasing block schedules with blocks adjusted to social needs;
- Seasonal variation where appropriate;
- Earmarking of water charges;
- Only a minimum of fixed and minimum charges;
- Information for water users;
- An understandable water bill;
- Transparency, and
- A gradual transition to the new pricing scheme.

The basis for full cost recovery is an economic analysis that was to be completed for each river basin in 2004 (Lanz and Scheuer, 2001). Though the EU Framework Directive tasks member countries with cost recovery and promotes appropriate pricing, water itself is not defined as a commodity. In a leaflet explaining the Water Framework Directive, the European Commission (EC) defines water as a "heritage" when explaining the "fair price" of water. The EC states that though water is not a commercial product, the pricing of it should be done in such a way to encourage sustainable use. This includes using the Polluter Pays Principle. The Directive also provides an affordable price for people in need (European Commission, 2002).

Water prices currently vary throughout the EU. A summary of average water prices in many countries in 2005 was calculated by the NUS Consulting Group (2006). Denmark and Germany had the highest reported price, at an average of US\$225/m^3. The Netherlands, France, Belgium, and the United Kingdom had prices from US\$149/m^3 to US\$190/m^3. Finland and Italy were in the US\$103-115/m^3 range. Sweden and Spain were the European countries shown with the lowest price of water, from US\$86-93/m^3. Most of the EU countries represented in the table have high water prices relative to other large countries including Canada, the United States, and Australia. The United States and Canada had the lowest reported prices, at US\$66/m^3 and US\$79/m^3, respectively. Prices for all countries had gone up noticeably from the NUS report done in 2005 (NUS Consulting Group, 2005).

10.3.7. Legislation: Law 9,433, the establishment of the National Water Resource Policy

Parties: Brazil
Date: 1997
Issue: Domestic water pricing strategy
Summary: The World Bank has promoted the French model of privatization of water systems, where there is public ownership and there is mixed public and private management (Ouyahia, 2006). The Brazil Country Management Unit of the World Bank completed a study on bulk water pricing in Brazil (Asad et al., 1999). They recommended that Brazil use water pricing to promote sustainability and efficient use and allocation of

resources. Though the report states that economic efficiency and full cost recovery are objectives, full cost recovery may not be feasible, and they propose full cost recovery for operations and maintenance and partial cost recovery for investments. To accomplish this, they advise establishing bulk water tariffs for each of the major water use sectors. Brazil has pursued bulk water pricing, adapting the French example to the legislative structures of Brazil (Lanna, 2003). Both state and union level laws institute water systems. Law No. 9,433 of 1997 established the National Water Resource Policy, which adopted the following principles (Brazil, 1997, Chapter I, Article 1):

- Water is public property;
- Water is a limited natural resource, which has economic value;
- When there is a shortage, priority in the use of water resources is given to human consumption and the watering of animals;
- The management of water resources should always allow for multiple uses of water;
- The river basin is the territorial unit for the implementation of the National Water Resources Policy and the actions of National Water Resources Management System, and
- The management of water resources should be decentralized and should involve participation by the Government, the users, and the communities.

Price considerations: The National Water Resource Policy also outlines fees for water use in Section IV of Chapter IV of the policy as follows:

- Art. 19. Fees for the use of water are intended:
    - To recognize that water is an economic good and give the user a sense of its real value;
    - To encourage the rationalization of water use;
    - To raise revenue for financing the programs and interventions provided for in the Water Resources Plans.
- Art. 20. Fees shall be charged for the use of water resources subject to award under the terms of Art.12 of the present Law.
- Art. 21. In the setting of fees for the use of water resources, the following elements, among others, should be taken into account:
- In diversions, catchments, and extractions of water, the volume removed and the variation in its flow;
- In the discharge of effluents and other liquid or gaseous waste, the volume discharged, the variation in its flow, and the physical-chemical and biological characteristics and toxicity of the effluent.
- Art. 22. In the allocation of funds collected from fees for the use of water, priority shall be given to the river basin in which they were generated, and they shall be applied toward:
- Financing studies, programs, and projects under the Water Resources Plans;
- Defraying implementation costs and administrative overhead for agencies and entities of the National Water Resources Management System.
- The payment of the costs referred to in paragraph II of the present article shall be limited to seven and one-half percent (7.5%) of the total amount collected.
- The funds mentioned at the beginning of this article may be applied without limitation to projects and public works that alter, in a manner considered to be of benefit to the community, the quality, quantity, and flow rate of a body of water. “

While implementation of water pricing policies will take many years, there were already pricing strategies in place for certain water sectors at the time the policy was written. Lanna (2003) identifies four different types of uses to price as follows:

- The use of water available in the environment—bulk water, as a factor of production or final consumer good;

- The use of water available in the environment as waste receptor;
- The use of water diversion, regulation, transport, treatment and distribution (supply service to domestic, agricultural, industrial users, etc.), and
- The use of collection services, transport, treatment and final disposal of sewage.

Prices for the latter two uses is fairly well established, according to Lanna, as set in agricultural and sanitary sectors, while prices for the first two uses is not established through the country, but local cases exist as examples.

10.3.7.1. Pricing in agricultural and water supply and sanitation sectors

In the agricultural sector, Law 89.496 of 1984 specifies that water tariffs for public irrigation projects be set at the sum of two coefficients, K1 and K2. K1 is supposed to reflect the capital costs of the project with a 50-year repayment period, and is an annual set value for all of Brazil. K2 is designed to include the operation and maintenance costs, and is estimated based on the volume of water used. While this system theoretically would work, administrative shortfalls can lead to strange actual charges. In 1995, tariffs for irrigation ranged from US$3 to US$40 for 1000 m^3 (Azevedo, 1997).

In the water supply and sanitation sector, users have paid a monthly fee for water, which rarely covered costs (Azevedo, 1997). New pricing is anticipated with the submission of a new bill regarding a national environmental sanitation policy that includes provisions for transparent rate calculations and user involvement (*BNamericas.com*, 2005).

10.3.7.2. Bulk water pricing and accounting for impacts to the environment

The State of Ceará was the first to implement water pricing policies regarding the first two types of water prices (bulk water and impacts on environment) that are in line with the 1997 National Water Resource Policy. As of December, 1999, charges for water were R$ 0.012/m^3 consumed by the concessionaires that have the delegation of public supply service for clean water and R$ 0.67/m^3 for water consumed for industrial uses and users. In August, 2000, in order to include the cost of electric energy consumption at pumping stations the value was established as R$ 0.028/m^3 to be charged for the use of bulk water by the public service concessionaires supplying cleaning water (Lanna, 2003).

10.3.8. Legislation: Council of Australian Governments (COAG) framework for water reform, 1994; Intergovernmental Agreement on a National Water Initiative (NWI), 2004

Parties: Various parties within Australia
Date: Original agreement 1994, updated 2004
Issue: Water pricing and trading within Australia
Summary: Due to Australia's arid environment, the government found it necessary to implement a framework for water reform in 1994 to manage scarce water supplies. Along with provisions for education, environmental requirement, and institutional reform, the 1994 framework addressed water trading and pricing. Water pricing was to be based on consumption-based pricing, full cost recovery, and transparency of subsidies. In addition, there were to be formal determinations of water entitlements and allocations. Trading of these entitlements and allocations were allowed within physical and ecological constraints of watersheds. The framework promoted the development of water markets to achieve goals of sustainable use and efficiency (Environment Australia, 2002). A system of water trading markets emerged.

The 2004 National Water Initiative (NWI) builds on the 1994 framework and covers a full range of objectives, some of which are specific to water trading and pricing. The NWI works toward the removal of institutional barriers to water trade. Under the NWI, water trading will not be restricted to within watersheds. Water pricing will be used to achieve economic efficiency and sustainable use of water resources,

infrastructure, and government resources. Pricing will also facilitate functioning of water markets and provide mechanisms for the release of unallocated water (Australian National Water Commission, 2006).
Price considerations: The Australian Bureau of Statistics analyzed results of the country's water trading program in 2004-05 (Australian Bureau of Statistics, 2006). The Bureau reports that in that year, a total of 1,802 permanent water trades with a total of 248 GL of water and 13,456 temporary water trades with a total of 1,053 GL of water were carried out in the country. Victoria had by far the highest number of water trades, both permanent and temporary. It also had the highest volume of water traded temporarily, though Western Australia had the highest volume of water traded permanently.

Though the average prices for many permanent and temporary water trades were listed as "not available" in the report, some figures were cited. The average price per megaliter for permanent trades in Queensland was $1,750 and in Western Australia was $680. For temporary trades, the average price per megaliter in New South Wales was $96 and for Western Australia was $80 (Australian Bureau of Statistics, 2006).

10.3.9. Arrangement: Bulk water supply exports to buyers from private entities

Parties: Corporate bulk water suppliers and buyers
Date: Ongoing offers
Issue: Selling of bulk water as a commodity by private entities
Summary: As the door has opened to treat water as a commodity, naturally private commercial interests have made developments in this market. WaterBank appears to be a hub of water selling and trading (WaterBank, 2007). WaterBank acts as a water rights broker and merger and acquisition specialist, and they state on their website that they are dedicated to the buying, selling, and trading of the following:

- Water rights;
- Water investments;
- Water utilities;
- Spring water;
- Bottled water;
- Bottling companies;
- Property and water;
- Geothermal water;
- Bulk water;
- Irrigation district water;
- Water from state trust lands, and
- Abstraction licenses.

Both Feehan (2001) and Baillat (2005) mention the development of WaterBank as part of a review of recent developments. Feehan states that as of August 2001, there had been no bulk water sales through WaterBank, though there had been 'lots of talk.' Baillat, reporting in 2005, states that few international trade operations have occurred through WaterBank. On its site, WaterBank reports being called on by the states of Texas and Florida, as well as FEMA for bottled water supplies needed in the 2005 hurricane season. It states that it has more than 375 sources of water worldwide for which it can arrange deals.

Other companies have developed to provide bulk water procurement and transportation. Water Exports NZ Limited offers water from Mount Aspiring National Park on the west coast of the South Island of New Zealand (Water Exports NZ Limited, 2007). The company's website states that they will provide both bulk and bottled water, after necessary infrastructure, including an 11 km pipeline from the water source to Jackson Bay on the west coast, is completed. Persons or companies interested in becoming venture partners can fill out a form on their website. As of January 2007, Water Exports NZ Limited was seeking partners to establish bottling facilities, distribution networks, and vendor services.

Flow, Inc., based out of South Carolina, offers on its website long-term bulk water supply from the Charleston area (Flow, Inc., 2007; EC Europe, 2007). The company offers up to 77 million gallons per day of high quality untreated water and 42 million gallons per day potable treated water from the excess municipal supply of Charleston. Flow, Inc., offers up to 20 year contracts. In a 1994 opinion piece in *National Geographic* magazine, the president of the company, Eugene P. Corrigan, Jr., states the significance of the source water's location at Bushy Park Reservoir near Charleston. Bushy Park is located at the 33° North latitude line, directly across from Gibraltar and the Suez Canal return route to Arabian Gulf oil ports. Surplus water can be delivered as backhaul loads in returning crude carrier tankers (Corrigan, 1994).

While other similar commercial or corporate entities exist, these serve as examples of private industry involvement in water commodities.

Price considerations: In the private arena, price figures for water are not readily accessible. One could surmise that each case is subject to considerable negotiation, and it is expected that commercial entities would choose to keep their price negotiations undisclosed. However, some general information was obtained about price considerations from various commercial entities.

Waterbank, serving as a broker for water deals, does list its service prices on its website, and they include sellers costs (water audit = $600 per tract, with additional contiguous tracts up to $100 each; title search and report = $200; closing costs = $800 each side; attorney review = $150; declaration = $200; brokerage commission = 10% + gross receipts tax), buyers costs (application filing and regulatory agency research = $120 per hour; closing costs = $800; attorney review = $150), reimbursable costs (copies, photography, maps, mileage, and the like, mostly at cost), and indirect costs (15% of the reimbursable costs).

Within its newsletter archives, WaterBank has a newsletter that covers issues associated with bulk water exports (Davidge, 1994). With regards to pricing of such exports, the author, Davidge, lists the following factors as critical:

- Length of contract (most important factor due to depreciation and amortization);
- Volume of water delivered;
- Distance of delivery;
- Security of source;
- Cost of transportation device;
- Cost of facilities at source and delivery points;
- Permitting and compliance costs, and
- Operating cost of transport system

Water Exports NZ Limited does not state prices for their water procurement and transportation services, though it lists its approximate annual sales with the Export Bureau as US$10,000,000 (Export Bureau, 2007). Eugene P. Corrigan, Jr., of Flow, Inc., states that the dominant cost is for carriage (ship charter) of water, which the company overcomes by backhaul shipments in the return leg of tanker voyages. In addition, there is the cost of payroll for workers and investors (Corrigan, 2007, personal communication). In the 1994 *National Geographic* opinion piece, Corrigan stated that 1 tankerful of oil (1/month) could be exchanged for 30 tankerfuls of water (1/day). Regarding the price of water, which Corrigan calls, "Possibly the world's most guarded proprietary figure in the Arabian Gulf," he states that it is quoted at $1.25 to $12/m^3 (or $4.73 to $45.42/thousand gallons) (Corrigan, 1994).

Future more detailed studies of water pricing will necessitate thorough investigation of pricing structures in the private sector.

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