

IWHA 2001 Conference abstracts
Second Call for Papers

2nd conference
10th -12th August 2001
University of Bergen, Norway

Abstracts 1st December 2000

Abstracts:	1. December 2000
Conference programme:	January 2001
Papers:	1. July 2001
Conference:	10.-12. August 2001

The International Water History Association (IWHA) 2nd conference will bring together researchers from different disciplines who all study the character and role of freshwater in history and development. It is organised in co-operation with UNESCO's International Hydrological Programme.

While freshwater is a true universal and no human being and no society can exist without it, its natural characteristics vary extremely from place to place and from time to time. Societies have managed and harnessed water in various ways with various implications both for water resources and for society. This conference will explore these variations in man/water relations in time and space, and examine why some societies have apparently succeeded, while others have failed to secure a sound management system of their fresh water.

The conference will have three main aims:

- to present different empirical research findings and to create a forum for theoretical discussions on how the relationship between man and water can be analysed and understood in the most fruitful ways.
- to produce relevant input into present day debates about issues including the control and ownership of water, water conflicts and water pollution.
- to discuss content and profile of a multi-volume World Water History planned by UNESCO in cooperation with IWHA. The conference will offer opportunities for researchers to present perspectives on water history useful for the book series.

We are inviting papers on the following themes:

(These themes are provisional at the moment - the organisers will welcome suggestions for individual papers and sessions):

A. The political economy of water – ownership and control

This session will deal with the changing histories of water as a private or common good. In what way has water been seen as a commodity standing outside "normal" economic theories? It will also be open to papers examining how regional and national control of water resources have been embedded into patterns of economic and political control within and across national boundaries, and has stirred up territorial disputes.

B. Images of water (in religion, myths, literature and art)

This session will deal with different aspects of the cultural construction of water – from ancient days until contemporary time. We are calling for papers on for example

the role of water in the world religions, myths of rivers as a source of life, and water as an object of art. Other themes could be the free flowing river as a state of equilibrium or as a chaotic and violent nature meant to be controlled by man.

C. History of hydrology and water control

This session will especially deal with the development of hydrological sciences and water controlling technology. We are not only interested in dam building and water regulation technology. We are also inviting papers on changes in and effects from irrigation and drainage technology etc. The session will encourage comparative perspectives on irrigation and drainage systems, both regarding technology, institutions and policy.

D. Narratives on the river and the dam

This session will discuss the harnessed river in a social construction perspective. What stories do we tell about free flowing, or harnessed rivers? Should this history be written as a history of progress or as a history of failure? The narratives have varied from a river lost to the rebirth of a new river or the remaking of a new nature. The narratives have also been written in a perspective of distribution of power (The Conquered River) or in ecological perspective (The Devastated River). How will the stories that we tell about man and the river influence the way we interpret rivers in the 21st century?

E. The engineering of water systems – engineers, entrepreneurs and bureaucrats

This session will examine the cultures, traditions and power of those designing and constructing water systems. It will, for example, look at engineers with reference to their aesthetic and technical influences, and their relationship to political power structures. It will also, for example, examine the entrepreneurial capabilities and goals of individuals, from private sector firms, or government departments, who conceived or guided the construction of water systems.

F. "Water and man" relations in science

This session will deal with how the relationship man/water has been understood and explained through the centuries and by contemporary scientists in all kinds of disciplines and traditions.

G. History of water, sanitation and health

In this session studies of water and health will be presented by a broad focus on water borne diseases and their vectors. We also call for papers that deal with the relationship between epidemics and water and how societies have worked to secure clean water to stem epidemics. This session will also deal with changes in water quality, and how these changes can be seen related to social developments. We also call for papers discussing the understandings – both contemporary and historical – of the concept of clean/polluted water.

H. Water, poverty and social development

This session will deal with development of the modern megalopolis and the water and sewage question and how clean water can be made available for the poor. Important changes are taken place in the distribution and control of water for household consumption. In some big cities the water issue has caused political turmoil, even street-fighting. How does the privatisation wave in water distribution

affect social relations, political systems and the water supply system? How does lack of water and poor distribution systems affect development and development in rural areas of the so-called "Third World"?

I. Freshwater and the coastal zone – integrated and ecological management

The main focus will be put on conflicts between user-interests, especially interrelated problems of freshwater, estuarine and marine areas. Both examples of how conflicts have been coped with historically, and more recently evolved problems and opportunities will be addressed. We also call for papers discussing principles for management of freshwater resources, estuarine and marine areas, as in the integrated and ecological approach in the new EU Water Resources Directive. Finally, attention will also be paid to the development of environmental goals and planning tools of interrelated fresh water, estuarine and marine areas.

J. Regional waters in a historical perspective

The conference will organise parallel sessions on water issues in a regional perspective (Asia, Middle East and Africa, Europe, America). Regional characteristics and different experiences and possibilities of human exploitation of water resources will be highlighted. The aim is to stimulate regional research collaboration and improve transfer of knowledge on man–water relations.

K. Water and Civilization. Why History is Vital to Reframing Current Water Policy Debates.

The point with this session would be to reflect on how and why history is important to current water policy debates. The panel will include water policy practitioners with expertise in history of water and historians, and be led by the editor in chief of Water Policy, Jerome Delli Priscoli.

Invited key-note speakers

Professor [Fekri Hassan](#), University College London, UK
Professor [Christian Pfister](#), Bern University, Switzerland
Professor em. John Opie, USA
Professor [Donald Worster](#), University of Kansas, USA
General Secretary Andras Szöllösi-Nagy, [IHP](#), UNESCO

Conference Papers

Abstract (250 words) sent to contact person by 1. December 2000 (see below). The conference papers will be edited by an international editorial committee and subsequently published. In connection with the conference we will organise a book exhibition on water related research. We will invite participants to send the organising committee leaflets about reports and books published on the conference topic. Posters are welcome.

IWHA

The first formal meeting of the International Water History Association will take place at the Bergen conference. The meeting will include election of officials, discussion on further conference plans etc. Membership of IWHA will be possible to sign at the Bergen conference. More information about IWHA on our web page www.iwha.net.

Travel support

It is envisaged that travel support will be available for selected speakers. It is the intention of the organisers to target this support towards speakers from universities and institutions which do not normally provide sufficient resources to fund extensive foreign travel.

Conference location

Bergen is the second largest city in Norway, and the capital of the Scandinavian rain coast. It is also a commercial centre which was historically one of the Hanseatic ports with strong maritime trading links to all parts of the world. Seven mountains surround it and the city is renowned for its beauty. Bergen is also noted for being the birthplace of Edvard Grieg whose music reflects the natural environment; mountains, fjords, but also running water everywhere. The location of the conference hall, Bergen Kongress Senter, is downtown Bergen.

Summer holiday on the western coast of Norway?

The conference organisers have managed to negotiate with local hotels a good deal for accompanying persons. Bergen and the Norwegian West Coast with its mountains, ocean and fjords will be an experience. (Have a look at these pages: www.bergen-guide.com/ and home.no.net/rostrand/)

Conference Organising Committee on behalf of IWHA:

Professor [Terje Tvedt](#), [University of Bergen](#)
Professor [Petter Larsson](#), [University of Bergen](#)
Dr. [Eva Jakobsson](#), [Rogaland Research](#), Stavanger

Contact person:

Alv Terje Fotland, e-mail: Alv.Fotland@sfu.uib.no
[Centre for Development Studies](#)
[University of Bergen](#)
Stromgaten 54,
N-5007 Bergen, Norway
fax: + 47 55 58 98 92
<http://www.iwha.net>

Time schedule:

Abstracts:	1. December 2000
Conference programme:	January 2001
Papers:	1. July 2001
Conference:	10.-12. August 2001

www.iwha.net

"The Role of Water in History and Development"

IWHA 2nd conference 10th -12th August 2001, University of Bergen, Norway.

This conference will bring together researchers from different disciplines who all study the character and role of freshwater in history and development. It is organised in co-operation with UNESCO's International Hydrological Programme and CROP, the Comparative Research Programme on Poverty.

While freshwater is a true universal and no human being and no society can exist without it, its natural characteristics vary extremely from place to place and from time to time. Societies have managed and harnessed water in various ways with various implications both for water resources and for society. This conference will explore these variations in human/water relations in time and space, and examine why some societies have apparently succeeded, while others have failed to secure a sound management system of their fresh water.

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- to produce relevant input into present day debates about issues including the control and ownership of water, water conflicts and water pollution.
- to discuss content and profile of a multi-volume World Water History planned by UNESCO in cooperation with IWHA. The conference will offer opportunities for researchers to present perspectives on water history useful for the book series.

The conference is divided into 12 different [themes](#) which are:

A: The political economy of water – ownership and control

B: Images of water (in religion, myths, literature and art)

C: History of hydrology and water control

D: Narratives on the river and the dam

E: The engineering of water systems – engineers, entrepreneurs and bureaucrats

F: Institutional frameworks for solving the disputes in conflict waters

G: History of water, sanitation and health

H: Water, poverty and social development

I: Freshwater and the coastal zone – integrated and ecological management.

J: Regional waters in a historical perspective

K: Water and Civilization. Why History is Vital to Reframing Current Water Policy Debates.

X: Others

Go [here](#) for complementary information on the themes.

Schedules:

Conference programme:	1. May 2001
Final deadline for payment: conference fee and hotel	1. July 2001
Papers:	1. July 2001
Pre-conference tour:	9. August 2001
Conference:	10.-12. August 2001

Program IWHA Conference 9th - 12th August 2001

Schedule:

Conference programme:	1. May 2001
Final deadline for payment: conference fee and hotel	1. July 2001
Papers:	1. July 2001
Pre-conference tour :	9. August 2001
Conference:	10.-12. August 2001

Friday 10th August

08.30-10.30	Registration
10.30-10.40	Kirsti Koch-Christensen , vice-chancellor, University of Bergen, "Welcome address"
10.40-11.15	Terje Tvedt , professor, University of Bergen:

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"An Introduction"

11.15-12.00	Fekri Hassan , professor, University College London, UK: <i>"Water: the Mainspring of Civilization"</i>
12.00-13.00	Lunch
13.00-15.00	Parallel session 1
15.00-15.15	Coffee/tea
15.15-17.15	Parallel session 2
18.30-20.00	Reception, Bergen City Council

Saturday 11th August:

08.30-10.45	John Opie , professor emeritus, USA: <i>"The Concept of Moral Geography: Public Responsibility for Declining Water Resources and Agriculture on the US Central High Plains"</i> Christian Pfister , professor at Bern University, Switzerland: <i>"The importance of studying rainfall patterns and climatic changes: The case of Europe"</i> Andras Szöllösi-Nagy , General Secretary IHP, UNESCO: <i>"Sustainable Water Resources Development: In Need for a Historical Context"</i>
10.45-11.00	Coffee/tea
11.00-13.00	Parallel session 3
13.00-14.15	Lunch
14.15-16.15	Parallel session 4
16.15-16.30	Coffee/tea
16.30-18.00	IWHA Foundation Meeting (approvals of by-laws, election of steering committee, secretariat, proposals for next conference, member fees)
19.30	Conference dinner

Sunday 12th August

08.30-09.15	Donald Worster , professor, University of Kansas, USA: <i>"Environmental History with a Focus on Water: A Critical Review"</i>
09.15-09.30	Coffee/tea
09.30-11.30	Parallel session 5
11.30-12.30	Lunch
12.30-14.30	Plenary session 6
14.30-14.45	Coffee/tea
14.45-15.30	"Future plans for IWHA"

Pre- and Post conference activities [here](#)

Invited key-note speakers

Professor [Fekri Hassan](#), University College London, UK
Professor [Christian Pfister](#), Bern University, Switzerland
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General Secretary Andras Szöllösi-Nagy, [IHP](#), UNESCO

Themes:

220 papers are accepted so far. Every parallel session will have about seven tracks with four papers in each. Each presentation 20 minutes plus 10 minutes discussion. The program is divided into these themes:

The Themes:

- A. The political economy of water - ownership and control
- B. Images of water (in religion, myths, literature and art)
- C. History of hydrology and water control
- D. Narratives on the river and the dam
- E. The engineering of water systems - engineers, entrepreneurs and bureaucrats
- F. Institutional frameworks for solving the disputes in conflict waters
- G. History of water, sanitation and health

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H. Water, poverty and social development (this session is organised in co-operation with CROP, the Comparative Research Programme on Poverty)

I. Freshwater and the coastal zone - integrated and ecological management

J. Regional waters in a historical perspective

K. Water and civilization. Why History is Vital to Reframing Current Water Policy Debates

X. Others

Complementary information on the themes [here](#)

List of accepted abstracts categorized in themes [here](#)

Accepted abstracts in theme A

The political economy of water - ownership and control

The abstracts are sorted alphabetically (number given in brackets refers to abstract identification number)

1. Fenda A. Akiwumi, USA (133)

Apparent Limitations to "Indigenous People Participation": Conflicting Water Use in an African Mining Economy

The notion that indigenous people's participation should be an integral part of decision making processes for water development projects has become a standard aspect of reform policy documents, particularly at the international level. However, an analysis of the proposed actions to facilitate this, specifically those drawn up at the World Water Forum held in The Hague, Netherlands in March 2000, as they relate to a water-based mining economy like Sierra Leone, West Africa, reveals some major limitations. The "alien new knowledge" of water use applied in the alluvial diamond, gold and rutile mining industries and triggered by a global economy does not appear to be compatible with the idyllic view that insists on respect for indigenous values and practices as regards this resource.

The conflict between river as sacred site and dredge mining pond, for example, are hardly reconcilable. A lack of political will at the national and international levels and the dominance of multinational corporations have been, and continue to be overwhelming forces for indigenous populations to contend with. Further, the introduction of new value systems and continuing modification of traditional world-views through co-optation have set a system in motion that may have rendered some of the proposed goals obsolete. Rational behavior patterns have emerged as coping mechanisms to deal with the tradition- modernity paradox. Within the prevailing development climate, reform can only realistically imply adaptation to an inevitable, often involuntary, western acculturation process.

"They were fighting against nature - just a warning of the change and movement which was to come. That oppressive dead spot would see life appear, men come and go, a mine grow up, gold pour down the Tebenko, and then, before many years, after man had all this wealth that he wanted, peace perhaps would come again...the futility of it all struck me for the first time...I realized that all this effort was to line someone else's pocket with silk."

Fowler Lunn, 1938

The Earth Summit held in Brazil in June 1992 called attention to the fact that indigenous people and women must be major partners in the sustainable development arena and should therefore be involved in decision-making processes. Further, the objectives of the World Bank's division that addresses social policy according to El Ashry (1993), is to place more emphasis on "social and cultural issues such as the role of women in development, cultural heritage and indigenous peoples...". President Wolfensen who heads the same organization corroborated this view of inclusion when in a speech at the IMF Annual Meetings in Hong Kong, China on September 23 1997, acknowledged that people:

"...want the opportunity to build from within. They do not want my culture or yours. They want their own. They want a future enriched by the inheritance of their past." (Wolfensen, 1997, 5)

Perhaps the greatest commitment to this idea was shown at the 2nd World Water Forum at The Hague, Netherlands in March 2000. There, at the sessions on "Water and Indigenous People" and "Water and Nature" it was officially acknowledged amongst other things, that indigenous people, generally, have an intimate, spiritual relationship with and thus respect for, and understanding of nature. Water sources, in particular, customarily represent sacred sites. As such they employ resource management practices that are more sustainable than modern technologically advanced methods. Nevertheless, their "unique systems of values, knowledge and practices have been overlooked in the Global Water Vision process." (The fact that incorporation and co-optation have been the means of their involvement in the development process thus far was also recognized. In a formidable, comprehensive list of proposed actions to rectify these discrepancies, it was stated among other things that projects involving water should have the approval of those groups whose lands might be affected. Further, adequate compensation must be paid when necessary.

However, a number of questions arise in regard to this. How, for example, might some of these actions be implemented in situations where there are major, often seemingly irreconcilable differences between traditional and modern world views on water use, sustainability and conservation? What happens in situations where countries are totally dependent on water based industries as revenue earners? Clearly, a thorough analysis of the current water policy in every country in relation to the ecology of administration must be carried out, in order to determine the reality of carrying out the suggested actions. This paper will present some case studies from the mining industry of Sierra Leone, West Africa shown in Fig 1, where differing perceptions of water use have historically led to conflict. Mining has been the mainstay of this country's economy since the late 1930's when it took over from agricultural production. It provides a very pertinent case study for analysis because methods employed to extract minerals are predominantly water based.

2. Karen Bakker, UK (174)

Privatising Water in England and Wales: Equity, Efficiency, and Ownership

Over the past three decades, the business of water supply in England and Wales has been gradually re-regulated. Under public ownership, water supply was considered a service, supplied at subsidised rates to citizens. Over the past thirty years, the business of water supply has been gradually commercialised, and a competing view of water has emerged, as a commodity sold on a full-cost recovery basis to customers. The progressive commercialisation of the water supply industry was consolidated by the privatisation of the state-owned water authorities in 1989.

This paper details the history of water commercialisation and the associated evolution in concepts of efficiency and equity underpinning water regulation. It evaluates the implications for water consumers of the shift from the principle of inter- and intra-regional equalisation to that of a relatively narrow definition of economic equity in water charging. This provides the basis for a discussion of the redefinition of water entitlements enacted by water commercialisation, illustrated by examples of changes in methods of water charging and water access norms, and by reference to private provision of water in nineteenth-century Britain. There follows a discussion of the challenge presented by water supply to the British model of price-cap utility regulation. The paper closes with some reflections on the political-economic strategies underlying the successive municipalisation, nationalisation, and privatisation of water supply in England and Wales over the twentieth century.

3. Vincent Battesti, France (201)

The Power of the Disappearance Water and Jerid in Tunisia

Although water is obviously the essential principle of the presence of oases in the desert, in the region of Jerid (South-Tunisia) water seems to be confined only in a registry of political and social claim, as a possible (and rare) free medium of expression. In some oases, water has even disappeared from the palm-grove's surface.

There are historical reasons that can explain such situation. It is perhaps above all a story of the control. Who has in hand this vital resource keeps in check all the local society. A story, because water has always been stakes of power in this type of region. The recent changes of control from a local "*jamaa*" to a colonial and then a national power enlighten the strategic significance of this element, but these reorganisations are not the first ones. Water is today a field of political and social discussions also because it is the only legitimate one permitted to oasian people and especially gardeners.

The positions and the behaviours of the different actors on the oases towards to the use of water are heterogeneous. The state itself has a "schizophrenic" attitude. In one hand, the administration wants to proceed to a mining exploitation of the water resource to take possession of other resources (to foreign currency through a particular cultivar of dates, *Phoenix dactylifera*, var. *deglet nur*). In the other hand, the state needs to control and "protect" it in the aim of keeping or restoring the "traditional scenery" of oases (government foresees to develop a Saharan tourism, the Mediterranean outlet is now blocked up). The local farmers have displayed a diversification of their practices, among other things a diversification of the origin of their water of irrigation with private wells. This diversification of thoughts and practices about water is a source of various conflicts of representation.

In a recent work (Battesti V., 2000), I have purposed a new comprehensive concept of "resources". They are the "socio-ecological resources": they combine in the same movement real and conceptual resources. The overall idea is first that a kind of natural resource is exploited thanks to such-and-such perception of the environment. In the second place, actors can play not only with different resources but also with different perceptions and practices of the environment (and they have to). The possibilities of perceptions and practices of the environment together can be symbolised by a space defined by three ideal-types. They are the "ideal-types of the oasian praxis" and they are part of "socioecological resources": actors make use of natural resources (water, in this article) and make use of "manners of use". With this approach, we can reread the shared history of Jerid and water. It is no longer an history of actors on the environment and particularly the water; the evolution, share and contamination of "what underlies the action on water" will tell us how regional and national control of water resources have been embedded into patterns of economic and political control.

4. Christoph Bernhardt, Germany (93)

Water Control, Political System and Institutional Change in Eastern and Western Germany after 1945

The paper analyzes in a comparative perspective the interconnections between water control and politics in the two political systems of "capitalist" and "socialist" Germany after World War II, taking the two border rivers Oder and Rhine as research areas. As a first point it will be demonstrated how the campaigns against the floods of 1947 along both rivers were used by the Soviet resp. the American army to consolidate their power and the different institutional systems in the two parts of Germany. Secondly the paper analyzes the changes in the institutional framework and the economical and political control over water in the context of the transformation of the planning system in the GDR until around 1960.

On this basis the distribution of power between regional and national authorities in the areas of water planning and water management in both system is analyzed. Special attention is given the very complex constellations of actors and interactions in different water-related fields of society and administration (agriculture, pollution, flood control). As a third point the paper demonstrates on a regional level the institutional change in the area of water control in both countries during the 70ies. The implementation of environmental standards and a fundamental institutional shift in the water authorities marked a new period of water history in Germany. It will be claimed, by looking at similar processes in other European countries during the 70ies and by interpreting this change in a long term perspective, that this decade marks also a turning point of modern water history in Europe. Focussing on a comparative analysis of the two German systems the paper will integrate the international dimension resulting from the border situation at both rivers. It is based on an approach of institutional history that brings together formal and informal processes of institutional change.

5. Jose Esteban Castro, UK (96)

Water, Power and Citizenship: The Valley of Mexico in a Long-Term Perspective.

This paper focuses on the interrelations between urban water development and citizenship rights over time in Mexico. It does so from the perspective of what could be termed the social character of water management as distinct from its physical-natural and technical features. It is part of a larger study on citizenship and social change concerning an elementary means of life—water—which is transformed through complex interactions with wider issues of social, economic, and not least political transformations. Human intervention on natural water systems has had an irreversible impact not only on the environment but also on the forms of social organization. The normally rationally planned actions directed at the control of water by human beings have also had unintended effects both on natural and on social systems. In addition to the well-known depletion of natural resources brought about by increasing exploitation, the control of nature is an inextricable part of what Norbert Elias termed the ‘civilizing process.’ Like in the case of the control of fire by human beings, which has been examined by the Dutch sociologist Johan Goudsblom in his thought-provoking study on *Fire and Civilization*, the control of water has been and still is enveloped in processes of social control and self-control.

The social apparatuses created to maintain a regular control over water, whether it be for irrigation, for protection against floods, for guaranteeing a regular flow of fresh water or for the control of pollution and depletion of water resources impose intergenerational constraints and duties upon human beings with far-reaching consequences for their forms of social organization. I delve into some of these processes by paying attention to such features as the evolution of formal and customary water law and institutions in connection with the formation of citizenship rights in Mexico. The paper also pays attention to current developments. Recent research has shown that conflicts over the access to and improvement of water services (for example different forms of individual and collective action ranging from bureaucratic complaints, public demonstrations, civil disobedience, to direct violence) have been an important component of Mexican public life.

The water authorities have been well aware of this phenomenon, which they termed ‘the conflict over water’ in Mexico, as in the early 1980s water scarcity and pollution had become crucial factors of social conflict. Notwithstanding the research already done, the interrelation between these events and the wider struggle over citizenship rights has by and large been missed. In this connection, I argue that the social mobilization over the delivery of water services forms part of a much broader confrontation against the prevailing exclusionary—some would say weak-inclusionary—model of social organization. I also claim that the overriding dominance of the technological paradigm in the sphere of water management and the slow development of theoretical tools and lack of studies within the social sciences focusing on the interplay between natural and social processes have contributed to maintain largely unobservable the social character of physical-natural processes.

6. Richard Coopey, UK (48)

Water Power as an Economic Catalyst: The Impact of the Downton Iron Forges, 1650-1815.

From the mid-17th century onwards the waterpower generated by the river Teme in Downton Gorge drove a series of watermills in what was to become the principal ironworking region in Britain at this time. Waterpower was thus at the heart of a regional economy of national importance and the exploitation of this resource can be viewed as the central dynamic to the growth of ironworking in the region. There were, for example, no iron deposits in the near vicinity and raw materials needed to be transported through difficult terrain at great cost. Later, tinsmithing was manufacturing in Downton, necessitating the transport of tin from as far afield as Cornwall. Delivery of finished goods similarly proved difficult from the inaccessible site. Downton, a relatively remote gorge on the western edge of the English midlands, provided the water-based energy concentration, which could overcome the relative expense of other factors of production.

The development of the cluster of ironworks in Downton had major ramifications for the development of the regional economy. The exploitation of waterpower set in train a series of changes, which resulted in the destruction of local forestry and the reconfiguration of the agricultural economy, and generated a new wealthy elite - transforming the local social and political structure. The cluster of industry and expertise which was established at Downton did not last, however, as new ironmaking processes saw a shift in the centre of importance to rival areas – notably Coalbrookdale.

This paper, based on archival research, will discuss the issues outlined above placing the importance of waterpower in the context of other factors generating economic change. The interaction between natural resources and entrepreneurial capabilities, technological skill and political-economic ideologies will be examined in assessing the reasons behind the rise and decline, indeed total eclipse, of this once very important industrial region.

7. John M. Donahue, USA (117)

Constructing a Commons: A Cultural Perspective on Water Conflicts in South Texas

One of the most popular analyses of the conflicts surrounding the commons is that of Garrett Hardin. Hardin argues that each household can take resources from the commons and deposit wastes. Using a calculus of neoclassical economics, as each household seeks its advantage, the costs to all seem small. Yet, some accumulate resources more rapidly and this gives them access to an even larger share of the commons. Add in a Hobbesian view of human nature, and selfish households accumulate wealth from the commons by acquiring more than their fair share of the resources and paying less than their fair share of the total costs. Ultimately, as population grows and greed runs rampant, the commons collapses. In South Texas one does not have to look far to find freshwater shortage, but the question is whether the commons is leading to tragedy or could such an idea be part of the solution to the semi-arid region's water woes?

This paper reports on efforts to craft a coherent local, regional and state water policy in Texas. Research reveals two competing cultural constructions of water, as a commons and as a commodity, that define current efforts to reach agreement on water use and transfers, further complicated by a disparity between hydrological and political boundaries.

8. Radha Fredie D'Souza, New Zealand (104)

How the Genie of the Law Rides the Currents on the Krishna River Sharing Krishna Waters or Metamorphoses of A Colonial Problem into A Developmental Problem?

This paper is part of a larger doctoral dissertation that analyzes the Award of the Krishna Waters Disputes Tribunal on the disputes relating to the sharing of the waters of the inter-state river Krishna in India. The dissertation analyzes the historical and geographical context of interstate water disputes and the intersection of international and national law in such disputes. The immediate cause for the inter-state dispute related to the legality of an agreement of July 1951 between the pre-reorganization states of Hyderabad, Madras Bombay and Mysore brokered by the Planning Commission. Related to this were clusters of claims arising out of the States Reorganization Act 1956. The States Reorganization Act 1956 redrew the internal boundaries of India on the basis of language. This paper traces two movements, one political the other economic, in relation to the disputes. The political movement is in the direction of systemic decentralization. Beginning with the 'high' imperialism of the colonial era in 1857, the trajectory of political developments progresses towards devolving power to the Indian people. The States Reorganization Act of 1956 was the final culmination of the process that saw India transform from a unitary state under colonial rule to a federal democratic constitutional republic.

The economic movement on the other had is towards systemic 'centralization'. In retrospect, during the era of 'high' imperialism in the wake of the Industrial Revolution, the structures of production and indigenous economic systems within India retained a high degree of autonomy. Since then, the economic movement has been towards progressive 'centralization', in other words subordination and integration of the economy to external imperial economies. How the opposing directions of economic and political forces are unified into a coherent political economy is the problematic addressed in this paper. The paper seeks the answers in the law and legal processes.

In the Krishna water disputes, the States Reorganization Act 1956 that was politically 'democratic' gave rise to a cluster of claims that arose from the economic interests of colonial rule. By analyzing the determination of those claims in the Award, this paper shows how the legal process, by applying international law on sharing of river waters to national jurisdiction of the post-independence era, is able to re-conceptualize a colonial economic tension as a developmental tension. By analyzing the determination of the disputed agreement of July 1951 this paper shows how constitutional federalism holds together the external economic domination and the internal political devolution of power to states within a coherent legal and institutional framework. The paper does this by examining the internal and external dynamics of planning under the constitution and center-state relations, political and financial, in river-basin development.

Law is conceptual in that, the dominant concepts of relations between social actors are expressed through ideas about law. The Krishna water dispute can be seen as a colonial conflict re-conceptualized by law as a developmental conflict in the post-independence era. However, the way it is re conceptualized fetishizes the structural continuities of colonial history and the continued role of external economic agencies and powers in the conflicts over water. The award of the Krishna Water Disputes Tribunal became open to review after May 2000 this year. Given the continued conflicts over the Krishna waters between the States of Andhra Pradesh, Karnataka and Maharashtra in India, it appears certain that the award will be reviewed. It is hoped that this paper, by examining the historical and geographical aspects of law and institutions relating to inter-state water disputes, will provide useful insights for the future.

9. Eran Feitelson, Israel (80)

A Retreat from Centralized Water Management? The Israeli Case

Government involvement is often presented by economists as a response to market failure. In the case of water in non-humid areas it may be argued however that market based mechanisms are currently introduced in response to government failure. In essence, in such areas water resource development was based on massive government intervention. But as water institutions were captured by sectorial interests they implemented unsustainable policies. This has led to a backlash, part of which is the introduction of market based mechanisms. This hypothesis is discussed within the Israeli context. Israel may be an especially interesting case as due to its high levels of water stress, on the one hand, and high adaptive capacity, on the other hand, it often faces situations not yet faced by other countries. In Israel all water resources were nationalized in the fifties and highly centralized institutional structure put in place. This was lauded as an example for an efficient water management system. Yet, the water resources have been over-utilized systematically leading the Israeli system into an unprecedented crisis. The sources for this crisis is identified as the loss of public oversight, and the dominance of the agricultural and monopoly interests. As a result of the recurring crises market based policies have been advanced. These reflect the ideological shift within Israeli society. Yet, they are opposed by the monopoly and agricultural lobbies. It is suggested that despite the ability of the opposition to delay the market measures they are slowly being adopted, thereby marking a steady shift from the past centralized management structure to a more decentralized market based one.

10. David J. Francis, UK (165)

Fighting for Survival. The River Politics in West Africa

In this paper I critically engage the controversial issue of river politics through the prism of the West African sub-region. The primary objective is to provide understanding of how rivers in West Africa are both sources of conflict and co-operation. This contradictory element of conflict and co-operation is reflected in the sense that the Mano, Senegalese, The Gambia, Lake Volta and Lake Chad Basin have provided opportunities for regional and sub-regional inter-state and intergovernmental functional co-operation in economic, political, socio-cultural, financial, technical and development issues. On the other hand, the regional co-operation to harness the water resources and harmonise water development policies for national and regional development have

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often led to conflicts and inter-state disputes. Rivers in the West African sub-region are therefore vital to the survival of the political communities, hence any perceived threat, 'real' or 'imagined', to the water resources is bound to provoke political tensions, complicate the already divisive geo-politics and further compound the security complex of the region. For instance, the proposal by the new president of Senegal Abdoulaye Wade to construct a dam on the Senegalese River immediately sparked off political disputes with Mauritania and Mali. What this example illustrates is that fact that Wade's proposal threatened the survival of both Mauritania and land-locked Mali. But this conflict and co-operation dynamics is not a new phenomenon. Its date back to the pre-colonial era when kings of West African kingdoms and city-states fought each other for the control of strategic riverheads necessary for the political and commercial survival of some of these kingdoms. Rivers in West Africa therefore support human security, but simultaneously serve as sources of insecurity.

Some analysts argue that river politics and resources have in several respects contributed to fuelling the civil wars and intra-communal violence in West Africa. This paper therefore analytically and empirically addresses the river politics in West Africa from a human security perspective and the implications for the changing nature of geo-politics and international conflict environment of post-Cold War Africa. It is hope that the analysis of the West African scenario will help to provide useful insights into the general phenomenon of river politics in other parts of the world.

11. Paul Gelles, USA (55)

Layers of History and Meaning in Andean Irrigation

In Andean society, as in many other areas of the world, irrigation water carries broad cultural significance and has long been a source of conflict. Using a historical and interpretive analysis, this paper studies the struggle over irrigation and over the cultural meanings of water in Cabanaconde, a large peasant community in southern Peru. The analysis shows that water, ethnicity, and power in Cabanaconde and elsewhere in the Andes must be understood against the backdrop of the region's colonial past and contemporary nation-building in Peru. Local models of irrigation, which previously served indigenous and Iberian states, have now become powerful tools of resistance against interference by local elites and the national government.

12. David Gordon, South Africa (178)

From Owners of the Lakes to Customs Officers and Fish Guards Colonialism and the Control of Water Resources in Central Africa

This paper details the transformation in the ownership and control of a river and lake system from indigenous African authorities to colonial states. In the 18th and 19th Centuries Lake Mweru and the Luapula River formed the heartland of the Eastern Lunda Empire of Central Africa. Owners of the Land and Lakes who predated Lunda conquest controlled natural resources, including the lake and river. The Eastern Lunda Empire, which rested on the slave and ivory trade, relied on the lake and river for transport and for fish.

With the onset of colonialism, the geopolitics and economics of Lake Mweru and the Luapula River changed. Instead of acting as the connecting network of an empire, the lake and river became the border between the British and Belgian colonial empires. Quite abruptly, the lake and river changed from a heartland to a borderland where colonial customs officers mediated trade. Moreover, fish became an increasingly important commodity with rising demand by the newly urbanized workers of the Central African copper mines. The Owners of the Lakes had established several rules that governed the exploitation of the water resources. The fishery was not an open access "commons"; rather, rulers managed it on behalf of ancestral spirits, local communities and the Lunda State. The colonial regimes did not recognize the authority of these environmental managers; instead, they appointed predominantly Lunda lords as colonial chiefs. These colonial chiefs and their "fish guards" enforced new rules of exploitation based on "scientific conservation".

The history of the confrontation between colonial states and Africans around the ownership and control of water resources is of crucial importance to an appreciation of restraints in managing rural freshwater resources, especially in areas where modern states only have questionable legitimacy. The paper is based on data collected by the author in Mweru-Luapula between 1997 and 2000 and on archival collections consulted in Zambia, England and Belgium.

13. Kristin Gaarde, Norway (103)

British Colonial Water Policy: The Case of Mandatory Palestine and Transjordan 1917-1948

Palestine and Transjordan were given to Great Britain as so-called mandatory territories after World War 1. Changes in the structure and size of the population and the use of modern farming methods rapidly increased the demand for water during the early 1930s. To ensure that water disputes did not threaten Great Britain as a Mandatory power it became a necessity for the authorities to develop a more unitary and efficient policy of water management. The attempt to create and implement legislation to secure state control over water was a vital part of this policy during the 1930s and early 1940s.

Several hydrological surveys were carried out and the various problems of sectorial allocation and distribution were discussed in a serial of governmental reports. There were also attempts to put all administration concerning water and irrigation under one authority; The Development Department, instead of parting it between different governmental bodies. How did the problems of water management influence the larger political conflict and vice versa)? And how did the British policy effect the later Israeli water policy? The topic will be discussed within a wider context of British colonial policy, bearing in mind the procedure of planning and implementation of similar measures in other British colonies. It will also be discussed if the theoretical models from the 1990s "water literature" are useful to create a better understanding of the British Mandatory period.

14. Paul Jeffrey, M. Lemon & B. Jefferson, UK (292)

My land, my water, your problem: Coevolutionary processes and the development of appropriate water policy tools.

Previous writers have argued that societies develop in relation to their environment; neither controlling it, nor being at its mercy. Many of them go on to suggest that even environmentally friendly concepts like sustainable development are dangerous when they rest on traditional modernist principles and suggests an alternative approach based on a coevolutionary paradigm. Indeed, the development of society in general can be seen as the compound result of different activities that to some extent fit together and need each-other.

Likewise, the present configuration and status of water supply and management systems (both physical, economic, and administrative) are a function of a number of inter-related processes. For example, technological development, behavioural change, regional and global market changes and local environmental conditions all influence extant water use arrangements. At the level of policy advice and decision making, an understanding of these coevolutionary effects is clearly desirable.

This paper explores the benefits of understanding the history of water use as a coevolutionary process. Using both quantitative and qualitative data from a case study region in the Argolid region of Greece, the narrative addresses the historical development of water usage customs amongst farmers, tracing the determinants of their water use behaviour in response to different economic, technological, environmental, and political triggers. Emphasising the cross-disciplinary nature of exploring coevolutionary change, we also comment on suitable methodological frameworks for collecting and collating relevant data.

Findings highlight the need for 'adaptive potential' in water resource management strategies. Laws, regulations, technologies, and institutional structures can all reduce the adaptability of water management systems to hydrologic and demand variation.

15. Mahmoud El Zain, The Netherlands (74)

Reshaping the 'Political': Focatorising the Nile Waters in the Sudan:

The concern of this paper is to explore the nature of interactions between the Nile and its wider environment and how these interactions reshape the power bloc, the state's discourse and the state's foreign policies? The principal question it poses is how the water use for economic development, in the central riverine zone in the Sudan, has affected the marginal lands of the non-riverine zones, and how, in turn, the marginal lands have induced a counter-effect on the riverine zone? This paper argues that water can reshape the 'political', in the modern times, by way of using it as enriching/impooverishing means of production, by contributing to generating population displacement and environmental catastrophes, or simply by becoming the major natural resource under a condition of environmental stress. The Nile water has played a significant role in transforming the nature of national economy and politics in the Sudan. The development of the river has contributed to creating regional disparities whereby the river's zone in central Sudan has hosted the major development projects that have enriched its vicinity, while the remote regions were neglected. The concentration of economic development in the river's vicinity has been a factor of displacing the then traditional farmers and pastoralists who were pushed to (and overwhelmed) marginal lands away from the river vicinity. The final consequence of these developments was the degradation of these marginal lands setting at risk the communities that dwell in them. The political economy of using and controlling the Nile waters has made of the Nile and the environment outside its riverine zone two separate worlds where the resources of the former are just enough for the riverine population while the poor marginal land dwellers should scratch at their depleting resources. The drought of the 1980s had come as the *coup de grâce* leading to the collapse of subsistence economies and mass displacement of the population from marginal lands to the riverbanks (mainly urban areas) as the major remaining survival niches.

Apart from the immediate burden that displacement adds to the Nile waters, it has political repercussions that manifest in change of the demographic-political map in the Sudan. It has broken the border between the world of poverty and the world of abundance, generating scarcity in the latter and inciting conflicts between beneficiaries from the river development and those impoverished by that very development. A significant change in the demographic-political map is more likely for two reasons. First, the enormity of displacement whereby 29.1% of the total population of the Sudan were displaced in 1988, ranking it the top of countries, which host internally displaced persons. Second, the displaced people carry with them, to the recipient areas, their social organisation, perceptions and political bias. Presenting a demographic pressure, the displaced can influence the existing electoral-political map and affect the state's discourse. In this respect, this paper argues that displacement in the Sudan has broke open the 'political', brought serious ethnic and religious discourses to the domain of real politics, and transformed the power bloc. While the overall change affects the political weight of groups that benefited from the development of the river, the ethnic and religious discourses aggravate the national strife between southern and northern Sudan and ultimately redefine the relationship rural/urban. At the international level, this change affects the historical 'unity of the Nile Valley' (deemed to be between the Sudan and Egypt) that was preserved and regulated by the sustenance of the old demographic-political map. In the same token, this change invites new inter-state alliances determined by the necessities of the new demographic-political map. The change of the Sudan's attitude towards Egypt and Ethiopia in the 1990s thus will be considered.

16. Juan M Mates, Spain (255)

Water Supply in Spain (1840-1870): A Service between Private Firms and Municipal Control

In this paper we intend to analyse the evolution of the gestion of fresh water public service in 19th and 20th centuries, particularly from 1840 to 1970. Fresh water supply is presented as a common good traditionally managed by town councils. During the second industrial revolution new models of consume appeared as well as private firms trying to satisfy the rising demand.

The evolution of the process is clear. At the beginning of 19th century water supply in towns was managed by the municipal gestion. From 1840 a new tendency appeared and a great number of firms managed this service in Spanish cities. But a new change took place in 1939, when the town councils adopted a strong intervention policy, and most of them took the control of

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public water supply. Along this period we notice the service alternate with the private firms and the municipal gestion, that is what we have called a "round trip" process.

We expose the reasons of the changes and why water supply is a sector between public and private interests. This theme is interesting for Water in History for several reasons. First, The context is the process of creation of a new service: fresh water in modern sense, due to its quality and quantity, together with other technical aspects –house distribution network, pressure supply-, representing a new economical and social concept perfectly associated with the second industrial revolution. Other aspects of the context are urban process, industrial technology and scientific development.

Evidently this is a great change in terms of demand: urban growing and rising of standard of living made a great water consume and a diversification of uses (household, industrial, recreative, parks, gardens, municipal cleaning, etc.) These new necessities demanded new water resources. Technological development gave some of these possibilities: hydraulic power engineering, development of pumps, treatment for the quality of water, etc. Besides, advances in medicine –sanitary hygiene related to water consume-, and changes in hygienic habits promoted a great interest for quality in fresh water.

17. Steve Matthewman, New Zealand (224)

Science in the Social Sphere: Weather-Modification and Public Response

This paper offers a critical examination of scientific attempts to tap the "rivers of the sky". The last four decades have seen weather-modification oscillate wildly between pseudo-science, orthodox science, and now, bad science. Paradoxically, widespread private scientific skepticism towards weather-modification has been matched by wholesale public belief in its efficacy. Weather-modifiers have been accused of causing drought instead of creating rain, of ruining harvests rather than encouraging cultivated wealth. The question of ownership of the weather cuts to the heart of these disputes. Who has the right to commodify and command it? These questions have inflamed individuals, communities and even populations in whole countries.

Far from being an interesting aside in meteorological history, weather-modification lurks perpetually on the policy horizon. To therefore ignore the circumstances under which weather-modification was first legitimized is foolish, since the recurrence of these material conditions could reinstate its scientific position despite scanty evidence of its efficacy. It will be argued that not only is the current practice of weather-modification a waste of time and money, it also postpones pressing decisions regarding water allocation and conservation, and annoys a lot of people in the process.

In the final analysis, attempts at weather-modification illustrate many key issues surrounding the relationships between and among science, technology and society. The weather-modification story tells us important things about the problems that arise when there is no time lag between a supposed breakthrough and its subsequent application, the difficulties that scientists encounter when working in politically charged atmospheres, and the problems that follow when such work intrudes upon the public domain.

18. Mario Montoya Brand, Colombia (14)

Predicting the failure of the water resources management's politics in Colombia

The article I propose, allow us to predict the failure of the water resources managements politics in Colombia. These politics try to control and stop waters destruction either qualitative or quantitative, but they are based just on technical ecological supposition.

That seems to be true in the fact that the main causes of water deterioration have political forms, which identification and solution haven't been considered by the people encharge of water politics. These causes are: a) the Colombian State hasn't territorial control, this control is on dispute by armed actors that aren't just the guerrillas or paramilitars; b) the state never did territorial presence in zones of high water wealth, that is why it (the state) doesn't represent credibility in population; c) the design of water politics has been a state monopoly, excluding population proposes who's entail just for the fulfillment of politics works; d) the public nature of water resources is just a normative declaration without real effects, because their accessibility, control and following are determinate by public and private intermediaries (bureaucracy and multinationals); e) in Colombia the concern of environment is settled in a difficult context for a public couple of reasons: In one way, the basic needs of security and food of population haven't been satisfied, and in the other side, neither the State or the territory are perceived as own, which decrease the sense of collective action that can be understanding in favour just for a few ones.

However what has been said before and further the supposition today doubtful that Colombia is a violent society, the comunitaries organizations are building relations of cooperation and solidarity around the water resources that frequently has been hostigueted for conflict dynamics or desestimulated for the state's incapacity of recognized and aglutinate interests.

In this way, the water problem is based more on mass media than in the collective imaginary and is closer to become a control mechanism that pretends to generate obedience, attachment or savings to the main hydroelectric enterprises than in a true social problem.

19. Daniel Murillo Licea, Mexico (166)

The Hacienda of San Nicolás de los Agustinos, Gto., México. A Water Conflict Story

Since 1580, the Hacienda of San Nicolás de los Agustinos, in the state of Guanajuato, was the biggest hacienda in colonial Mexico. From 1583 to 1585 there were granted water and land rights in that zone, know as Salvatierra and Valle de Santiago. The conflict story is about the water rights granted by the Spanish Real Crown for all the haciendas in that area that had repercussions in the year of 1919 when the proprietaries of the haciendas of Santo Tomás, La Magdalena, la Zanja, La Bolsa, Grande, Santa Mónica and Pastores, neighbours of San Nicolás, claim for their water rights. To the Secretary of Agriculture

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(Secretaría de Agricultura y Fomento) there were necessary to make a review of old documents, including a Real Provision to determinate the water volume granted to San Nicolás and a geographic description about the situation of the small rivers that were connected to the Río Grande or Río Lerma. The story is, then, the story of a water conflict unresolved from 1585 to 1930, and it is a perfect case to explore the possibilities about the origins of the conflicts for the water and its social and cultural significance.

20. Jouni Paavola, UK (47)

Bargaining on Water Quality: Industrial Discharges, Water Pollution and Common Law in the 19th Century United States

This paper examines how riparian law governed industrial water use and especially its effect on water quality in the United States from the early 19th century until the First World War. Its aim is to explain legal change and to identify its distributive and other consequences. The paper is based on the analysis of old court cases, other legal documents, and secondary literature.

The paper's first section discusses the nature of early mills and the water use problems they created, of which the flooding of upstream riparian land was the most common. The section also examines how early riparian law governed the mills' use of water, protecting other riparians' use of land and water strictly as their absolute property.

The second section examines how the size and number of mills increased in the early 19th century, transforming the water use problems. It indicates how larger mills now flooded the water wheels of upstream mills in addition to riparian land. Their diversion of water and disposal of wastes also injured downstream riparians. The section analyses how these changes pushed riparian law to change and resulted in the adoption of the doctrine of reasonable use. This doctrine allowed mills to harm others within certain limits without compensation.

The third section examines how the doctrine of reasonable use was applied in water pollution litigation and transformed into a balancing test in the mid-19th century. The balancing test enabled industrial water users to take water rights of others for their private use even without compensation, if the industrial water use was more valuable. The section also discusses variants of balancing test and their consequences for the distribution of wealth and water use.

The fourth section examines the counter-reaction to balancing at the turn of the 20th century. The size of industrial establishments had grown significantly by this time and their effluents often included chemical and toxic compounds. The adverse consequences were felt often by a very large number of people. The power of big business also met increasing criticism during the Progressive Era. The section examines how these developments pushed riparian law to give better protection against adverse industrial water users.

The concluding section seeks to explain the change of riparian law in the examined period. It demonstrates how common law gave stronger incentives and opportunities for industrial water users to protect their interests in the courts than it gave to those harmed by industrial water use, resulting to legal rules that favoured industrial water users. The chapter also indicates the role of changing values and water use problems in legal change. Finally, the section examines the role of the availability of abatement methods for the evolution of riparian law.

21. Amreeta Regmi, India/Nepal (29)

Trajectory of Regimes, Regulations and Rights from Traditional to Contemporary Urban Water Uses in the Kathmandu Valley: A View from the Window.

Water has generally been perceived as a common property resource, which, with the current urban forces at play, has given rise to various interpretations of entitlements and rights. With modern trajectories, water rights become complex and are construed differently in an urban context. This paper presents an analogy between traditional and modern drinking water arrangements in Kathmandu Valley in the backdrop of normative and empirical understanding of water uses. In this process, social and economic valuations of water provide aspects of the past and the present, the traditional and the modern.

The physical determinants of traditional stone waterspouts or *dhunge dharas* reflect a construction that not only enhances the aesthetic quality of the environment but also embodies the diverse socioeconomic lives of the city that co-exist in harmony. The attainment of an urban order is attributed to the syncretic composition of water in the overall urban organization. The advent of modern water supply system altered traditional regimes and regulations influencing the responses demonstrated by users, reminiscing of rights from individualized to self-help demands. The overlapping uses within the frameworks of customary and statutory regimes present anomalies between the perceptions of traditional and modern rights to water.

This paper presents the perspectives of the local water users and how they conceive their appropriation of water. Through observations, surveys and studies, evolution of rights, control of resources and access to water in the urban domestic sphere are synthesized, juxtaposing the changing water use patterns and the significance of the institutional evolution within an organic urban community.

22. John Sheail and Simo Laakonen, UK/Finland (71)

The Stockholm Conference, The 1970s, and Water Resource Management – an Historical Perspective

In a self-promotional commentary on "the politics of survival", Friends of the Earth emphasised how the world's environmental problems would not be solved by the Stockholm Conference of 1972 – they would be with us for a very long time. Much less explicitly stated was the fact that, however novel the methods and impact of the burgeoning "green" movement, the problems had also been recognised and tackled for many years previously. Far from modern scientific-technological environmental protection emerging almost out of the blue in the 1960s, the progress made in managing the behaviour and purity of both rivers and coastal waters had already achieved much in terms of "postponing doomsday". AS well as marking a further beginning to the conservation movement, the success of the Stockholm Conference owed much to the recognition of the improvements already

made and, therefore, the confidence that considerably more might be accomplished. Illustrative material is drawn from earlier experiences of Great Britain and the Nordic Countries.

23. Martin Griffin Smith, USA (73)

Enforcing Property Rights in Western Water Resources: Is It Better to be Upstream with a Shovel, or Downstream with a Model?

The West's doctrine of prior appropriation is a property rights based system. Historically, this system has been administered in the field by an extensive, but unsophisticated network of simple measuring devices and the ditchriders, water commissioners and state engineers who manage the system. As the West grows, ever increasingly competing demands stress resources. States expect their full compact entitlements, cities covet every drop they buy and transfer from farms but farm communities want to make sure that they get nothing more; those with transbasin water endeavor assure that it is used to exhaustion.

Innovative technologies offer means for resolving these issues. While a property right, water is also a fugitive resource. Knowing where your water is requires tracking it over space and time. New technologies make this possible. This paper will focus on technological innovations being used to clearly define property rights to water in the West. Our aim is to show how technology can not only protect existing property rights, but in doing so, make it possible to reallocate water to serve society's changing demands on the resource. Two cases will be examined - the middle Arkansas River Valley of Kansas and Colorado and interbasin transfers by the city of Colorado Springs.

The middle Arkansas River Valley provides an example of innovations in monitoring and computer modelling that resulted in quantifying the volume of Arkansas River to which the states of Kansas and Colorado are entitled under the 1949 Arkansas River Compact. For a compact to be effective it must be enforceable. The Arkansas River Compact failed as an enforcement tool because the framers did not clearly establish property rights, in the form of a specific quantity or percentage of Arkansas River flows, to which the states of Kansas and Colorado are entitled. In 1986 Kansas brought suit against Colorado alleging damage under the compact. This case finally proved what Kansas has been alleging for most of this century; continuing water development in southeastern Colorado diminishes usable flows for Kansas's irrigators. Kansas' success in the 1986 case is largely attributable to advancements in monitoring technology and a better understanding of hydrologic connections between surface and groundwater flow. Improvements in database technology allowed Kansas to integrate the extensive data set needed to support their case while advances in computer modelling allowed results of a model rather than streamflow measurements sustain Kansas' claims of material injury to property.

Colorado Springs imports a significant share of its water supply from the Colorado River basin. In contrast to "native water", which can be used only once, transbasin water may be used by the importing entity, over and over again to exhaustion. However, using this water to exhaustion requires first tracking it through the city's potable and non-potable systems, then onward downstream into exchange agreements (trades) with other water users. This high degree of resource utilization requires not only thorough monitoring and measurement, but also detailed accounting for both direct returned surface flows and delayed return groundwater flows. In tracking its transbasin water, Colorado Springs uses realtime monitoring of streamflows via satellite uplinks from gaging stations. Integrating this realtime data through the City's water model allows engineers to specifically identify surface flows attributable to water imported by the city. This water can then be either exchanged for native flows belonging to downstream appropriators or sold.

In contrast to many other natural resources, western water law was founded upon a strong property rights tradition. This doctrine is currently under attack from many sides – by those who feel it fails to adequately protect the public's interest in instream flows; by basin-of-origin communities; by those who believe it provides insufficient incentive for conservation; by federal reserve water rights interests. Without new storage, resolving these conflicts will come through reallocating existing supplies. New technologies such as satellite monitoring of surface flows, sophisticated computer models and improved data management and analysis are the key to this reallocation because they help assure that property rights are protected.

24. Devi Tewari, South Africa (128)

The History of Water Law in South Africa

South Africa is an extremely water-stressed country. Because of aridity and recurring droughts, water has been a key concern to rulers from times immemorial. The current paper would review the historical development of water law, more specifically from 1653 when first colonization began in the Cape by Dutch people. Dutch law treated water as a national resource and private rights were not granted. Later, when British took over of Cape, they instituted private rights to water. This continued for a long time until the latest law on water in 1998. The new water law entrusts the national government with the responsibility of water resource management for the best of the society. The paper would also discuss the economic impacts of these laws.

25. Motlatsi Thabane, Lesotho (27)

Ownership, Benefit and Power Relations in the Terms of Lesotho's Highlands Water Project

Lesotho is home to one of the largest water projects in the world, the Lesotho Highland Water Project. It is envisaged that when the Project is completed, a series of dams will have been built in the highlands of Lesotho together with a network of tunnels connecting them. The primary aim of the project is to sell water to the more economically developed and politically stronger South Africa, which also happens to be Lesotho's only neighbour. Secondly, the project aims at making Lesotho self-sufficient in a resource for which Lesotho has always depended on South Africa, electricity, by generating hydro-electrical power from the water as it delivered to South Africa for sale. The first phase of the Project had been divided into two further phases and the first

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one of these has already been completed while the second is due to be completed a year's time. Up to this point, the work of the Project has resulted in disruptions in which highland communities' lives have changed for the worse. In particular, communities whose villages are due to be inundated have been forced to new areas and to environments to which they are not used and which are not suited to their lifestyles.

The questions that the paper that is being proposed here will look at will include: Notwithstanding the fact the source of the water is in Lesotho, is the country in a position to negotiate favourable terms on which to sell its water to South Africa or do circumstances such as the fact that South Africa is the only potential buyer of Lesotho's water and the country's political and economic weakness vis-a-vis South Africa work against Lesotho's and in favour of South Africa's interests? In other words, to what extent does the agreement between Lesotho and South Africa reflect a relationship of an owner and seller (Lesotho) on the one hand, and a seeker and buyer (South Africa) on the other? These questions rise further and more general questions of whether weaker countries can use ownership and control of resources found within their borders to extract more favourable terms from stronger and powerful countries that need such resources? This latter question is even more pertinent in the case of Lesotho's water, which (a) Lesotho does not have the resources to harness, and (b), which therefore ends up in South Africa anyway. Water is an ecological resource and as with all other ecological resources, its exploitation and use have an impact that extends beyond the boundaries of the country of its source. Given that Lesotho is a poor country that cannot afford a proper management of its environment in general and more specifically its water, should the water originating Lesotho's highlands be treated as a regional asset?

Despite the fact that Lesotho produces more electricity than it needs, the Lesotho government still pays large sums of money to South Africa's Electricity Supply Commission, on which Lesotho depended for its electricity supply before the establishment of the hydro-electricity scheme. This is also true of Lesotho's water supply. Even after the delivery of water to South Africa began rural and urban communities continued to depend on water supply systems that operated before the construction of dams supplying water to South Africa. Not only are these systems old but the growth of the urban areas particularly has meant that these sources are increasingly becoming inadequate and many are occasions when the people of Lesotho experience water shortages while supplying South Africa with water. Has the process transforming Lesotho's water from a communal resource to a commodity to be purchased solely by South Africa taken place at the expense of the people of Lesotho?

The government has used the revenue that has begun to trickle in from the sale of water to launch a number of schemes, which are intended to alleviate poverty in Lesotho. The paper will also examine the manner in which these schemes have changed the lives of Basotho and the economy of the country in general.

26. Joao Luiz von Hoeffel, Brazil (102)

Regional Watersheds and Development in Metropolitan São Paulo

The São Paulo Metropolitan Region (RMSP), comprising an area of approximately 8,000 km², concentrates the largest urban conglomerate and industrial complex in the southern hemisphere. The 39 counties that together make up this metropolis presently hold a population of around 17 million people; corresponding to about 10% of the Brazilian population. The majority of the world's metropolitan areas have developed along coastal strips and the margins of fast flowing rivers; Greater São Paulo however, has developed in an area that although criss-crossed by springs is naturally low in water availability.

Besides this quantitative aspect of low water availability, the development model adopted by the State of São Paulo has historically relied on the use of natural resources without incorporating even minimum conservation precautions. This practice has determined a substantial reduction to the supply of drinkable water. As an alternative, it has become necessary to make use of increasingly more distant watersheds, resulting in high cost undertakings such as the implantation of the Cantareira damns system at the end of the 1960s, in order to transport water from other watershed basins.

Although it has partially resolved the problem of supplying Greater São Paulo with water, the damn system has also resulted in a substantial reduction of the flow of water available to other urban centres; generating serious conflicts, especially for the Campinas region, one of the principal social - economic development areas in the state's interior. The objective of the work presented is to analyse, within a historical perspective, environmental problems generated by the use of regional watersheds in the development of Metropolitan São Paulo, along with present day efforts being made to implant policies and programs in order to maintain water resources, through preservation of natural vegetation, the implantation of public sanitation infra-structure, and the recuperation of degraded areas.

27. Eberhard Weber, Fiji (218)

The Political Economy of Water Supply in Madras, South India

For many years Madras is known for its huge problems in supplying enough drinking water to its citizens. In 1993 the situation was especially bad: rainfall during the monsoon season between October 1992 and January 1993 was much less than normal. The three water reservoirs at the outskirts of the metropolitan area held water enough until March 1993 and the next substantial rainfall was expected only after October 1993. The Government of Tamil Nadu and the Madras Metropolitan Water Supply and Sewerage Board (Metrowater) had to prepare for seven long months with scarce water to distribute among the more than 6 million inhabitants. The paper takes its beginning at the water crisis of 1993. It presents a detailed analysis of the measures taken up by various administrative units in Tamil Nadu and shows how the water crisis could be averted for a section of the population. In a second part however the paper indicates that a huge proportion of Madras's population is suffering from inadequate water supply not only in years like 1993 but also in "good" and "normal" years.

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The paper analyses what water scarcity means to poorer sections of the population living in slum areas that are not served by the distribution network of Metrowater. It asks why water supply in Madras is erratic and not sufficient despite the fact that since the early 1970s plenty of money was spent and several projects were started to ease the situation. By analysing the Political Economy of Water Supply in Madras the paper concludes that competing powers at the State level (of Tamil Nadu and a number of other Indian states involved) and the Central Government (of India) are responsible for not completing the projects and not solving the problem of scarce and erratic water supply in a satisfactory way.

28. Geof Wood, UK (124)

Contesting Water in Bangladesh: Knowledge, Rights and Governance

Management of water pervades the entire society and economy of Bangladesh. Inundation is a regularly recurring fact of life. In rare years, there is excessive flooding which causes serious damage to people, their shelter and their crops (a mainstay of their livelihoods). More often, the rainfall is inadequate creating a drought. Every citizen in Bangladesh has a legitimate and acute interest in water policy.

The Flood Action Plan (FAP) has dominated policy formulation in water resource management in Bangladesh during the last decade, and the management of surface water will continue to dominate the livelihoods of most people in the country, more directly for some than others. The policy process to date has been ridiculed by many critics (e.g. Adnan 1991, or Boyce 1990) as a donor, capitalist or engineers' conspiracy with knowledge and argument apparently manipulated through power structures and vested interests rather than rational thought reflecting both popular interest and sustainable objectives. At the same time, with such a centrally important natural resource determining so many other features of life in Bangladesh: first, it would be surprising if there was no controversy; and second, it would be irresponsible if there was not an entire library of research, action-research and consultancy reports (see the library held by the World Bank in Dhaka). Nevertheless, the policy process has revealed key weaknesses, reflecting an over-limited approach to stakeholding restricted more to actors with claims to scientific and technocratic expertise. In short, there has to date been a problem of participation, and this is likely to continue from policy into practice and iterations between them (Adnan et al 1992). Water management is a democratic not a technocratic issue. Such problems of participation are not unique to the water sector in Bangladesh; nor, of course, are they unique to Bangladesh. However, in the context of national level water resources management, these problems reveal deep issues about rights, citizenship, governance and appropriate institutional forms for managing commons resources (conceived especially in terms of relations between the state and community/civil society).

This paper is based upon two recent exercises related to the FAP. The first was as a member of the Independent FAP Review Mission (Faaland et al 1995), and original drafter of the report. The second was as a reviewer of the Ministry of Water Resources 'Guidelines for People's Participation in Water Development Projects' (Wood 1996). Both of these exercises were facilitated by UNDP to open terms of reference.

29. Mao Xianqiang & Li Xiangqian, China (225)

Institutional Reform in China's Water Environmental Management System and Aquatic EKC Analysis

China's rapid social and economic development has made water pollution an increasingly serious problem in recent decades. Recognizing the importance of this problem, the Chinese government has established and implemented numerous pieces of environmental protection legislation in urban areas. The types of legislation range widely, including command and control measures, environmental economics instruments, rational water pricing and wastewater emission charge systems.

This article will review the evolution of institutional reform in China's water management system in urban areas and industrial sectors, and analyze parallel developments in the evolution of water pollution management. The Environmental Kuznets Curve (EKC)—though still an ambiguous and disputable methodological approach according to some environmental economists—is used to illuminate the relationship between the water environmental situation and economic growth in case study Chinese cities. An econometrically based analytical proof mapping how institutional reform could alter the path of water pollution against the broader background of China's economic reform and development is also included. The concluding section of the paper offers policy recommendations based on rational institutional reform in water environmental management legislation and economic instruments for developing countries. The ultimate goal of the policy recommendations is to suggest a means for institutionalizing general sustainability.

Keywords: Water Pollution, Environmental Kuznets Curve, Water Environmental Legislation, Economic Instruments, Institutional Reform

Images of water in religion, myths, literature and art

This session will deal with different aspects of the cultural construction of water – from ancient days until contemporary time. We are calling for papers on for example the role of water in the world religions, myths of rivers as a source of life, and water as an object of art. Other themes could be the free flowing river as a state of equilibrium or as a chaotic and violent nature meant to be controlled by man.

1. Daniel Aberra, Ethiopia (116)

Portrayal of Reflections about Rivers and Water in Ethiopia: A Study of Amharic Songs and Proverbs

The objective of this project is to draw attention to the songs and proverbs of various Ethiopian languages depicting various aspects pertaining to rivers and water, specifically in this paper the official language of Ethiopia, Amharic with 35% speakers of the total 60 million people of the country have been studied. The study highlights on the performers of songs and proverbs – the people. Their perceptions, responses, feelings and attitudes with the underlying assumption that songs and proverbs are repositories of people's unguarded reflections and images of their world outlook.

In order to do so therefore 10 songs and 250 proverbs with themes on rivers: (Nile (locally Abbay), Awash and Omo and water have been considered in this study as a sample. These have been analysed thematically for their metaphoric and connotative meanings and sociolinguistically for their cultural, social, economic and historic backgrounds and nature.

The result indicate that oral literature, mainly songs and proverbs are an indirect and unguarded access to people's images, feelings, conceptions and reflections. The River Nile is especially depicted as a source of demise for Ethiopia by being enemy from her strong neighbouring countries like Egypt and Sudan. Moreover, the songs and proverbs express the contempt of the people towards its uselessness in the country.

In view of this, the study-paper suggested the need of an in-depth study of the literature heritages of other Ethiopian languages including of course Amharic that focus on rivers and water. They i.e., the songs and proverbs (the literary heritages) re manifestations of the creatively, dynamism and vision that people exhibited in their attempt to conceptualize, explain and recreate rivers' and waters' images.

2. Daniel Alemu, Austria / Ethiopia (114)

Discourse analysis of Claude Sumner, Hailu Gabre-Yohannes, Tsegaye Gabre-Medhin Poems on the Blue Nile

The article makes a preliminary enquiry into the nature and significance of poetry that takes as its subject matter Blue Nile, which more than its counterpart the White Nile was responsible for the rise of Pharonic Egypt, one of the earliest civilizations of mankind. It provides a modest anthology showing the following range of sentiments: nostalgia for the history of Ethiopia, philosophy, profound appreciation for its identity and marvel at its scenic beauty, especially that of its great cataract locally known as Tiss Issat (Smoke of fire). These deep feelings, however, are manifested in sonnet and poetry forms reflecting history, philosophy and theology, poetically juxtaposed with wrath and indignation at the utter indifference and destruction the river brought home with the enormous benefits it rendered abroad.

The article first and foremost shades light on the historical, philosophical, theological and political background of the poems to be analysed in an effort to decipher the embedded meanings of the sonnet and poems of Claude Sumner et al using the linguistic method called Discourse Stylistic Analysis. This analysis utilizes an intuitive response to be followed by a linguistic analytic description.

In my conclusion, I underline the need for the riparian states to seek a peaceful solution in harnessing the bounty of the Blue Nile River. Therefore, cooperation must take place, concerning the river Nile. The lack of clear general rule, necessitates the riparian states to resort for a peaceful solution based on sustainable agreement and equitable distribution of water in the region. Peace in the "Great Lake Regions" squarely depend on the ability of the riparian states to respect their needs in mutual consent.

3. Mukerjee Aniruddhe, India (324)

Religious Activities and Management of Water Bodies. Case Study of Idol Immersion in Context of Urban lakes Management

Immersion of idols by Hindus and taking of tazias possession by Muslims are old traditions in all parts of India. After completion of the festival idols and tazias are immersed in water bodies which are nearby or accessible to the people. Earlier the immersion used to be done in the lotic water resources but now people have started using lentic water bodies too. The urban settlements have limited water resources which are accessible to the people, so people have started using even small lentic water resources for the immersion of idols as per their convenience. It is immaterial for them that the water resources get polluted, whether they are being used for drinking water or have other important uses but rituals are performed all the same without considering the environmental consequences or impacts.

The idols of Lord Ganesh and Goddess Durga worshipped by Hindus are immersed in the month of September and October respectively every year. Similarly during the Moorum festival, tazias are being immersed by Muslims in the month of May every year. The idols are been made up of Clay, Hay, Cloth, Paper, Wood, Thermocol, Jute, Adhesive Material, and Synthetic Paints etc while tazias are made up of almost same material except clay. Out of the all material used in making the idols, Thermocol is Non-Biodegradable while paints contain heavy metals such as Chromium, Lead, Nickel, Cadmium and Zinc.

Upper lake of Bhopal is an example where even a sources of potable water is being used for idol immersion. Similarly the well known Buda Talaab of Raipur and Hanuman Taal of Jabalpur are examples of water bodies which are being used for idols immersion and other rituals. The famous Pichola lake of Udaipur, Rajasthan is also used for idol immersion. It has been observed

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that religious activities and way of worship, performing of rituals are somehow closely linked with the water bodies. Earlier such activities were linked with the reverse but now people are using lakes, ponds, tanks etc for the same.

Immersion of idols after the rainy season allows the biodegradable and non biodegradable matter in the water bodies to settle down. This leads to eutrophication of the water bodies. The bio-degradable matter after decomposition recycles to the system while non biodegradable substances form sediments. The recycling of bio-degradable components directly enters to the food chain of aquatic ecosystem and accumulates in the different parts of the plants and animals. The bio-accumulation of heavy metals in biological system transfers the toxic element from producer to consumer level which can be a future health hazard. This contribution addresses the highly sensitive issue and attempts that are being made to tackle them.

4. Adrian Armstrong and Mary Hancock (330)

A Christian perspective on water and water rights.

Although Christian origins are deeply imbued with imagery of water as the source of life, western Christian theology does not say very much about water. Indeed, it can be argued, along with Lynn White, that because of its strict segregation of this world and its concerns from the divine world, Christianity is in some respects responsible for some of our current environmental problems. Nevertheless, there is also a strong basis in Christian theology for a concern for creation. We can base this on a variety of parallel insights derived: a) from the incarnation, b) from the love of God for all creation, and c) from the Christian social gospel. Ultimately we cannot follow a God who teaches us to love one another without translating that into a full demand for Water Rights for all human beings. But the command to love also extends to the whole of creation, and so leaves us with the problem of balancing the needs and rights of all creation, both human and inanimate: both the human need for water, and the place of water in the whole earth ecosystem.

5. Jon Askeland & Alvaro Ramirez, Norway (211)

Images of water in films from Latin-America

The New Latin American Cinema of the sixties had a clearcut political profile and dealt to a large extent with social and economic issues in a direct manner. The film was considered an important weapon in the political struggle and was supposed to contribute to raise awareness about inequality and injustice. One of the socio-economic problems presented had to do with the unjust distribution of fundamental natural resources like land and water.

More recent films like the ones Fernando Solanas made in the nineties ("The Voyage" 1992 and "The Cloud", 1998) present a new approach to the same subjects and the images of water acquires new symbolic and allegoric meanings.

6. Fred Batengaya, Uganda (41)

Hydro-development and its victim. Has the Collapse of Traditional Religion Arrived?

Regardless of the level of development, all known societies have certain basic needs which have to be met in order for people who live therein to lead a complete life. Besides the conventional basic needs - Shelter, food, and Medicare – are other needs that are many a time underscored or forgotten altogether whenever mentioning basic needs. Some of the underscored needs of people are the psychological and spiritual ones. The purpose of this paper is to recount the psychological and spiritual needs of an African Community amidst development interventions and other related influences from the West.

To satisfy their psychological and spiritual needs African people turned to a religion, which various writers have called the traditional African religion. This is a religion, which sits the level of development and is thereby practiced within that framework, a fact which is reflected by the places/areas where it is practiced/performed namely, forests, hills and water bodies, rivers, lakes, stream. As a point of reference, this paper will focus on the significance of water bodies in Traditional African Religion in contemporary African Communities that live on the banks of river Nile.

Traditional African Religion dates back to the days before the continent came into contact with the outside world. At that time, the river Kiira as it was called then belonged to Katonda (God) but kept by Balubaales or spirits as there were no central administrative and international structures to look after it. However all this changed with the penetration of colonizers as not only were administrative structures put in place to pacify the Africans who had resisted colonialism but also new religions were introduced to help them in this effort.

Despite the gusto with which the Western religions were spreading, they didn't affect or conflict directly with the Traditional African Religion. Due to the similarities in view of water as spiritual symbol shared by both sets of believers there arose a dualism of sorts as some Africans embraced the Western religions but also continued with theirs. This dualism has persisted because there has been no competition over space between the two. Furthermore the timing of the two does not conflict, as they are carried out/performed at different times. The paper will explore in detail these and other reasons for the dualism and the future of that dualism in face of major development interventions.

However this dualism is about to be affected as a result of the impending construction of a second dam, just less than 10kms from the Owen Falls Dam, which is to start sometime in the year 2001. With this Hydro Development project, there is going to be an inevitable competition over space between the project and Traditional African Religion institutions like shrines, sacred spots and other functions (All found in the flowing river).

The likely changes in Traditional African Religion that will happen in the event of this development intervention will be: limited access to the free flowing river which is seen as purifier, destruction of shrines which are places of abode for spirits and change in definition and explanation about spiritual symbolism of water, which three are all pillars of the Traditional African religion.

7. Kate Berry, Nevada/Hawaii, USA (77)

Changing Narratives of Water Control in Oahu, Hawai'i

During the last quarter of the 20th century, water issues have taken on increasingly prominent roles in the efforts of native Hawaiian (or simply Hawaiian) activists and their supporters to reclaim and protect Hawai'i. Revisions to the state constitution as well as the state water code, made at the insistence of Hawaiian activists, establish a framework for protecting water rights on Hawaiian homelands and recognizing limits to water use. Testimony on water issues by Hawaiian community groups in court cases and administrative hearings have resulted in legal decisions which consciously rely on water use concepts in place during the Kingdom of Hawai'i and earlier. Furthermore, a growing number of educational books and films about water issues in Hawai'i aim to communicate the magnitude of water problems for readers and viewers throughout the archipelago as well as across the United States and point out solutions that would reinvigorate Hawaiian communities.

This paper considers how historical concepts about water are being recovered and used by Hawaiian activists by focusing on one of the most prominent contemporary water conflicts in Hawai'i, a conflict about control over water from the Waiahole Stream and adjacent streams on the windward side of O'ahu. For nearly ninety years water from these windward streams was diverted and sent through a tunnel to provide irrigation water to the leeward sugarcane fields of the largest agricultural companies in Hawai'i. Declining export markets for sugar led many small windward farmers and Hawaiian community organizations to tackle efforts to keep water in windward streams rather than diverting it to leeward side. In recent years these windward groups and the Hawai'i Supreme Court have used concepts of water use originating during the era of Kingdom of Hawai'i to recognize that waters should be retained in Waiahole and other windward streams. This paper will discuss various types of narratives surrounding the Waiahole stream controversy, including books, media coverage, online sources, and legal/administrative testimonies and decisions, to examine changing narratives of water control in Hawai'i.

8. Mauricio Borrero, USA / Russia (52)

Lake Baikal: Frontier and Icon

Located in southern Siberia, close to the Russian border with Mongolia, Lake Baikal is one of the true wonders of nature. This paper examines the history of the lake from two interpretive perspectives: as a frontier region and as an icon of religious and environmental significance. It is part of a larger history of Lake Baikal that I am currently researching based on Russian, English and Buriat sources.

In pre-Soviet times, Baikal served as an internal, multi-faceted frontier of an expanding Russian Empire. For generations of political exiles it became a *political* frontier. For government officials and engineers building the Trans-Siberian railroad to link Moscow with the Pacific Ocean it became a *strategic* frontier, since the lake was the last natural obstacle preventing its completion. For ethnographers, limnologists and other scientists attracted by its cultural and natural diversity Baikal became a *scientific* frontier. Finally, Baikal became a *religious* frontier where Christianity from the west and Buddhism from the south met and superimposed themselves on the shamanistic traditions of the indigenous populations.

Religion and environmentalism have been the main sources for Baikal's iconic status. The lake has long had a sacred meaning to its original inhabitants and to the Buriats, a Mongol-speaking people who had migrated to the area by the sixteenth century. In the 1960s, public uproar over plans to build industrial in the vicinity of the lake marked an important stage in the development of a Soviet environmental consciousness. In the 1980s and 1990s, the struggle to protect the lake achieved a place of prominence in the global environmental movement, a process best symbolized by UNESCO's addition of Baikal to its list of World Heritage Sites in 1996.

9. Michael J. Chiarappa, USA (280)

Cries Across a Freshwater Sea: Oral History and Lake Michigan's Contested Fisheries Legacy

Cries Across a Freshwater Sea: Oral History and Lake Michigan's Contested Fisheries Legacy Following World War II, the debate over Lake Michigan's fisheries became acute as four stakeholder groups—state government, commercial fishers, sport fishers, and Native Americans—made highly vocal and strident claims to the fisheries resources of this ecologically sensitive freshwater basin. The documentary record commonly depicts this history of contested viewpoints as emerging solely from two abstract issues: allocation of the resource to respective users and conservation to insure greatest economic return. While financial interest is critical in the positions taken by each group over the past fifty years, oral history reveals that each stakeholder has, and continues, to historically construct and justify its claims through an array of cultural, political, environmental, and technological considerations. This paper examines oral history's capacity to illuminate the most longstanding cultural and political dimensions of fisheries claims on Lake Michigan. In short, oral history will contextualize the four principal stakeholder positions of the later 20th century: state governments re-claiming managerial control they had informally relinquished to the federal government; sport fishers creating what they saw as a more economically and ecologically sustainable fishery; Native Americans re-claiming treaty fishing rights in an act of cultural and economic re-vitalization; commercial fishers seeking to occupationally survive. These verbal expressions of the history of divergent Lake Michigan fisheries values will reveal paradoxical considerations that will continue to inform the evaluation of fisheries history and the formulation of future fisheries policy and stakeholder relations.

10. A. Damodaran, India/Canada (16)

Cultural Vehicles and Cases of Man-Water Relations in Rural India: Righting the Wrong

Traditional systems of man-water relationship in rural India mark the stamp of amazing complexity. Social and cultural factors have customarily served to guide and structure the economic utilization of fresh water resources in village India. Fresh water sources and resources has been for long a cultural symbol of the caste system. These intricacies have been however lost to policy makers. Program interventions attempted by the India's State apparatus to render water a truly socially egalitarian and

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ecologically sustainable natural resource have thus not taken off. Indeed, water policies of the State have tended to operate in a milieu of cultural neutrality both in pre-independence and independent rural India. This is natural given the fact that centralized State power had no means of capturing the local community idiom or enthusiasm for upholding the norms of local justice exemplified by 'village community republics'. The result is that high volume public investments made by the State in rural India to create self-sustaining hygienic water sources fail for want of cultural acceptability. This contrasts with the situation within rural communities where cultural vehicles are creatively employed to secure desired and advantageous adjustments in man-water relationships. Village communities of India creatively use cultural vehicles to blunt the edge of State driven water resource development and conservation programs.

This paper presents three cases from South India to advance its propositions regarding the relevance of cultural vehicles in regulating man-water relationship in rural India. Of the three cases, two are contemporary while one is historical. The first case is that of a semi-arid village, situated in a ground water depleted zone, which constructively employed "rituals" to mobilize the villagers to pressurize the Provincial Government of Karnataka to relax its prohibition on drilling of bore-wells. The second case is that of coffee plantations of the hilly Western Ghat zone of Chickmagalur District in Karnataka. These plantations when faced with notices of closure of their operations for discharging of waste water into freshwater reservoirs of low-lying communities, converted their victims (the lower-reach human communities) to their cause by invoking the spirit of the common cultural heritage of Chickmagalur District to which coffee plantations had significantly contributed. The third case brought out in the paper relates to the collapse of a public drinking water supply program of the Nizam of Hyderabad in the 1940s, to induce changes in water use habits of rural communities. The new "architecture and design" of drinking water wells introduced by the ruler under this program, in order to obviate the guinea worm disease, was culturally found unacceptable to the rural populations of the Hyderabad State. The result was the decline and collapse of these safe drinking water wells and the persistence of the guinea worm disease even to this day.

The thrust of the three case studies is to suggest that the cultural connotations of man-water relations in rural India have to be imported into policies and program interventions even where the objective of policy is complete restructuring of man-water relationship in the sustainable direction. The paper is narrative and analytical in its method and is based on the field level and archival work conducted by the author in India in the past 10 years

12. Erlend Eidsvik, Norway / Nepal (200)

Dimension of a River: Bagmati River in Kathmandu, Nepal

The Bagmati River in Kathmandu is a small river, but still a major physical feature in the townscape of Kathmandu. Its religious and cultural meaning in the Hindu-Buddhist society of Kathmandu Valley is of great importance. The Bagmati's religious importance is described in several religious Hindu-textes, and in a mythical context the river flows in the name of Saraswati, the mythical river from which the ancient Vedic society rose. The source of the Bagmati River is situated in the hills north of Kathmandu only 20 km from Pashupatinath in Kathmandu, the most important Hindu-schrine in Nepal. 10 km further downstream, at the outlet of the valley, several tributaries has joined the Bagmati River which by now has been converted into an open sewer. Due to the bowl-shaped topography of the Kathmandu Valley, the Bagmati River is the only drainage out of the Valley. As the river reaches the populated areas on the Valley floor it becomes heavily polluted by industrial and domestic waste, the latter being the most important. The river's status as a polluted river is rather a modern status, as it only 20-30 years ago was in drinkable condition, highly appreciated for its purity, both physical and ritual. 20-30 years ago many Hindu devotees conducted daily rituals on the banks of Bagmati River, but at present rituals concerned with the river are mainly performed during festivals, using tap water in stead of the contaminated river-water.

The reasons for the polluting state of the river can roughly be summarized as the consequences of increasing population in combination with lack of proper waste management, both domestic and industrial, and lack of sufficient sewerage-line system.

On this basis the main research question is: What happens to the holy meaning of the river when it become physical polluted? How do people conceptualize the river as it has become physical deteriorated? To get an idea of different perception of the river in terms of age, main empirical focus is young students and old ritual-practising people. The paper will deal with the different concepts of Bagmati people cope with, and try to go further into the concepts of holyness, purity, pollution, modernity and the meaning of the holy river. Fieldstudy for the paper was carried out in the period September 1999 – February 2000.

13. Evy Johanne Håland, Norway (150)

"Let It Rain", or "Rain, Conceive": Rituals of Magical Rain-making in Ancient Greece, A Comparative Approach

Rain-making rituals is an important theme in all religious festivals in Greece, ancient and modern, because the religious rituals are performed by the farmers to ensure the forthcoming rain, so the crops may grow, and give a plentiful harvest. The early rains in autumn are of great importance as a preliminary to the sowing. From this perspective, rain-making rituals represent fertility-cult.

Ancient and modern Greece represent two peasant communities, inhabiting the same landscape, with the same climate and almost the same technological level. Both communities show similarities in several ways, such as folk religion, which relates to the basic economic needs of the community. The sowing of cereals today extends from the middle of October to the end of December, depending of the rains. The best guide for the farmer has always been the rain, the condition of the soil, and his own experience and weather-wisdom. The season of sowing was and is a time of great anxiety for the Greek farmer. Perhaps the rains will be delayed or will not come in the right amount, at the right intervals. People feel a greater need for ritual and magic on occasions when their own technical skills are limited.

In ancient times, springs where representing water-nymphs. Today springs are dedicated the Virgin Mary, the *Life-giving Spring*. In ancient times the life-giving spring was also a female goddess, connected with Mother Earth, but she needed to be fertilized by a male god. The Mysteries at Eleusis was celebrated around the first of October, one month before sowing, to ensure rain to make

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the corn grow. During these ceremonies dedicated the Corn-mother, a magical formula "rain, conceive" was uttered and a water-purifying ritual was performed.

Since there are some important characteristics connected with the rain-making rituals in Greece, ancient and modern, despite many changes in the dynamics of history, modern rituals as observed in rural Greece can give a clearer picture of the way ancient people perceived the way they could influence the gods to ensure their life-giving water.

The paper will make a comparison between some important ancient festivals celebrated before sowing, and modern parallels, celebrated "to let it rain".

14. Basia Irland, New Mexico, USA (227)

Water Library

"Water Library: A Sculptors Research into the Phenomenon of Water" is the title of a series of international projects and exhibitions by Professor Basia Irland. Each project is housed in a portable sculptural repository containing research, maps, water samples, hydrology reports, photographs and video documentaries. The Library is sub-divided into Chapters, each of which is being compiled into a book. A brief synopsis of some of the Chapters follows:

Chapter I: "Inscriptions: Stars, Tides and Ice". Sculptural projects based on water research done in four countries incorporating overlays of pre-Keplerian archeoastronomy drawings of the moon's pull on the tides.

Chapter II: "A Gathering of Waters: The Rio Grande, Source to Sea". A five-year grassroots project, focusing on diverse communities along the 1,875 mile length of the Rio.

Chapter III: "Tools for measuring and finding water" which includes such work as divining rods for dry river beds and sculptural hydrographs.

Chapter IV: "Reading Water". Carved wooden books covered with earth from river shores are embedded with natural objects from specific sites forming "words" and "paragraphs", thereby creating an international language.

Chapter V: "Holy Water". Sculptures constructed in Indonesia during a Senior Fulbright Grant and in Brazil.

Chapter VI: "Waterborne Diseases". A vast and ongoing series of projects including Port Hope, Ontario's problem with ground-water contamination due to radioactive waste and the city of Walkerton, Ontario, Canada where e-coli seeped into the city drinking water supply.

Chapter VII: "Desert Fountain". A permanently installed cast-bronze "fountain" at the Albuquerque Museum that only flows when there has been rain, thereby making visible the arid eco-system.

15. Arie Issar, Israel (21)

Water, Gods and Rituals

Since the earliest period of his history, and most probably since prehistoric times, the human being sought to explain to himself the nature of the phenomena which mean life and death. In the arid and semi arid regions whether water was available or not meant life or death. Thus, it is no wonder that the first documented "scientific theories" namely the mythologies of the Ancient Near East start with the "hypothesis" of the Primeval Water, which existed before creation. The Sumerians in southern Mesopotamia told the story of a universe composed only of water, a primeval sea which engendered a cosmic mountain consisting of heaven and earth united. The Babylonians, of Semitic origin, who adopted many of the Sumerian traditions, used to chant during their New Year festivities the epic tale of the victory of Marduk, the benevolent god, over Tiamat, the goddess of abyss. In the Hebrew Bible the existence of a primeval ocean "Tehom" is taken for granted. In the Canaanite myths El, the primeval deity, lives at the sources of rivers in the midst of the outlet of two deeps, called "Teohomotaim". The ancient Egyptians equally believed in the emergence of the first solid mound from an abyss of primeval water, at the site of the temple of Atum-Ra at Heliopolis. Outside the ancient Near East in the cosmic myth of India, the god Visnu, the source of the world and all things, is grasped in the state of pre-creation as being asleep in the primeval ocean, on the thousand head serpent Sesha. A similar concept one finds in the pre-Hellenic mythologies of ancient Greece. Although in these myths creation was attributed to a woman's touch, still the main motifs of a primeval ocean of water and a snake can be perceived.

16. Joicy James, India (68)

Highlights on Rivers from the Vedas, Epics, other ancient books and traditional practices of India

The importance given to water in ancient India is reflected from the several hymns of the *vedas* and epics and the narratives from other valuable works such as the *Arthashastra* of Kautilya. The concern for water turned their attention to the rivers, on which they depended for their entire water requirements, and to the basins of which they confined their main activities. Therefore, their entire life centered around the river systems, so much so that rivers played an important role in moulding and sustaining their civilisation. This influence is seen in their religious practices and social observations as well as in their literature, art and architecture.

It is with the *vedas* that the Indian philosophy takes its shape; the Rig vedic period is attributed to 1550-1000 B C. In a hymn on Creation, the Rig veda gives precedence to water over everything. The *veda* mentions the names of all the important rivers in the country. Some of these references help in understanding the details of some of the rivers, such as Saraswati, which have disappeared in course of time. The excavations in the Indus Valley have brought to light the drainage system and the wells which existed during this civilisation (3000-1500 B C). There are several legends, rituals and ceremonies associated with the River Ganga, which is considered to be the lifeline of the country. The epics (4th century B C - 4th century A D) also highlight the importance given by the Indian to water, especially the fresh water of the mountainous rivers.

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The *Arthashastra* of Kautilya (3rd century B C) gives a vivid picture of the first ever-used rain gauges in the world. The Jungadh inscription enlightens on the reservoir made during the reign of Chandragupta Maurya by the construction of a dam. Several such records highlight the water management practices in ancient India.

The theme of water has found its expression in art, architecture and literature of the people of India. The paper also highlights the important cultural elements of India related to water.

17. D. Janaki, India (279)

Aadiperukku, Water Ritual through Religious Practice

It is described that rivers are accounted for divinity. In India the rivers Ganges and Jamuna, Cauvery and Gothavari are considered with sanctity. Just like earth gives us food, water also is considered as a sacred necessity to meet the needs of human individuals. People began to worship water in the form of wells, tanks and rivers. It is common among Hindus in India to throw fruits, saffron cloths, etc., when the rivers are in flood purely with the belief that these rivers are the species of female deities. Similarly every temple has sacred wells and tanks and water in these resources are considered as sacred. There are Hindu mythologies, which highlight many variations on the theme of primeval water which shows that water culture and civilization represent the human interest with sacredness.

In narrowing down to the ritual case study of Aadiperukku – a water ritual practice by women on the bank of river Cauvery, the longest one in Tamil Nadu, one of the federal States in India, this paper elucidates water ritual practice. In this ritual practice, water is considered as natural resource resulting in the use of water for cleaning the body with a bath.

Aadiperukku, otherwise called Padinettam Perukku – this is peculiar to the Cauvery delta and is intended to celebrate the rising of the river, which is considered to occur invariably on the 18th day of the solar month, Adi (Sanskrit Kalaka) corresponding to 2nd or 3rd August every year. Hence the "Padinettamperukku" Padinettu signifies eighteen and Perukku, rising. This festival is observed predominately by women in Tamil Nadu. The Aadiperukku as a water-ritual by women is said to honour Nature. The myths of this ritual practice explain that the water is propitiated as Mother- Goddess. It is formed that water is metaphorically linked to the reproduction i.e. a significant medium of exchange as reflected in the water ritual. The association of this ritual practice with Fertility, Sex and Reproduction is both natural and human. This water ritual practice is performed on the banks of Cauvery River in Tamil Nadu, which is described as a rice-cultivation tract. The history of this ritual practice dates back to the ancient period and patronised by the Kings and Royal households. This ritual practice existed in various historical periods. The water ritual practice AADIPERUKKU – is a cultural system of Cauvery delta where women are involved.

To describe the ritual practice in detail, it may be seen that it is a Hindu religious practice. It is associated with the use of water for the prosperity of the farmer community. It is linked with the reproduction of natural capacity of the earth and women. i.e. a significant medium of exchange as reflected in the water rituals. The form and shape of this ritual varies as per vision and imagination of the people over a period of time in different regions. But it is having a cardinal symbolism of associating fresh water with the fertility of the earth. This ritual practice is increasingly becoming a cultural factor related to worshipping water as nature – ritual valour and demand the role in honouring water as Goddess.

18. Deepa Joshi, India (163)

Water, Mythology and an Unequal Social Order

This paper argues that water and the human body in the Hindu social paradigm, are not merely physical entities but social constructs too. Seeking justification and legitimacy from religious doctrines and texts, in practice, the inter-relatedness of water and the human body has historically been used as instruments to institutionalize social inequality. The externalities of ignoring this reality are highlighted in drinking water projects, which reduce the existing inequity in water distribution to physical water scarcity linked to technological irregularities.

The spiritual connotation of water, traceable to ancient Vedic religion, structures the water behaviour of a Hindu society. Surface water positioned in Hindu Vedic mythology as a Goddess, '*Jal Devi*', is endowed physical and spiritual, cleansing and purifying properties. Vedic Hinduism also ascribes the human body states of social purity and pollution, which can then pollute the 'sanctified' construct of water. Individuals born into an irreversible social order of castes, and placed lowest among the social hierarchy are internalised to be 'polluting'. Women, irrespective of their social caste are universal pollutants - related purely to their biological conditions.

Field research on water uses and rights show that local interpretations of notions of pollution and purity in a rural setting determine and reinforce an inequitable access to, control over and distribution of water. The ritualistic attributes of water are translated to exploitative social practice, legitimised as culture.

Current policy visions of 'participatory and decentralized' community participation in water projects idealize the altruism in 'communities' and sanctification of inequality as local culture. Popular visions of restoring the 'community's' supremacy in water management are grossly counter-productive if the ground realities of the social distribution of power are unidentified and reinforced.

19. Erjen Khamaganova, Russia (241)

The Concept of Water in the Worldview of Buryat-Mongols

Representing the Northeastern area of the Central Asian Mongolian cultural-historical region, Buryats—the nation to which I belong—connects its origin, history, and life with Lake Baikal. Native pre-shamanistic beliefs, Central Asian shamanism, as well as Buddhism, played an important role in the shaping of Buryat environmental attitudes, ethnoecological views and traditional

environmental ethics. This paper examines water sentiments in the worldview of Buryat-Mongols. Different images of water in Buryat-Mongolian societies in historical retrospective will be presented.

The concept of "sacred" water is explored as a vivid embodiment of traditional values, perceptions of and attitudes toward nature. The theory and practice of taboo connected with perception of water is framed and analyzed in detail.

20. Vicky Khasandi, Kenya (152)

Of Frogs and Cows Having a Drink: Water in Olukabarasi Folklore, Kenya

"The eyes of a frog do not scare the cow from having a drink" so goes the Olukabarasi proverb. Water has always occupied a prime position in Olukabarasi folklore. This is because water is the very essence of life among the Kabras of Kenya, East Africa. Right from dawn the Kabras women and children balanced earthen pots on their heads and breathed the fresh morning air, snaking their way down the valleys to the whispering springs. They braved the chill and the dew on the grass lining the narrow pathways in order to get to the river first because 'she who gets to the river first gets the best water.' They would, of course, wake the sleepy frogs that would croak and leap away to the flora to hide. The crickets would click away, as would the crabs, fish and other river life. From the huge evergreen indigenous trees, the birds would continue their sweet morning tunes, which would turn into a veritable harmony for sheer variety. On arrival at the door to the mud and thatch houses, the women would carefully unload their pots since '*istongo yatichilanga amuliango*'. (The pot breaks at the door). These porous pots ensured evaporation hence provided a cool drink, especially to the men who came from working in the fields in the hot tropical sun. Proverbs in Olukabarasi reflect the vitality of water in the lives of the Kabras of Western Kenya. Rainwater was collected for drinking, 'mudding' houses and was used in agriculture. People would gather to wash clothes, and take a bath in the thickets by the streams. Young boys would enjoy a splash as they grazed their animals and fished. The river was also significant during initiation rites since it was symbolic of life and spiritual power.

In this paper we examine the portrayal of the river in Kabras folklore, particularly in proverbs and oral narratives. These will be analysed to reflect the importance of water sources as well as any dangers associated with rivers. Folklore is dynamic and Kabras proverbs reflect the changing trends in the role of the river in their lives. For instance going to the river entailed a distance but now due to population growth and other socio-economic factors, settlements are close to the rivers, leading to a host of problems. Similarly, the streams are getting so polluted that one hardly sees animal life in the rivers anymore.

21. Gert Knutsson, Sweden (248)

The History of the Use of Springs in Sweden

There is an all-pervading theme that springs have been used for local water-supply during all time. Many of the pre-historic settlements of the inland, for example from the stone-age in the county of Västergötland, have been found in close connection to springs. The water-supply of the first small towns was in many cases based on water from springs for example S:t Erik's spring in Uppsala and the Kallebäck's spring in Gothenburg. And several of the more modern water-supply wells for cities are located within or close to springs. Another typical use of springs during time is for water cults: in heathendom for offering (for example in the spring of Woden and Thor) and in early Christian time for baptizing and healing. Many saints have given their names to springs (for example S:t Erik, S:t Olof and S:t Sigfrid) but the springs were often the same as in heathendom. A very intensive period of using springs started in the 17th century, when the famous chemist Urban Hjärne introduced water-therapy at Medevi spring, whereafter a lot of spas was established at springs all around Sweden during the 18th and 19th centuries. Most of them were closed in the first half of the 20th century but some are still active and/or mineral water is tapped for example at Ramlösa, Porla and Loka. Today there is an increasing interest to use springs for environmental control, for example for monitoring the acidification of soil and groundwater.

23. Fibian Kavulani Lukalo, Kenya (131)

"The Waterside Dwellers Sleep Thirsting:" Cultural Interpretations of Water Forms in a Rural Community

Rural areas in Kenya receive water from a variety of sources: rainwater, bore holes, wells, piped water, streams, rivers, large water masses (Dams, Lakes, The Indian Ocean), and surface seepage. The manner in which these people access and use the water resources is as important as the intrinsic quality and quantity of these resources. Consequently people are responsible for the use and misuse of water and its related benefits like food and the security these water forms.

Water resources are rapidly being depleted through various mismanagement practices. The extensive use of this resource has led to presentations of water being linked to life in many rural communities. These presentations distinctly edify the intricate relationship between water, man and society. In this paper an exploration of the cultural presentations of water among the Bantu – Maragoli group in Kenya is presented. The focus on this community lies in the current high population being experienced, agriculture, and the pivotal role water plays in society. Further, the paper examines the philosophy of life, of the Maragoli community, the imaging of water as projected in oral traditional forms of song, proverbs and cultural practices. A historical presentation of the exploitation of water is presented and is linked to the philosophy of life of this community.

The paper subsequently examines broadly, the social construction of the reality of the place of water within this community as presented in oral traditions.

24. Meredith McKittrick, USA / Namibia (145)

"The Wealth of These Nations": Rain, Rulers and Religion on the Ovambo Floodplain, 1870-1910 (Namibia)

Using missionary and trader accounts and oral history, this paper considers the history of water in the late precolonial Ovambo societies of northern Namibia and southern Angola -- or, more precisely, how the quest to control water shaped people's

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relationships with their environment and with each other at a time of incorporation into a colonial world. "Water is life," the current government of arid Namibia proclaims while proposing drastic plans to ease the country's water crisis -- including a pipeline from the Congo River. That motto, however, was equally apt in the 19th century, when elders, kings, ritual leaders and others justified claims to authority and privilege in terms of their ability to provide water for people living on the edge of the "thirstveld," at the southern margin of agricultural viability. A missionary noted that rain was considered "the wealth of these nations" in a region with no permanent lakes or rivers. The control of water was understood in simultaneously religious and secular terms: ensuring the seasonal rains and flooding in a region where precipitation varied wildly from year to year and managing the supply of precious ground water were equally important bases of political power. Water lay at the heart of processes of political centralization which occurred in the first half of the 19th century, creating strong kingships in most regions and civil war in others. And water was important to another change later in the century -- the arrival of missionaries and the creation of Christian communities in the region.

Missionaries lay claim to authority and privilege within a variety of local idioms, and Ovambo incorporated them into their cognitive world through these same idioms. Among these was missionaries' purported ability to control water -- both by creating and presiding over wells and waterholes and by summoning or blocking the arrival of the rains. Missionaries held prayer meetings during drought to ask God for rain; locals argued alternately that church bells were rung to halt the rains or to call them. Kings granted missionaries control over specific districts to curry favor, giving them the ability to allocate water to whom they chose. In times of drought, missionaries frequently built fences and locked gates to waterholes so that others could not use them. Their interventions into Ovambo ideas and practices surrounding water foreshadowed the much greater interventions of the colonial government established in the 1910s, and shaped how Ovambo understood and responded to colonial policies.

25. Mika Merviö, Japan (180)

Construction of Meanings for 'Water' in Japanese Culture and Politics

My paper analyses the ways that water has been understood in Japan. First I show what kind of diversity of interpretations existed in various historical settings by analysing cases presented by historical, anthropological and religious studies. After that I proceed to look at the impact of modernisation and how the contemporary Japanese society, and especially its political elite, have adopted quite extreme technocratic attitudes to water and how Japanese river banks and coastlines have been layered with concrete. Since I interpret the situation from the contemporary context, I attempt to build a comprehensive analysis of most important factors related to modern understanding of water in Japan. By doing so I go through such issues as the changed Japanese agricultural methods (in relation to water use), industrial use of water, water as an energy source, water and public works, water as a human rights issue and an issue of basic needs, water and city planning and water security and international co-operation.

26. Azuhan Mohamed, Malaysia (209)

Water in Islam

Water is a gift of God. The importance of water in Islam does not derive from the facts of life in the Arabian peninsula, but directly from the revelation of God. "*We made every living thing of water.*" (21:30). The Qur'an states that water is a source of life. The Qur'an reveals the importance of water in more than one hundred places. The Qur'an generally link water to life and God is the giver of rain and snow. In this respect Allah says in the Qur'an: "*See ye the water which ye drink? Do you bring it down from the cloud or do We?*" (56:68). The importance of water is also highlighted by the traditions of the Holy Prophet Muhammad p.b.u.h. and he forbade the wasteful use of water, even when one is at the side of a river. Water plays an important role in Islamic rituals, and Islam also teaches her followers other aspects of water such as pollution, conservation, ownership, endowment, distribution and territorial prerogatives. The Quran also relates water to the water cycle, the separation between freshwater and seawater, the promotion of agriculture, sources of foods and jewellery, and means of transportation.

27. Wendo Nabea, Kenya (188)

Images of Water in Kiswahili Literature

This paper will focus on the images of Water in Kiswahili Literature. In this Literature, water is treated specially for various purposes in the life of a person. It is the source of life, it nurtures the physical and spiritual life, while lack of it is a symbol of death.

This paper will focus on four genres of Kiswahili literature, which exemplify the life of a person from the moment of conception in the womb until death in relation to water. These are a poem, *Fumo*. (spear) in Salim Zakwany's *Diwani ya Jinamizi*; Prof. Katama Mkangi's novel, *Mafuta* (Oil) ; Prof. Ebrahim Hussein's play, *Kinjeketile* and "The Epic of Fumo Liyongo."

According to the poem *Fumo*, water is the source of human life. Life begins in "Kisima" (the water source), which the poet uses as a symbol of woman's vagina. This takes place when *fumo* (the spear), a symbol of a man's penis, is implanted in the symbolic water source. In yet another state, a living person is nurtured by clean water. This is evident in Katama Mkangi's novel, *Mafuta*. The author juxtaposes water and oil symbolically, and argues that unlike oil, which is counterfeit, our physical bodies are nourished by water. In short, those who embrace water are fidel and hence, socialists, while those who crave for oil are corrupt, and in this case, capitalists.

Ebrahim Hussein's play *Kinjeketile* elevates us to the spiritual world as far as water is concerned. By capturing a historical event which took place in the colonial Tanganyika, the writer shows the spiritual dimension of water. During the Maji Maji (Water Water) Rebellion, *Kinjeketile*, the leader, treated water with some concoctions and spilt it on the bodies of the freedom fighters, convincing them that their bodies had become bullet -proofs to the fire of Germans.

Finally, in the *Fumo Liyongo* epic, the mighty Fumo Liyongo dies after being tricked by his son to reveal what can kill him. After a number of temptation, Liyongo gives in to the questions of his son and reveals that he can only die if he is speared right in the navel. His son kills him hoping to get a lavish reward from Liyongo's adversary, a king in a neighbouring country, but he is

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disappointed. But where does the body of the gigantic Liyongo rest? Right at a source of water. Unfortunately, country people are not aware that he is dead, but imagine that he is annoyed. For fear of Liyongo, they refuse to draw water and go thirsty, a symbol of loss of life, thus, loss of water.

28. Charles M. Namafe, Zambia (111)

The Lozi Water Tradition

The Lozi people of the Upper Zambezi river in Western Zambia have been known in both the popular and academic literature to conceive a distinct idea of themselves as contrasted with others. The Lozi think of themselves as leaders of a particular mode of Noahs flooding as opposed to the widespread humanity who portray Noah's flood event as predominantly destructive. The Lozi, therefore, recognise their destiny in a particular tinge of flooding. In this regard, the purpose of this paper presentation is to provide an interpreted official Lozi version on water, in general, and flooding, in particular, as it has existed over time since the creation of the world.

29. Bienvenu D. Nizesete, Cameroon (315)

The Symbolism of Water in African Traditional Societies: A Case Study of North Cameroon

(letter only)

30. Michele Anderson Schmidt, Colorado, USA (107*)

Matushka Volga--An Interpretation of a River

The Russians call her "Matushka Volga"—Little Mother Volga, a diminutive phrase, which verbally reflects the feelings Russians have for their great River. The Volga River, revered as the "Mother of All Russians," represents an image of nature and appears to serve as a microcosm of the entire environment of its nation. The Volga is a dichotomy, much like Russia itself, with both positive and negative elements—it is up to interpretation and perspective to determine which outweighs the other. The Volga also demonstrates the fragility, and yet the resilience, of an environmental entity—a living, ever-changing monument to humanity and all our goods and evils.

The paper I will present began as a "thought experiment," written to reconcile the meaning of nature along the banks of the Volga River. The paper attempts to define the social, cultural, economic, and ecological aspects of the Volga. An American visitor to the Volga may perceive it differently than a Russian who has lived and worked along the River for an entire lifetime. It is these cross-cultural comparisons that may contribute to a new form of historiography that not only helps explain the Volga's role in the cultural construction of Russia, but can also, in a larger sense, acknowledge that any free-flowing river becomes a dynamic, and often chaotic and challenging, entity in nature. The underlying argument of the paper is that nature, and the Volga as it occupies a definitive part of nature, is subject to interpretation. But, as William Cronon points out in *Uncommon Ground*, isn't all nature subject to interpretation?

31. K.N. Sharma, India (321)

Status of Water in Ancient Indian Literature and Mythology

The Indian Hindu socio-religious scriptures are historically the most ancient pieces of sound knowledge base that are still relevant to the modern times. The wealth of literature created from as back as 8500 years (C. 6500 B.C.) in the form of Vedas, Brahmanas, Upanishadas, Puranas, Smritis, etc. vividly enunciate theories of creation of the galaxies, universe and its stars and planets (specifically earth). Evidences from recent archaeological excavations and supplemented by earth observation data from satellites that reveal existence of numerous palaeo-geological hidden water channels of most described and revered river Saraswati, are establishing and confirming the indigenous evolution of a civilization that flourished as back as 6500 BC, when such earliest treasures of knowledge as the Rig Veda were composed.

In the social and religious traditions and culture of India since the Vedic times, water has been enjoying the most respectable and unique status. Water has been described and referred to as nectar, honey, source of life, protector of earth and environment, cleanser of sins, generator of prosperity, and so on. The rivers were considered as divine and worshipped as Goddesses in mythological descriptions and people were ordained to use their life sustaining waters most judiciously and with greatest reverence. Water is the single most important tool/mode for performing daily religious rituals or social ceremonies and a primary means for purification of body and soul.

The ancient scriptures present in great detail, interalia, the evolution of earth, the science of rainfall, its measurement and forecast, climatology, meteorology, hydrology, water use and management, agricultural planning etc. while describing and hailing the five elements of nature - water, fire (energy), space (atmosphere), air and earth, of which all living and non-living bodies are made up. Even, today water festivals, popularly called 'Kumbh' are held every third year on astronomically specific occasions where an estimated 1-10 million people congregate on the banks of holy rivers for a dip. From birth till death in a Hindu society, water remains an essential ingredient in performing all rituals.

The paper will present historically the importance and place of water and rivers and their relationship with environment in the socio-religious Indian tradition as propounded in one of the most ancient literatures and cultures of the world and how the prescriptions are still relevant in the water management scenario in modern time.

32. Mame Demba Thiam, Senegal (176)

Hydronomy, a multi-thematic source : the case study of Senegal.

Hydronomy is the study of hydrological organisms. To put it briefly, it is considered as a branch of onomastics which deals with proper nouns. In our context, hydronomy is used to put a stress on the significance of attributing names to the water in African societies, particularly in Senegal. This popular tradition shows the importance of the water sites as sources of life, but also as sources of natural calamities. A thorough study of the naming of hydrological organisms may reveal an underlying multi-thematic system of references.

- Spatial references : the river is a natural border. What name is given to it? Appropriation, through naming the river water, has often inspired the control of a territory.

- Socio-historical references : by its purity or impurity attributes, the water, in its cathartic function may be a provider of useful information.

- Economic references: as a network of human intercourse, the water is a means of communication and agricultural development. Fossilized rivers no longer represented on modern cartography constitute an informative source that can be exploited through hydronomy, in order to demonstrate that, traditionally, the water partakes of an ancient civilization. In fact, what does living nearby the water mean for Africans, and for Senegalese people in particular?

- Cultural references : In Africa, water chores have a significance that can be characterised as feminine. Additionally, the different names used to designate the water may reveal gender clivages.

Water worshipping has a visible impact on hydronomy. By expressing through names the feelings Africans have toward the water, one perceives an instinctive adoration resembling the one that Europeans entertained during the Renaissance. From a scientific point of view, hydronomy is a demanding subject because it presupposes a thorough knowledge of the systems of beliefs, norms and convictions which underlie testimonies and outline unspoken mysteries.

33. Zheng Xaio Yun, China (146)

Water-Culture as Ethnic Traditions and Sustainable Development in The Tai peoples of China

Tai peoples in China called Dai nationality, more than one million of Tai peoples settled around the drainage area of Mekong River, south China, and this area is the biggest tropic forest zone in China. According to Tai peoples's legend, this ethnic group origin from water, meaning of water in Tai peoples's mind is holy matter. Water has closely relations with their real-life in every aspects, for example, Tai peoples in China is called Water-Dai, and Tai peoples's new year festival is called Water festival, water carnival. More, the most important is the Tai peoples keeping the harmony between human being, water and natural environment. But goes with currently development, social and environmental rapid change, such a harmony also facing harm and issues, I believe that the traditional water culture is a key for keeping the harmony of human being and nature in their sustainable development, we need deeply understand the value of water culture as ethnic traditions on the contemporary development. My paper focus on explore the relationship between water and the Tai peoples's history, culture, social life and sustainable in south China.

34. Terje Østigaard, Norway, Nepal (256)

River and Rain -Life-Giving Waters in Nepalese Death Rituals

Water is the most important life-giving element and process in both Hindu and Buddhist death rituals, but to various degrees and with different qualities, creative capacities and powers. Funerals are a part of a set of rituals by which the living deal with the dead. They are their own interpretation of the meaning of ordinary life. Cremation is generally perceived as the most auspicious funeral practice in Hinduism. The deceased is cremated at holy riverbanks and the corpse is returned to the river as ashes. The ashes immersed into the river will float to Ganges and further on to Varanasi, and the deceased will attain salvation. In the Himalayan Mountains, Buddhist death rituals were rainmaking rituals and the interdependency between cremation and air-burial controlled the amount of precipitation. Water in the forms of river and rain when incorporated into death rituals highlights some general principles of life-giving processes. Ecological constraints can be necessary but not sufficient conditions for natural symbolism in death rituals. Water is a transformative means to other ends, and these aims vary according to religion, economy and ecology. Water as an element in the cosmology, the use of water in the rituals, and the importance of water in the society, illuminate why water as a life giving process is incorporated in Nepalese death rituals.

Theme C: History of Hydrology and Water Control

This session will especially deal with the development of hydrological sciences and water controlling technology.

We are not only interested in dam building and water regulation technology. We are also inviting papers on changes in and effects from irrigation and drainage technology etc. The session will encourage comparative perspectives on irrigation and drainage systems, both regarding technology, institutions and policy.

1. Adnan Akber, Kuwait (89)

History of Development of Kuwait and Its Water Resources

In the early days of its development, the Kuwaiti community had to explore numerous sources of much-needed usable water to meet the growing demand. These efforts were made difficult by the harsh living conditions dictated by poverty and by extreme climatic conditions. As a small community, the Kuwaiti people initially relied on rainwater that collected and infiltrated in surface depressions and was exploited by shallow hand-dug wells. As a result of the growth in population, however, the need arose for more sources of usable water. This, in turn, led to the reliance on fresh water that was imported by primitive dhows (boats) from Shatt-Al-Arab in Iraq in the early part of the twentieth century. The continuous growth of population that resulted from the influx of oil wealth in the 1940s and 50s, dictated that modern water production facilities like seawater desalination plants be established to cater for the increasing fresh water demand. With the increase in living standard, the urge to enhance the environment through greening escalated. Agricultural farming was also encouraged by the government as means of self-sufficiency in food and fodder. Both these factors put extra demand on the available water resources.

The high cost of construction and maintenance of the desalination plants necessitated that other sources of usable water be exploited. Groundwater was envisaged as a potential source of usable water for agricultural greening purposes. By the beginning of the 1960s, this source has been overexploited to levels that exceed the natural replenishment. As the groundwater supplies became more and more stressed, other sources of usable water had to be sought. The possibility of the use of reclaimed wastewater as an alternative source, especially for the greening and agricultural purposes was looked into. The efforts to utilize the reclaimed wastewater was, however, hindered by numerous factors that include social, psychological, and religious believes. This paper traces the evolution of water demand and supply in Kuwait with changes in its economy and the surrounding environments and sheds some light on the difficulties and opportunities that were encountered during the past and at the present time.

2. Peter Beaumont, UK (204)

Twentieth century changes in water use in the Middle East

Although the Middle East is a dryland region water shortage was not a major constraint to development during the early part of the twentieth century. This was due to low population numbers and, therefore, low water demand. At this time water abstraction from surface and groundwater sources used mainly traditional techniques and as a result only a small proportion of the available water resources were actually utilised. During the twentieth century the rapid growth in population, from around 80 million in 1900 to over 400 million in the year 2000, has put tremendous pressure on the water resources of the Middle East.

Since the second World War major water resource projects, and especially large dams, have become success symbols for the states of the Middle East. Their great advantage has been that they permitted a higher proportion of the flow of the regions' rivers to be utilised for human activities. A measure of this success can be gauged by the increased area of irrigated agriculture. Between 1960 and 1998 the irrigated area of the Middle East grew by 13.4 million hectares; an 80 per cent increase. In water terms this required a new water use of around 134,000 million cubic metres annually. This represents about 1.5 times the flow of the Nile; four times the flow of the Euphrates or about 75 times the water use of Israel. At the end of the century over 90 per cent of all water usage is still for irrigation.

It is now increasingly recognised that in future the supply of water for urban needs can only be met through the reallocation of water from agriculture to other demands. A driving force for this is the low economic productivity of agricultural water use. For example, in Israel two-thirds of all water use is for irrigation, yet agriculture only contributes around 2 per cent to GDP. At the end of the twentieth century all the easily available water resources of the Middle East are committed to one use or another. In these circumstances economic prosperity can only be increased if water is allocated to the most productive uses. The only other alternative is the creation of new water through desalination. With desalination costs now less than 2 US\$ per cubic metre water from this source is now a viable commodity for urban/industrial use in many places, but it will never be cheap enough to be used for irrigation.

3. Kulkum Bhattacharyya, India (170)

Floods: Resource or Hazard – A Case Study in the Lower Damodar River, India

Flood, once the basis for riverine civilizations of riparian landscapes has been translated into social disaster due to negative interaction between human use and floods at a particular historical juncture within specific economic, social and political systems. The same phenomenon was significant during ancient times when the communities in the riverine environment used to look on the bright side of the flood. This paper addresses the question of whether flood in the Lower Damodar river is a natural hazard or a resource. A corollary is whether some control structures like dams and barrage augment the resource potential or enhance hazard propensity of the flood phenomenon. The Damodar river, one of the endemic flood prone rivers of Lower Bengal, has gone through several river-training programmes. Embankments, canals, sluices, weirs, barrage, dams, and reservoirs are now significant physiognomic components of the Lower Damodar landscape. The river started losing its identity as a natural river in the later half of the eighteenth century with the construction of embankments. The river was disturbed in different phases by

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artificial base levels created by weirs, barrage and dams. A chain of sandbars has emerged within the riverbed below the control structures and most of the sandbars subsequently have been settled primarily by refugees from the former East Pakistan (present Bangladesh). The river has been transformed into a reserved controlled channel. Under natural flow conditions, on average 12 days per year experienced a flow above 2266 cumec. This has been decreased to 4 days under the artificial condition. Monsoon discharge has been reduced, but non-monsoon flow has been increased but with a large standard deviation and very high variability in the post-dam period. The bankfull stage, a flow of 7080 cumec with a recurrence interval of 1.8 years in the pre-dam period, increased to 14.81 years in the post-dam period. The magnitude of the design flood from Maithon and Panchet reservoirs has been reduced by about 56 per cent. During non-monsoon period canal discharge in most cases exceeds the river discharge. The low volume of water released downstream during dry months virtually transforms this section into a sandy waste whereas the high discharge released during monsoon months converts the section to a vigorous flowing channel. The Damodar riverbed consists of a series of alluvial bars, which are now used as a resource base mostly by the refugees. Based upon their knowledge of river stages, they have matched land use at fine scales to flood experiences applying a concept of flood zoning to the riverbed. Every available space has been utilized rationally and judiciously. From their personal experience, people can assess short-term risks and long-term benefits of release of water from the reservoirs. The controlled lower Damodar is a product of twin processes: hydro-geomorphic processes on the one hand and anthropogenic land utilization process on the other. Major findings of the paper are as follows: 1. Flood behavior of the river has been changed due to major control structures. 2. A set of landforms has appeared on the riverbed at the expense of water resource, which has been utilized as a resource base. 3. The impact of dams on the river is noteworthy in continuously preventing the river from retaining to the natural hydrological behavior.

4. David A. Biggs , USA, Vietnam (53)

Hydraulic Networks, Hydraulic Agriculture and Local-State Relations in the Mekong Delta under the Nguyen Dynasty and Early French Colonial Rule

Canals served both strategic and economic purposes for the state, leading to broad environmental and social changes in the Mekong Delta. They extended not only a network of waterways and villages but also a network of state officials-land surveyors, administrators, and tax collectors--bringing the land under a system of law. This paper will begin by looking at the ways the Vietnamese kingdom in the 18th and 19th centuries enticed people to settle in the Delta, bringing a system of land-use and taxation into newly cleared and irrigated lands. Then, with the French conquest in 1862 and the introduction of steam-powered dredges after 1900, both the hydraulic regime and the legal one changed dramatically. The discussion will then examine both the environmental and political challenges brought by colonial rule, looking at specific local exchanges between land owners, engineers, and colonial officials during the period of extensive land development. Finally, this paper considers the ways that both the pre-colonial and colonial patterns of canalization are connected and form a historical foundation for continuing public works and water use issues in the Delta.

5. S. Bou-Hamad & A. Al-Saffar, Kuwait (26)

History of Water Desalination in Kuwait

Since water resources in Kuwait are very scarce which is characterized by desert weather condition, scarcity of rainwater and absence of rivers, lakes and limited underground freshwater resources. In view of the scant natural fresh water resources, Kuwait since founded has to look for other sources to secure potable water requirements.

In the past, Kuwait relied mainly on the rainwater found near the surface in shallow wells. But, due to the growth of population that scant water source become no longer sufficient to cater for this growth. In the early fifties, a plan was endorsed to establish seawater desalination plant to overcome the demand of fresh water in Kuwait.

This paper provides an overview of the history of water desalination and how to overcome the shortage of freshwater in Kuwait. Also discusses the new advanced techniques used for water desalination and their benefit to the water resources in Kuwait.

Keywords: Multi-Stage Flash, Reverse Osmosis , production, Brackishwater.

6. Neville Brown, UK (331)

Chequered though his career was politically, Karl Wittfogel is especially remembered for two things. He was a doyen, arguable the doyen, of the Frankfurt School of ultra-Left cultural Marxism. More specifically, in the 1950s he was the author of the Hydraulic Civilisation/Oriental Despotism thesis. This said that, in various locations across the Ancient East, the management on the grand scale of riverine water resources (for flood control, irrigation and transportation) called into being "oriental despotism" –very centralies and autocratic regimes exercising saway over vast areas. In particular, the "oriental despotism" of hte North China "hydraulic civilisation" was, Wittfogel stressed, translated via the Mongols to Russia.

The period my critique of the Wittfogel thesis will mainly concentrate on will be, in terms of European history, between Late Antiquity and the beginnings of the Renaissance – i.e. between AD 200 and 1350. One general weakness perceived is Wittfogel's failure to consider climate change and its impact. Another is that no hydrological contrasts are drawn between different river basins, the Nile-versus-Mesopotamia being a very obvious omission. Nor are any comparisons attempted with empires which arose on landscapes other than unitary river basins. India, Persia, Byzantium and, indeed, Rome come readily to mind.

Ignored, too, are examples of how the elaborate control of water flow regionally can be achieved on the basis of devolved management. Sri Lanka is one example. Roman Egypt is another. Above all, however, is the very dubious case of Russia. Neither Mongolia nor Russia ever had a hydraulic substructure in the sence envisaged by Wittfogel. So how can they come within the ambit of his very narrow determinism?

Yet despite all the shortcomings, logical as well as evidential, it is hard to persuade oneself there is nothing in Karl Wittfogel's hypothesis. It is a pity he did not seek to apply it to modern times. How does it relate to. let us say, the Tennessee Valey Authority or the dam-building in Stalin's Five Year Plans? How does it to the Soviet gfrand design (extant from c. 1965-1986) to

divert the Siberian rivers? How does it to the current concern of the ecological Left to resist new dam construction and even press for the removal of existing dams? And how about water management at planetary level in the light of the greenhouse effect? Might this not require a supranational authority with more draconian powers of intervention than most of us would readily find acceptable?

7. Joël Burny, Belgium (12)

The rediscovery of small-scale irrigation of grassland, with emphasis on its function in the ethno-ecosystem of the former heathland area of the Campine in northeastern Belgium.

From 1994 through 1998 the author carried out some 200 conversations with 96 old farmers (men and women) who on average were born in 1913. They had worked their parents' and their own farms before the mechanization of work on the fields and before the unlimited access to nitrogen as artificial manure. This research yielded several unknown facts about the way these farmers worked the land and how different activities in the hay-meadows, in the heathlands and on the arable fields were interconnected. One of the important activities on every mature farm was the irrigation of grassland with water from small brooks. This was done in order to increase the amount of hay to be harvested as winter fodder for the cows and other livestock, who themselves produced milk and manure. The information pertaining to the spatial and temporal organization of irrigation as well as to the ecological settings of irrigated plots was compared with what could be read about that in 19th century literature.

All the data collected with the farmers and found in the literature were brought together and published in 1999. It appeared that irrigation of grassland was a very old technique, whose occurrence in this area is at least six centuries old. It may now reasonably be assumed to be much older even. Starting in the 1840's, the then newly established Belgian regime ordered some engineers to build huge irrigation schemes, to be watered by means of canals bringing a richer type of water to this sandy area with acid soils. These government-sponsored industrial irrigations proved unprofitable.

Farmers had established irrigated grassland plots on every type of soil occurring throughout the researched area. A puzzling aspect was the establishment of small-scale irrigation of grassland on wet, peaty soils. It was not easy to find out how bringing water to marshy areas could work altogether as a means of improving a farm's yield. This could be understood when detailed information became available as to the different activities the farmers had to develop each year in every irrigated plot.

Interviewing older farmers (men and women) about how the land was used in their time changed our insights in the local landscape's history as a geographical feature and should stimulate new social research in order to discover the main landscape building agents and forces. In the end, a new vision of the very nature itself of the Campine heathlands landscapes emerged. The balance between spontaneous and man-made features and between the "sums" of both tilts more strongly in favour of the man-made features than was acknowledged up to some years ago. The redefinition of the very nature of the farmer's hay-meadow has important consequences as to how these now protected areas should be managed.

8. Neil Coles, Australia (254)

Drought Proofing, Myth or Management: The Role of Government in Developing Reliable Farm Water Supplies in Western Australia

Drought, it has been said, is often used as a sustainability indicator, and since the beginning of agricultural development in Western Australia during the late 1800's, the procurement of reliable water supplies from both on- and off farm uses has been paramount. The majority of farmers in Western Australia rely on a mixture of tanks, dams and groundwater systems to provide these supplies required for livestock, crop spraying, and domestic use.

As the practical reliability of any on-farm water supply is finite, an emergency off-farm water supply strategy is required to be in place, and be implemented in accordance with localised demand and available resources. Regional long-term water resource planning is crucial for both on-farm and off-farm water supplies if the existing water resources are to be managed sustainably.

A mix of policy, both pro-active and reactive: public opinion and climatic intervention has driven the development of water supplies in Western Australia's dryland agricultural areas. Government assistance in developing on-farm water resources is not a new concept. One of the first assistance schemes in Western Australia was proposed in the early 1900's with the introduction of the Sutton Scheme in 1912. Since then a succession of schemes have been implemented, with varying degrees of success by Federal, State and Local Governments, to provide reliable water supplies to meet seasonal conditions.

The development of water management strategies and their targeting of farm enterprises in the last two decades have resulted in significant improvements in water supply reliability. This paper discuss the mechanisms that have been employed to encourage landholders to become self-sufficient, rather than rely on large-scale government funded water-carting operations during times of low rainfall or water deficiencies.

9. Øystein Dalland, Norway (136B)

Telemark- in the light of waters - a "sequent occupance"- approach to planning

I would like to strengthen the relevance of long term human-ecological approaches even to industrial phenomenas as the "history of Hydro", its landscape and dispositions, (today the biggest fertilizer company in Northern Europe).

Based on previous studies and hence by running the county watershed plan of Telemark 1989-1994, I became more aware of the intricacy of the Skien city site history; the physical as well as the economic strategic site. The physical impetus being the coincidence of the national innovation of water driven saw mills *and the isostatic raising of the Skien water falls above sea level, just during the peak and fall of the Skien monastery Gimsø at 14-1500*. The "peak/ fall-period" of this monastery was also related to the innovations by the "new imported Lutheran" German miners, (1538); namely fire-eroded water beds in waterfalls, in Norway at Skien. (From a more "narrow" historical angle, I. Seierstad, E. Østvedt, and others during the 1950-ies and 60-ies brought the latter happenings into focus).

From its start at 1120, the economic power of the medieval Gimsø (Benedictin nuns') monastery had developed and kept transaction loyalties with thousands of woodland farmers upstreams for more than 300 years. This may even have been a key

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element in establishing the economic base of the 1800-industrial revolution of Telemark. *By that time the Cappelen-Aall dynasties, from now on managing these cultural herited "monastery loyalties and economic transactions", are being able to act as a parliament lobby and as grunders ahead of the desision of the Telemark Canal enterprise in 1854. This canal prerequisites the location of "Hydro" at its inner end, some 50 years later. In between, (ca. 1560-1800) the "close-to-king" citizen families of Telemark; Bjelke and Adeler, from Lutheran times had possessed these properties and loyalties in their sort of cultural heritage during 8 generations.*

During the building of the Bandak canal (1889-92), at that time the biggest industrial water enterprise in Norway, *the chief engineer, (being the state canal director, Gunnar Sætren), achieved the relevant and updated hydrological "know how" to be put into the role of being a chief advicer towards the Hydro-grunder Sam Eyde, convincing him; Notodden/Rjukan should be the site. Sætren's own fate was to loose his job, by, in his eager, in this new patriotic country, having privately bought share parts of the Rjukan water falls.*

Two other causal network perspectives are included in the study; the very roots of industrial tradition previous to monastery times, being the combination of strategic hardstone deposits for eurasian export, postglacial hardwood montane pine forests and nearby iron mires, and hence the waterway, being a functional lowland fiord (140 km) from Eidsborg to ocean.

The last point to be included in the study is the practical planning aspects of this long-wave sequent occupance approach, site by site downstreams the river, and the discussion of the approach itself, as a tool in physical and environmental planning.

10. Constant Dangbegnon, Benin (100)

The evolution of the platform for Lake Aheme's resource management in Benin, West Africa

Stakeholders in fishery resource's exploitation are moving into more and more complex situations at different parts of the world. Therefore, in many situations, social institutions and organisations for governing lake fisheries do not successfully respond to changing ecological, socio-economic, technological, cultural, and political conditions. Deliberate interventions for the control over fishery resources, are often, a theatre of conflicts, fights among stakeholders and impasse. A global challenge for sustainable and equitable lake fishery resource use is to design a platform for collective action, conflict resolution, social learning, and breaking impasse.

The paper analyses the specific case of the evolution of the platform for managing Lake Aheme's resources: since the pre-colonial times (before 1894), through the colonial period (1894-1960) and after independence (1960-1990), and to the recent democratisation era in Benin (after 1990). It focuses on factors that influence the successes and failures, from a historical perspective. Lake Aheme is located in the southern area of Benin. With 24 km in length, the lake's surface is 78 square km during low water level and 100 square km at the periods of inundation of its floodplains. Forty villages are surrounding the lake. The Pedah (fishers) and the Ayizo (fisher-farmers) are the dominant ethnic groups around the lake, among many smaller other ethnic groups. Lake Aheme case is continuously changing under the influence of several factors that have influenced its institutions and organisations since pre-colonial times. The case is heuristic and helps gain a deep understanding into factors that are relevant for successfully managed fishery resources. Beyond the insights gained into the ongoing struggles, conflicts, negotiation, mediation and adaptations of stakeholders, major learning points are identified to discuss the extent to which lake fishery resources can be better managed in the future.

11. Jacobus J. de Vries, The Netherlands (30)

Early developments in Dutch hydrogeology

Early developments of groundwater hydrology in the Netherlands were strongly related to the search for fresh drinking water in the densely populated western part of the country, where most of the groundwater is brackish. Interest therefore concentrated on the coastal dunes, which were renown for their fresh groundwater reserves. Amsterdam started in 1853 with groundwater extraction from the dunes. Lack of insight into the vertical extent of the fresh water pocket underneath and the fear for salinisation initially led to a groundwater production with drainage canals. In 1888, Badon Ghijben postulated his well-known hypothesis about the occurrence of a fresh groundwater pocket under the dunes with a thickness of 40 times the elevation of the groundwater table above sea level. His ideas however, did not receive proper recognition until the German A. Herzberg in 1901 independently reached the same conclusion.

At about the same time the groundwater flow around the drainage canals in the dune catchment caught the attention of an engineer with the Amsterdam Waterworks, J.M.K. Pennink. It was generally thought in those days that groundwater could not flow in an upward direction under free water table conditions. Pennink thus initially assumed a horizontal groundwater flow to his canals, leading him to underestimate the thickness of that part of the subsurface which contributes to flow to a partially penetrating channel. The discrepancy between the measured flow in the canals and the calculated discharge into these channels based on the underestimated thickness of the participating aquifer, brought Pennink to propose the idea of radial and upward bending flow in a vertical section to the drain.

Pennink splendidly demonstrated, from both field experiments with a large number of piezometers and experiments with parallel-plate models, the flow pattern below a partially penetrating drainage channel, showing that in such cases the hydraulic head decreases with depth under the recharge area and increases with depth under the drain. He further simulated with his analogues the formation of a fresh water lens beneath the dunes, proving the validity of the Ghijben-Herzberg principle, not generally accepted at that time. Drilling to a depth of more than 100 m indeed proved the existence of deep fresh water, but opponents of the Ghijben-Herzberg theory explained this phenomenon as caused by an artesian water vein at greater depths, with its catchment far to the east on higher grounds.

This controversy led to not only scientific, but also political debate for more than 15 years at the beginning of the 20th century, because of its implication for the amount of water that could be extracted without depletion and salinisation of the resource. It was notably through these discussions that groundwater hydrology in the Netherlands was brought at a scientific level around the

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turn of the century. Subsequently, research concentrated on the problems of groundwater flow in leaky aquifers in the Dutch polder area. High groundwater table, together with large transmissivity, causes strong groundwater seepage through semi-pervious confining layers into deep polders and into excavations for the construction of hydraulic devices such as locks, sluices, weirs and tunnels. J. Kooper was the first in 1914 to approach this problem of radial flow in a leaky aquifer. He already arrived at the well-known solution with Bessel functions.

It is evident that the early developments in groundwater hydrology were strongly stimulated by the needs of society for good drinking water and the solution of water management problems in an area with shallow aquifers of high permeability. Not surprisingly therefore, the contribution of Dutch hydrologists was notably related to the specific conditions and problems of a coastal lowland, including land drainage, and groundwater flow to wells, excavations and deep laying polders in leaky aquifers.

12. Cornelis Disco, The Netherlands (336)

Diverting Rivers. Transforming the Rhine Delta into a National Freshwater Distribution System for the Netherlands: 1935-1970.

The Rhine enters the Netherlands as a unitary river, but soon thereafter it splits into a number of branches which carry its water to the north and the west of the country. The division of waters between the north and west was artificially fixed at the beginning of the 19th century. Between 1935 and 1970, Dutch engineers created a new system based on moveable weirs which allowed for the flexible redistribution of Rhine water according to need.

This paper analyses the construction of this "water household" as the intrusion of a new large technical system into an existing complex of river-based large technical systems like drainage, agricultural irrigation, public water supply, inland shipping, and flood defenses. Unlike many large technical systems, however, the Rhine freshwater distribution system was not conceived in terms of a master plan. Rather, the system was developed piecemeal and almost opportunistically in the interstices of other major projects aimed at improving coastal flood defenses and the navigability of rivers. There were two arenas of negotiations which ultimately shaped the fresh water distribution system: 1) negotiations about local freshwater quality and the relative need for Rhine water and 2) negotiations about how to fit the new water distribution system into already existing systems grafted onto the very same river segments.

The paper will describe the content of these two simultaneous arenas of negotiations, their political containment and how the outcomes shaped the emergent design of the freshwater distribution system.

13. J. Dooge, Ireland (11)

River Works in Famine Ireland

The natural topography of Ireland with a central plain and coastal hills is such as to present a serious impediment to land drainage for agricultural improvement. The first successful attempt to improve the drainage function of Irish rivers dates from the Arterial Drainage Act of 1842. The work under this Act was only just underway in 1845 when the country was struck by the disaster of the massive failure of the potato crop. William Mulvany, the Commissioner for Drainage, was quick to react and in November 1845 proposed the adoption of "summary proceeding" in relation to arterial drainage schemes. An amending act was passed which allowed for a speeding up of procedures and led to an enormous increase in the number of schemes investigated and carried out.

The works carried out are of great interest not only from the point of view of the economic attitudes and the social conditions of those years but also in relation to developments in hydrology. The staff of almost 200 engineers spread throughout the country were instructed to keep records of rainfall and of river flow in order to improve the methods of estimating the design flood for future schemes. The concept of time of concentration of a catchment and its relation to critical storm duration were formulated as a result of the installation of special continuous records in hilly country. This became the foundation of the "rational method of flood estimation". After the passage of the crisis, the landed proprietors objected strongly to the levying of the drainage rate on improved land. An inquiry was established by the House of Lords and as a consequence a large quantity of reports and correspondence which would otherwise have been lost are available in the parliamentary papers.

14. Walter Dragoni, Italy (105)

Ancient Water Supply of Jerusalem: The Unsolved Problem of the Gihon Spring, the Siloam Channel and the Hezekiah Tunnel

The most ancient part of Jerusalem is located on top of a limestone hill; the area is waterless, and the only permanent spring is the karstic Gihon spring, located on the slope of the hill. The spring is much lower than the top of the hill, thus it is located outside the ancient city walls (dated back to 1800 BC). During sieges, for safety reasons it was necessary to conduct the spring water into a pool within the city walls. This was done by means of the Siloam channel (altogether about 400 meters long, in part a tunnel) and the more recent Hezekiah tunnel (dug around 700 BC and about 550 m long).

The underground part of the Siloam channel is very close to the steep-sloping ground surface. The tunnel has several horizontal openings, which connect the tunnel with the outside. According to a widely accepted theory, the function of these "windows" was to let irrigation water flow to the valley below, through a set of "falls." In this paper it is suggested that the "windows" were opened to control the direction of the digging and to remove the excavated material: examples of this technique are not rare in ancient times, and can be found from Italy to China.

Two teams dug the Hezekiah tunnel, starting from opposite directions and meeting underground. The tunnel has no intermediate shafts and has an overall "S" shape. Regarding how the two teams were able to meet, the most common explanation is that they dug the tunnel following one or more fractures, through which part of the spring water was already passing. However, fracturing is rare in the tunnel, and there are no traces of continuous and persistent fractures. Moreover, various directions of digging that had been abandoned characterize the meeting area: the two teams, at least in that particular area, were not following any direction which had been clearly defined by a fracture, and they had no clear idea of the other's position. They most likely met thanks to

the noise produced by the excavation tools and by following a particular "rule" frequently used in digging ancient tunnels. It is still completely unknown how and why the "S" shape of the tunnel was designed and executed.

15. Victor Dukhovny & Pulat Umarov, Uzbekistan (69)

The role of Irrigation in Historical Development of Central Asia

The largest part of Central Asia is in arid zone. Therefore people living there always were in lack of water. Water is identified there with life and life is identified with water. Water in this region always enormously impacts to the historical, economic and cultural development. In the article authors had tried to show the place of Central Asia in the sphere of world historical development. Ancient irrigation and primitive agricultural cultures of Kopetdag and other zones of Central Asia, the development of flood irrigation and oasis irrigation, ancient irrigation of Khorezm and irrigation in the lower reaches of the Syr Daria river described in the paper.

Emphasized the role of irrigation in civilization – development of state in Ancient and the Middle Ages. The progress of science in connections with the development of irrigation in the history of Central Asia is specified. Defined engineering aspects of ancient irrigation. Founded interrelation between colonization of Turkestan and new approaches to the development of irrigation. Traditional and Moslem rights for water is compared. Finally development of water management in region in Soviet period, Aral Sea and its ecological history, modern situation with Trans-boundary conditions between new independent states in Central Asia are analyzed.

16. Gini Egan, USA (240)

Relationships among watershed degradation, salmon restoration and dam removal

This paper explores relationships among watershed degradation, salmon restoration and dam removal - three significant environmental and economic issues within the American Pacific Northwest. It suggests that environmental conflict over declining salmon resources and proposed dam removals is most intense when the competing stakeholders focus only upon their own narrow interests, failing to incorporate into their debates the needs of the watershed as a whole. In contrast, regional watershed management, especially through collaboration among local watershed councils such as those in Washington and Oregon States, may offer the potential for stakeholders to explore their individual issues in ways that enable them to more easily weigh priorities and competing needs. To this end, expanding and clarifying roles for citizens and incorporating their knowledge and priorities may also improve watershed management.

Not only is it important to involve stakeholders as participants in the planning of comprehensive watershed management and restoration programs, they are becoming essential partners in successfully implementing and modifying these plans. Finally, the economic costs associated with watershed management and restoration requires the strong support and involvement of a committed and knowledgeable citizenry, rooted in their home watershed and willing to work in its best interests.

17. Herb Eling and Martin Sanchez, Mexico (141)

The Granary of New Spain: Cereal Production and the control of Water in Mexico

At the end of the 17th century several regions of New Spain began to transform their socioeconomic structure as they passed from mixed agricultural-livestock activities to become preeminently agricultural regions dedicated to cereal production. This extension of agricultural activities required not only better quality lands and large areas of cultivations, but also an increased demand for water and a more efficient system for the exploitation of this vital resource, given that water was considerably less plentiful than land.

With an annual precipitation rate of between 400 and 700 mm and the prevalence of sources of surface water that were only intermittent and insufficient to guarantee the sustained growth of irrigation agriculture, cereal producers came to center their efforts on the exploitations of torrential (rain) water, and the use of a technology appropriate for this purpose became generalized. This was the so-called siltation method of irrigation, based on building up mounds around the edges of the fields and allowing water to enter and form what were known locally as "water box" (cajas de agua). The objective of this study is to demonstrate the importance of the control of torrential waters in the transformations of the region of Mexico known as "El Bajío" into the principal cereal producing area in the country towards the end of the 17th century.

18. Maha Abd El-Salam, Egypt (234)

Environmental Impact assessment of Transferring the Rosetta Branch into Navigational Canal on the Groundwater

After completion Aswan High Dam, the Rosetta Branch was acting as drain to discharge the Nile water into Mediterranean Sea during the closure time. Accordingly, the discharge has been released from Rosetta Branch was decreased from 70 to 18 Million m³/day. This led to decrease the importance of Rosetta Branch as Water body and it acts as drain to the groundwater with additional to the impacts on some drains adjacent to the branch.

This paper presents the environmental impact on the groundwater aquifer adjacent to the Rosetta Branch and the assessment of both negative and positive signs, obtain the best engineering solutions. To minimize the negative signs and maximize the positive ones.

During this Study, available data has been collected and some field investigation has been carried out for additional data. Groundwater flow and quality models and some development scenarios have been simulated. For prediction the environmental impact on the groundwater as result of transferring Rosetta Branch to the navigation channel.

From the result of groundwater flow model, the piezometric head of the adjacent areas from Rosetta is increased which will cause drainage problem for agricultural lands. With additional to the change in the water balance which leads that some of the main canal (as example Nubarya canal) will act as drainage canal with change in its quality.

19. Noureddine Gaaloul, Tunisia (37)

Thirtyfive Years of Land Drainage in the Cherfech Experimental Station (North of Tunisia)

Drainage in the arid and semi-arid zone plays an important role. In fact, it prevents and combats irrigation-induced salinisation. Waterlogging and salinity problems arise as a result of poor water management in irrigated agriculture. In the Mediterranean area Tunisia is an example, where the water resources for agricultural use are rather limited, and the extension of irrigated agriculture is only possible by using saline water. For this reason, extensive field research was already carried out in the 1960's, within the framework of UNESCO project.

The use of saline water for irrigation is subject of increasing interest because of the augmenting water requirements for irrigation and the competition between human, industrial and agricultural use; and also because of the pressure for the disposal of drainage water through reuse. The total area of irrigated perimeters in Tunisia is about 350.000 hectares, in which 30.000 hectares are affected by salinity (12%). The salinity is found in the whole territory, but particularly in the North and in the South of the country.

Subsurface drainage has been tried in experimental field research station (Cherfech) in the northern part of Tunisia, by using tile drained installed in manually excavated trenches in silty clay loam soils, with a shallow ground watertable and irrigated by saline water. Nowadays, 45.000 hectares was drained in the North of Tunisia by pipe drains in tiles and Poly Vinyl Chloride (P.V.C). Soil salinity in the experimental station Cherfech is a product of climatic conditions, original soil chemistry, land use, irrigation practices, and the shallow depth of the watertable. This study presents an evaluation of performance of drainage system from thirty-five years in the Cherfech experimental station. It presents an evaluation of salinity changes from observations performed over 35 years.

20. Gunleiv Hadland, Norway (230)

Environmentalist ideologies and administration of water resources

Norway has very large numbers of rivers and waterfalls. They are of great importance both to commercial interests and to public interests generally, for instance in connection with nature conservation and outdoor recreation. A number of local communities have grown up around various forms of commercial utilization of rivers. The exploitation of river systems brings together many conflicting interests. As far as we know, the oldest way of using rivers and lakes is as drinking water, and this is still the most important use today. Apart from this, fishing, timber floating, travel, irrigation, water mills and more recently, hydropower production, are the best-known and most widespread forms of use.

Electricity production is the most important commercial use of Norwegian river systems today. The awareness of environmental issues in Norway has by and large been built up through public discussions of issues concerning Hydropower- development projects. In most of the world hydropower is categorized as a renewable and alternative energy source in contrast to coal- and atomic energy plants. Most of the electricity used in Norway comes from hydropower, and for the consumer electricity has traditionally been cheaper than in most other countries. In spite of these facts there has been a considerable resistance to hydropower- development projects since the 1970s. The critics contend that the damming of rivers is ecologically objectionable. The goal of the first environmentalists at the turn of century was the establishment of national parks, a "classical environmentalism". In the 1960s several new ideologies emerged, among them ecologism and "deep- ecology". In connection with left- wing political groups civil disobedience and demonstrations were used as means to reach their goals. These ideologies are part of international developments and trends. How does the shifting of administrative ideologies influx the administration of water internationally ?

Although environmentalists and ecologists all over the globe share certain basic goals-less consumption, less waste, less energy use--there is a bewildering variety of ideas, concepts, and theories, some incompatible with others, that is associated with the movement. Indeed, one might more accurately think of a series of movements rather than one "movement."

21. Jeffrey Himel, USA, Cambodia (202)

Back to the Future – The Past and Present of Agricultural Water Control in Cambodia

The control of water has always been of critical importance to the Khmer civilization. It has been argued that the development of sophisticated irrigation systems led to the rise of the Angkor Empire that dominated much of mainland Southeast Asia from the 10th to the 14th Centuries. The massive development of irrigation systems by the Khmer Rouge regime during 1975-1979 seems to have had its basis in recapturing this ancient glory. But was this the case? There is growing evidence and opinion that the large tanks built by the Angkorian Kings and extensive network of manmade channels were not primarily made for irrigation.

If the "hydraulic city" so beloved of the French scholars did not provide irrigation water for triple cropping of rice, then how did the empire grow to such prominence and afford such a plethora of public works? Most have argued that the natural hydraulic regime allowed additional crops of floating and flood recession rice that provided a surplus to support the Kings, their cults, their temples and their armies. Yet these same cropping systems have existed throughout Khmer history and still persist today while Cambodia remains barely self-sufficient in rice production.

This paper offers an alternative theory. Aerial photography from the 1950's shows how large areas above the lowlands had been carefully contoured for soil and water management for other crops. In addition, the large number of ponds suggest that the ancient Khmer were frequent bathers and had good sources of water supply throughout the year – this would have had a huge effect on the economy through improved health of people and their livestock. These lessons from the ancient Khmer could be usefully applied to the modern development of the country as it emerges from decades of conflict.

22. Heather J. Hoag, USA / Tanzania (64)

Designing the Delta: Colonial Development Efforts in the Rufiji River Basin, Tanzania, 1945-60

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With its soils reenergized yearly with the annual flood, the Rufiji River floodplain and delta has the potential to become an important producer of agricultural products for Tanzania. However, unpredictable rainfall and flooding has meant that the region has historically been characterized by chronic food shortage. This paradox—food shortage in the midst of fertile soils—has prompted colonial, governmental, and international development planners to search for ways to develop the rich resources of the region. Development efforts ranging from colonial soil conservation schemes to post-colonial resettlement of villagers into *ujamaa* villages have been largely unsuccessful. This paper addresses the question of why colonial development efforts in the Rufiji River area failed, both in their goals of bettering the lives of Rufiji residents and in the desire to harness the resources of the Rufiji for the benefit of the Tanganyikan economy.

Throughout the debate on how to develop the Rufiji region, outside agents (colonial and post-colonial planners as well as international non-governmental organizations) have conceived of the natural resources of the area in terms different from those of the local residents. My contention in this paper is that these ideological differences were at the root of the failure of development in the Rufiji region. Using archival sources, oral history, and data collected in the Rufiji region using the PRA technique, I analyze how colonial planners and Rufiji residents conceptualized, used, and managed the Rufiji River and its wetlands during Tanganyika's late colonial period. I address the different symbolic, ritual, and productive meanings water had for local residents and colonial development planners, arguing that these ideological differences were at the root of the failure of development in the Rufiji region.

This paper is part of a larger study that examines the history of water management in the Rufiji River delta between 1945 and 1985, from British attempts to implement natural resource management in the area until the adoption of the World Bank's Structural Adjustment Programs (SAP) in 1985. Using the lens of ecology, I examine the hydrological history of the region in light of changing ideologies of development and local perceptions of resource use. Areas addressed include: local water use and concepts of environmental change, British colonial conservation campaigns and resource management, post-colonial resource policies and *ujamaa* villagization, and international non-governmental organizations' (NGOs) involvement in the region. The primary objective of my study is to understand how the environmental ideologies of the constituencies involved have changed over time (1945–1985) and how these changes have impacted how the Rufiji River has been defined, managed, controlled, and exploited. By doing so, I will provide an historical context to current debates about water development and management in Tanzania that will aid decision-makers in future development efforts in the area.

23. Christopher Irons & Angela Arthington, Australia (192)

Rehearsals in global warming: learning to manage water for Australia.

The zones of highly variable and extreme hydrological events associated with the dryland conditions found in many arid and subtropical regions are expected to expand due to global warming. Land and water use practices in affected areas will require modification and public policy will need to mitigate the social, economic and demographic consequences. Lessons still being learnt from experience gained over the last 150 years by European migrants to the Australian continent offer a rich source of material for managing this process of social adaptation pro-actively. Australia's hydrography is unique among nations for the variability and extremes in its natural regimes. Modern Australians, still new people in an old land, are learning that effective exploitation and conservation of land and water resources under these regimes demand a fundamentally different philosophy to principles developed under more stable, seasonal and predictable conditions.

Ever since European settlement, land and water users and managers, technologists and engineers have striven to meet the economic and social expectations of the time. To do so, they have implemented policies and techniques for managing land and water based on assumptions about more predictable regimes in Europe and North America. With the benefit of hindsight, however, ignorance of Australia's particular hydrological characteristics appears to have reduced the integrity and productivity of the natural resource base. Modifications to overland, in-stream and sub-surface flows, especially for irrigation, are primary causes. A significant indicator of an emerging trend towards ecologically sustainable adaptation is the extent to which water policy and praxis in Australia are now diverging from the models and methods applied to more resource-rich and predictable environments. Flow management regimes formulated to reap the benefits of variability and extremes rather than to mitigate them are one example. As global warming extends the zone of dryland conditions across the planet, the story of European adaptation to Australia's hydrology offers a unique case study of increasingly global relevance.

24. Salila Jayanethi & S.P. Goonetillake, Sri Lanka (215)

Comparative Study on the Ancient and Modern Water Resources Management Systems in the Dry Zone of Sri Lanka

Sri Lanka has a long history of a hydraulic civilization dated back to 500 BC and a tradition of a culture even longer than that. It has been described as one of the oldest irrigation systems of the world. The dry zone of Sri Lanka is dotted with thousands of ancient tanks still in operation and abandoned. The dependency of the economy and the society on its water resources was remarkably high in the history and is likely to be continued so in the present and future.

The paper examines the mechanism for the water resources management in the dry zone of Sri Lanka for its agricultural development. It is critically analyzed to identify failures of the system due to political and socio economic changes of the country. The role of community involvement in the past, present and future will also be reviewed for the sustainable management of water resources in these irrigation systems.

The land use pattern associated with the tank cascades, demonstrated a profound knowledge of integrated natural resources management. The system management required community effort and coordination for efficient control over distribution and allocation of water between top to tail ends of the system and could be achieved through the closely linked traditional village system. There had been an institutional setup to facilitate the fair distribution of water resources at grass root level. However, it is revealed that water resources management in the modern irrigation systems has designed beyond biophysical and social carrying capacity. This has become a failure due to involvement of wage labour and heterogeneous characteristics of the resettled

agricultural community in the commanding areas. This has further emphasized the need of an integrated water and land management system to the dry zone of Sri Lanka.

25. Kouosseu Jules, Cameroon (142)

The artificial Lake of Maga and its impact on the developpement of the Logone plaine (Cameroon)

Since 1950, the population of the Logone plaine has been benefiting from one of the most important socio-economic investment's in Cameroon. In order to introduce rice cultivation as a vital integrative factor in capitalist economy, the french administration put in place rice production.

To ensure survival, a barrier was constructed along the logone river to stop and prevent floods, thus creating the artificial Lake of Maga. Consequently this has led since 1979 to the constant sustainability of rice cultivation through irrigation. This Lake covers a surface of 36000 hectares, water coming mostly from the mandara mountains, the Logone through the Djaga spring, the Mayo Tsanaga and Bonle. Its presence has influenced several migrants engaged in rice cultivation or fishing which gives the area an anarchic exploitation of waters in a soudano-sahelian area has provoked certain environmental issues.

These findings and others constitute the basis of our fauns which includes the social, economic and ecological consequences of the presence of the Lake of Maga. As synthesis of work completed by observations and field studies permits the putting up of this study.

Key words: digue barrier, artificial Lake, rice cultivation, water resources, ecology

26. M.A. Kahlowan and A.D. Khan, Pakistan (137)

The World's Largest Contiguous Irrigation System: History of Development, Successes and Challenges in Indus Basin of the Pakistan

Indus Basin irrigation system is the world's largest contiguous system, which irrigates about 16 million hectares of land. It has a long history dating back to the Indus Civilization. The early history of the Indus Civilization and irrigation is shrouded in the mystery. However the authenticated history reveals that irrigation in Indus Basin was developed from Persian wheel and use of the river bank overflows during the rainy season to the present day modern system, which utilizes the technologies to develop the hard rock aquifers and regulated canals supplies. The irrigation system has been developed in different phases of which the periods of the pre and post independent of the Pakistan are of prime interest. The vastness of this Gigantic system consisting of marvelous hydraulic structures, a continuous aquifer and irrigation network which delivers about 197 billion cubic meter annually offers a lot to irrigation engineers. The Indus Basin irrigation system consists of five main tributaries (rivers), more than 60000 km long earthen canals and main distributives, 3 main reservoirs, 23 barrages/hadworks/syphons serving 43 canal commands through more than 100,000 outlets.

The investment in irrigation sector doubled of irrigated area from 9.1 in 1947 to the 18 million hectares in 1988. This investment also increased the cropping intensity from 60 to 120 percent and agriculture production by four folds in 50 years. The water conservation through control of seepage by lining of the watercourses and on farm water conservation contributed in improvement of irrigation efficiencies. The system is managed through a principle, that " Federal Government (Water and Power Development Authority) is the custodian, provinces are the owners and farmers are the end users of the waters. These developments in the water sector coupled with the industrialization have changed socio-economic conditions and brought prosperity in the flourishing Indus Civilization. But the continuous increase in population and use of water in agriculture and industry has turned the Pakistan from water surplus to water deficit country. The social implications include transboundary disputes and settlements, non-participation of the beneficiaries in O&M of the system and reservations of the provincial irrigation authorities. The technical issues include the water scarcity, low system efficiency, water logging and salinity, groundwater mining, disposal of the saline drainage effluent, deterioration in water quality due to pollution and degradation of the environment. The widening of the gap between demand and supplies is shifting the trend towards the use of non-conventional methods of the water use at farm. This paper presents a brief history of development of Indus Basin irrigation system, challenges and use of latest non-conventional methods of water in Indus Basin.

27. Ahmed Kamal, Bangladesh (306)

The History of Water Management in Bangladesh, A Study in State-Agrarian Relations

Water is a vital resource in Bangladesh. But its abundance during the monsoon with three mighty rivers draining a vast watershed inundates the country with floods at regular intervals, damaging crops, destroying infrastructures and causing losses of life. And the recent floods (1987, 1988 and 1998) brought untold sufferings to the life of people and caused enormous damages to the nation-building process. The poor are the worst sufferers. Some suffer loss of life and most suffer loss of livelihood. Hence with the growing intensity of the demand for water management the stress on the existing agrarian relations is only increasing. This brings the whole question of existing state-agrarian relations in Bangladesh into sharp focus- thus transforming the issue of water management into essentially a political question.

The discourse on the process of colonial state formation strikes one by the callousness and ignorance of the alien bureaucracy towards the needs and efforts of the community regarding water management. These were not acts of absentmindedness but rather were reflections of a development perspective inextricably intertwined with the process of colonial state formation. Records show that the colonial state assumed a centralized, elitist and overwhelmingly technologically oriented perspective towards the development of water resources in the country. Significantly, this legacy continued during the post-colonial period. That the peasant at times confronted the state, if necessary, as in Madarsha in North Chittagong in September 1948 and in *Bil Dakatia* in Khulna in August, 1990 - to mention a few among many other such confrontations of different intensity - are illustrative of the people's capability to determine and launch their own initiatives - even if it meant going a different way from the path chalked out by the bureaucracy.

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The current institutional practices and policies regarding water resources' management hardly reflect the sensitivity that was evident in the historical past, the paper will highlight the subtle and complex system of understandings, attachment to, and care for, water resources that the people of Bangladesh have developed after hundreds of years of working and living in the evolving environment of a deltaic land mass. Hence, an attempt will be made in the paper to look into the history of water management in Bangladesh from ancient times to the present day in order to understand the evolution of state-agrarian relations in the domain of water management

Methodology: The paper is based on research in the archives of Bangladesh and West Bengal. District records, Newspaper reports and Legislative Assembly proceedings and other published studies are the principal source materials for the paper.

28. Bong W. Kang, South Korea (120)

The Role of Irrigation in the State Formation in Ancient Korea

Irrigation agriculture theory, formulated by Karl Wittfogel (1955, 1957), has received a great deal of attention from anthropologists and archaeologists in conjunction with the question of state formation. Although many people have used Wittfogel's hypothesis to explain the emergence of state-level society in terms of cooperative voluntaristic perspectives, many scholars have argued that a large scale irrigation works should be viewed as a result of state formation rather than as a cause.

Thus, some questions concerning the role of the irrigation works in association with the state formation remained. While water is indispensable for any plant cultivation, wet-rice needs a tremendous amount up until it is harvested. Therefore, irrigation systems may have played a critical role in the success of we-rice agriculture and other plant cultivation as well and may have closely related with the appearance with the ruling bureaucracy. In this paper, on the basis of historical documents, inscriptions, and archaeological data, the influence of irrigation works in relation with the sociopolitical development of the Silla Kingdom in ancient Korea (0 – 700 A.D.) will be examined.

30. Aysegul Kibaroglu, Turkey (231)

Progress in the Management of Irrigation Systems: Turkey's Southeastern Anatolia Project (GAP) Experience

Management of water resources can conveniently be considered under two major headings. First, *supply management* which comprises activities required to locate, develop and manage new sources. Second, *demand management* which incorporates mechanisms to promote more desirable levels and patterns of water use. Population growth and economic development have overwhelmed traditional water management practices all over the world. Given the constraints on augmenting the existing water supplies in the near future, far greater emphasis should be placed on demand management practices to better deal with current and anticipated problems emanating from water scarcity. More so, for transboundary water resources some of which have become quite problematic over the last decade.

This paper is based on the assumption that countries riparian to a transboundary water resource can adapt themselves to the limited availability of, and the growing demand for water by stressing institutional development, including community participation as a major goal for water-using activity together with the creation of an enabling environment with appropriate policy and legal frameworks. For instance, in the Euphrates-Tigris river basin, irrigation accounts approximately for 75 percent of water withdrawals by the major riparians, namely Turkey, Syria and Iraq. Hence, in this region, institutional interventions that can reduce water use have a particular potential in irrigation. There are technological and managerial demand management options that can improve irrigation water use efficiency. Thus, the proposed paper will look into the Turkish experience in improving irrigation water use efficiency through managerial options with special regards to the developments within the Southeastern Anatolia Project (hereafter: GAP-the Turkish acronym of the Project).

The GAP being the largest multi-purpose integrated development project of the region is envisaged to expand the irrigated area by adding 1.7 million hectares to the current 4.16 million hectares of irrigated area in Turkey. Agriculture is, indeed, signified as the leading sector to develop the region which is far backward when compared to the western districts of the country. For a long time, existing water resources of the region especially the major surface water resources, namely the Euphrates and the Tigris rivers are thought to be fairly enough for prospective developments in the irrigation sub-sector in the country. However, the GAP being a multi-sectoral integrated development project equally emphasizes the development of other driving sectors of the region such as hydro-power, industry, urbanisation all of which emerge as competing sectors with agriculture in water use. Hence, action is needed concerning the policy, management, and technological aspects of the irrigation sub-sector in order to enhance the productivity of the systems in an environmentally sustainable manner. Land and water being the major natural resources that form the driving force of the GAP, the Project aims to achieve economic and social development through the optimum utilisation of these resources along with the principle of sustainability. In line with this goal, various projects have so far been implemented, and are in the process of being implemented, with a view to attain appropriate use and management of available resources.

The proposed paper will scrutinise the GAP Project on the Management-Operation-Maintenance (MOM) of Irrigation Systems. In the early 1990s, GAP Regional Development Administration (RDA) has introduced the Management, Operation and Maintenance (MOM) model in order to identify the most suitable management, operation and maintenance arrangements so that the resources invested in irrigation development are utilised optimally. With the implementation of the MOM model RDA envisages to address many institutional and technical problems which stem from the prevailing structure and practices of irrigation management organizations in Turkey.

With an ambitious start, the MOM Study envisaged to identify the most appropriate organisational structure for water users who are to undertake the management, operation and maintenance of irrigation systems in the GAP region. In line with this major objective, the model was designed to provide a framework for equitable water distribution and higher levels of water use efficiency that ensure the protection of soil and water resources. Hence, socio-economic studies of farmers in the region focussing on their future participation in irrigation activities were conducted along with the evaluation of the current technologies and practices adopted for operation, maintenance and management of large irrigation systems in Turkey and other countries.

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Through these studies and others the preferred management model was developed. The model is based on a bottom-up organization of village-level associations of irrigators.

However, the implementation of this theoretical exercise, namely the MOM model was limited and 38 irrigation associations established in the region were realised under the pragmatic approach of the major water agency of the country, namely the State Hydraulic Works (DSI). Hence, the paper will proceed with an analysis of the overall DSI experience in irrigation management transfer by drawing comparisons with the MOM model. Achievements and bottlenecks of both models will be exhibited in due course.

On the other hand, the GAP constitutes a unique case to be examined in that a transboundary river system, namely the Euphrates and the Tigris rivers are the major sources for irrigation in the Project area. Hence, improvements in the patterns and levels of use and management of these water resources will not only contribute to the increasing water use efficiency at national level, but will also support policies to stretch the existing capacity of transboundary water resources to meet the growing demands of co-riparians. More importantly, experiences which are gained in the GAP case in terms of attaining higher levels of productive efficiency through the adoption of advanced management options in the irrigation sector will represent a standing example which challenges the existing water use and management practices of co-riparians, namely Syria and Iraq. Thus, the paper will conclude with an analysis of the impacts of the overall change in the irrigation management in Turkey on the water use and management practices of the downstream riparians.

31. Keely Lange, USA (325)

No title

Of the two great rivers that form the Central Asian "fertile crescent," the Amu Darya and the Syr Darya, much attention has been paid to the plight of the Amu Darya and the ever-shrinking Aral Sea. The role the Syr Darya plays in exacerbating regional tensions is only recently claiming a limelight of its own. The Syr Darya is responsible for destabilizing both the energy and environmental security in the region. Originally dammed for irrigation purposes, Kyrgyzstan's use of the river for hydroelectric power generation caused unforeseen environmental damage. Rather than the usual environmental problems above the dam, disastrous flooding has occurred downstream. This situation results from the timing of the releases-winter when energy is needed as opposed to summer when the agricultural lands need water. These environmental problems are compounded by energy needs and Kyrgyzstan's decision to charge, in coal and gas, for the timing of water releases.

The supply and denial of gas, coal, and water has become a new form of regional conflict. The river presents a fascinating means of analyzing the interplay of environmental and energy security in the region and presents a new and intriguing twist on the "water wars" said to the peril of this millennium.

32. Jørgen Lennqvist, Sweden (229)

The great drainage project in central Sweden 1850 - 2000

The purpose of this paper is to show the waterhistory of a drainage area in Scandinavia. I intend to address the alteration of the landscape in an agricultural region in central Sweden, from the middle of the nineteenth century to present, from a waterhistorical view.

The shift from traditional agriculture towards modern, market oriented farming initiated the great drainage project that changed the landscape of the flatlands that surround lake Hjälmaren, a large lake in central Sweden. This drainage of several wetland lakes also included a lowering of the lake Hjälmaren. The great drainage was initiated and driven through by the great landowners of the region and the drainage company was massively subsidized from public funds.

To fully understand how man's actions have affected the environment from the middle of the nineteenth century to present, it is necessary to see the watersystem and wetlands both as a context for actions and a result of these actions. Nature and man together have formed the present agricultural landscape in central Sweden.

The actions that have been taken to control water in the region have been a result of natural processes, either "natural" as in the physical continuum of water, or basically natural processes, i. e. processes that are natural even if in this specific case they are started by man and they continue due to human efforts and land use. As a result of the lowering of land levels that occurred in the former wetlands and lakes that were used for agricultural purposes, increased flooding became a major problem for the region during the first half of the twentieth century. As a result of the consensus of opinion on proper land use the regional agricultural bureau carried out a project, constructing dikes and pumps, to hold the water in place, and away from places where water was undesirable. This project was also largely financed from public funds and was finished during the late 1970's.

The dikes did make it possible to reconstruct an artificial wetland that was meant to harbour wetland birds. These lakes now covers a small part of the drained area and were also government financed.

33. Fiona Miller, Australia (210)

Adaptation / Control: Perceptions and Responses to Environmental Risks in Water Resources Management in the Mekong Delta, Viet Nam

Agricultural development in the Mekong Delta, Viet Nam has historically been framed by the state as a struggle to overcome the two environmental risks of salinity intrusion and flooding. Yet, despite the construction of a dense network of canals over recent centuries, particularly during the period of French colonialism (refer to paper by David A. Biggs), the experience of war and international economic isolation has meant large scale investment in water infrastructure to 'close off' and 'protect' the Delta from salinity and flooding has been delayed until recent times.

This paper will discuss the perceptions and responses of key resource actors to the environmental risks of salinity intrusion and flooding in the Mekong Delta, primarily focusing on the role of the state in alliance with external actors such as the World Bank; this discussion will be situated within the regional context of intensifying development and resource conflict in the Mekong Basin. The paper will examine the multi-scale political and ecological implications of the current shift in the water regime of the

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Delta from one that was relatively open and naturally regulated, where farmers had developed sophisticated and adaptive coping strategies to alternating periods of water scarcity and abundance, to one that is now increasingly reliant on the control and regulation of the water regime through large scale infrastructure, including flood diversion and flood protection, and physical salinity intrusion protection structures. How these structures affect local farmers' access to water, the scale at which production decisions are made, and the development of 'necessary' water management institutions at a local and regional scale will be examined with reference to issues of equity and ecological sustainability.

34. Eric Mollard, France (147)

The meanders of history: is a history of irrigation imaginable? Analisis of three deltas: Camargue, Chao Phraya and Nile

In order to base a history of irrigation in the world, we test its feasibility through the ecological, social and technical history of three deltas. The methodology relies on a model of development to stress the main factors which explain the current land use. We conclude that, at this level of artificialization in agriculture, the ecological history basically depends on political and social environment. We suggest that a history of irrigation would begin by such an entry.

35. Francois Molle, Thailand/France (36)

Water control and agricultural development : crafting deltaic environments in Southeast-Asia

Deltaic environments suffer from various constraints which have often long deterred human settlements: they include dramatic flooding, water shortage in the dry-season, saline water intrusion, soil acidity or salinity. In the course of time, people have come up with a variety of solutions to either adapt to these constraints or to modify them through the use of technological innovation (land development, water control, agronomic innovations, etc).

The paper reviews the successive strategies adopted in Southeast Asian deltas, and emphasises their commonalities but also their differences. These differences are interpreted based on a series of climatic, physical and politico-historical reasons.

36. Ingeborg Nordbø, Denmark, Chile (221)

The Destiny of the Bio-Bio River - Indigenous or National Rights?

This paper will deal with water, values and identity and will debate different approaches to water and development – *the short-term economic approaches or the more long-term human-ecological approaches*. Thus the paper will touch several of the given themes: The political economy of water – the right to and control of water? Images of water – water as a resource for humans to explore, or water as a symbolic feature: Narratives on the river and the dam - the religious river or the energy producing river?: "Water and man" relations in science – should nature adjust to man, or should it be the other way around?

In front of the fight to preserve the Bio-Bio river in the South of Chile is a group consisting of five women, who together with GABB (Grupo de Acción por el Biobío) – an environmental grass root organization fighting for the Bio-Bio and the right of the Pehuenches – has obtained the Alternative Peace Prize (Stockholm 1998) and the Petra Kelly Prize (Berlin 2000).

The Mapuche people is the largest ethnic group in Chile and constitutes approximately 10% (more than 1.000.000 people) of the Chilean population. Pehuenches, people of the *pehuen* tree (*auracaria*) area, is one part of the Mapuche people, who live in the Andes and alongside the Bio-Bio River (Hernandez 1998:8,22). ENDESA – the largest energy company in Chile – has already constructed the hydroelectric plant Pangue on the Bio-Bio River. Now the battle is about RALCO – the second dam in a series of total seven planned dams. RALCO is the most extensive dam, and will, when ready, put an area of 3.467 ha under water, forcing some 91 Pehuenche families to move from their lands (Calfucura 1997).

The project was initially financed by the The International Finance Corporation (IFC) – with a \$70 billion loan. IFC also provided a \$28 million loan through the Swedish board for Industrial and Technical Cooperation (BITS) and the Norwegian Agency for Development Cooperation (NORAD), which gave \$14 million to the project. Finally, ten European Banks lended \$100 million dollar (Usher, 1997). When the World Bank leader - James Wolfensohn – after two independent investigations of the project had to go public with an apology to the Pehuenche people, it was already late – ENDESA had managed to refinance the project.

Today, some 84 families has signed the contract to move, but seven families are still resisting, claiming the right to their land and the river they have lived by - and of - for centuries. The Indigenous Law (*La Ley Indígena*), which came into force in 1993, proclaims that the Pehuenches – as indigenous beings - cannot be forced to move from their land (Ley

37. Jacinta Palerm-Viqueira, Mexico (28)

The Self-management of Irrigation Systems: A Typology. The Mexican Case.

The discussion concerning the management of irrigation systems has centered on State- vs. self-management, but very little attention has been paid to the question of the different type(s) of self-management.

In Mexico, we have about 6 million hectares of irrigated land. Approximately half of this area is irrigated by small systems (the largest system for which we have information spans 10,000 hectares and includes 4,000 irrigators). Irrigation areas as such go back to prehispanic and colonial times and also include more recent efforts. Existing organizations for the management of these irrigation systems date from the Mexican Agrarian Reform (1930's) in multi-community cases, although at the community level they may go much further back.

The other half is mostly irrigated by large systems (the largest is over 200,000 hectares), that are called *irrigation districts*. They are in a process of partial turnover, with the State operating the reservoir and other large water works and the irrigators the network of canals through water users associations. Most of these irrigated areas are located in northern Mexico ("arid America") and go back to colonial times, but have been greatly expanded through State investment in large reservoirs in the first half of the 20th century.

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The critical differences between small irrigation works and the recent cases of turnover of larger systems in Mexico are: (a) the longer experience in self-management, (b) the smaller size of the irrigation systems, and (c) the absence of a hired professional staff. The self-management of small irrigation systems is based on local authority and local systems of knowledge. These systems include participative and democratic organizational know-how, as well as irrigation techniques for crops and specific hydraulic methods, of which we know very little (a short list: *entarquinamiento, cajas de agua, pantles, tepamitl*, that sometimes resemble techniques in other parts of the world known also by local names, such as: *sailaba, jessour, gavia, natero*).

The self-management of new water users associations in irrigation districts depends on a hired professional staff, and the irrigators themselves do not seem to be acquiring knowledge of technical and operational aspects.

Our objective is to characterize these two types of self-management because of probable differential consequences and evaluation of the type of self-management in turnover cases. For example, in the case of *irrigation districts*, is the dependency on a hired professional staff the only option? Is the staff hired by water users associations more efficient in its efforts than the former State hired staff? Do small irrigation systems lack a greater input of technical know-how? Can the two types of management be combined in larger irrigation systems?

38. Ayaz Latif Palijo, Pakistan (115)

Indus, Dams and Participatory Irrigation Management for Water Rights

Today in South Asia we are faced with the challenge of adapting our interaction with our environment to create a sustainable society. The people of Sub-Continent believe that the best defense against destructive influences is to track both their activities and their effects on natural resources. But we the South Asian (Indian, Pakistani, Bangladeshi and Sri Lankan people) have not learnt how to live without consuming the very resource base that sustains us and that will sustain future generations. Since early 90s more than 80 million people in South Asia have become unemployed and as a consequence, millions of people have been reduced to absolute poverty. It is an established fact that South Asia in general and Pakistan in particular remained a land divided between the hopes of the rich and the despair of the poor in which the richest one-fifth earned almost 40 percent of the region's income and the poorest one-fifth makes do with less than 10 percent.

Dealing with environmental and ecological threats, shortage and misuse of water and issues like poverty, corruption & governance our today begins the struggle of survival for 115 million poverty-ridden destitutes, and tomorrow threatens the future of 395 million illiterate adults with nuclear arms, climatic changes, land degradation, scarcity of water and mismanagement of natural resources. In case of Pakistan, which has one of the lowest literacy rates and lowest indicators of gender development in the world, widespread poverty prevails because of most powerful feudal-industrial interests, absence of conceptual environmental knowledge, undemocratic governments and illiteracy. Now a days internationally more emphasis and more concentration have been paid to sustainability, right to say, forest protection, ozone depletion, waste management, environmental justice and natural resource management worldwide but Pakistan lags behind developed world and Far east Asia in terms of environmental awareness, community rights, NRM and conservation of biodiversity.

All along the Indus Basin but specially in Sindh, economic growth and progress towards poverty alleviation are now critically threaten by wide spread loss of productive farmland due to miss management and degradation of water and soil resources. Due to miss management and water shortage at canal tail ends competition for water between different classes and clan have increased. This has led to catastrophic impacts on rural livelihood and entire rural communities are being forced to abandon their lands and to work as agriculture wage laborer or to migrate to overcrowded cities in search of employment. This has been experienced by working with Community Based Organizations (CBOs) in Hyderabad, Thatta, Badin & Dadu district of Sindh Pakistan. These Peasant Organizations and Farmer Networks are supported by few NGOs, Political Parties and Govt departments which are trying to strengthen their capacities to organize farmers and to take collective action for participatory irrigation management. Though there is a lack of Integrated Natural Resources Management Program, but the rural communities are striving for developing sustainable soil and water management systems to attain a sustainable livelihood and their main objective is to ensure a more efficient, equitable and transparent distribution of canal irrigation water by strengthening the involvement poorest farmers in irrigation management. Several farmers Organizations have been formed through the institutional and strategic support to existing CBOs in major distributaries having different ecological and management issues, thus ensuring the sustainability of newly formed Farmers Organization FOs. This is also an attempt to address the issue of participation of people in Mega Projects like World Bank National Drainage Program and Kalabagh Dam.

The area of present-day Sindh province was the center of the ancient Indus Valley/ Mohen-jo-daro Civilization (2300 BC-1750 BC), it was named after Indus, the great Trans-Himalayan river of South Asia and one of the world's longest rivers, with a length of 2,900 km. The Indus (also called Mehran and Sindhoo) rises in southwestern Tibet at an elevation of about 18,000 feet (5,500 m) and flows in a northwesterly direction along the slopes of the Himalayas. Recently the Government of Pakistan has announced its decision to construct Kalabagh hydro power dam on Indus. According to the reports of international experts, World Commission on Dams (WCD) and International Rivers Network (IRN) over the past 50 years, some 30 to 60 million people worldwide have been displaced by large dams and tens of millions more living downstream have been impoverished due to falling productivity of their farmland and fisheries after dam construction. Many dams, such as Sardar Sarova/Maheshwar Dam on the Narmada River in India, Arun in Nepal, Kaeng Sua Ten in Thailand, and Bakun in Malaysia, are being opposed by the environmentalists . Pakistan is the signatory of the Declaration of Rio which states that "In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it."

This Paper will discuss the proposed construction of Kalabagh Dam and institutional development strategy of Farmers Organization with historical perspective. It will also discuss the impacts of organizing farmers on the social context and relationship of the people and the lesson learnt for development practitioners. It will discuss the future role of political activists, CBOs and FOs in participatory Irrigation Management and in the rural development of the area and on policy advocacy for water sector in Indus basin

39. Walter E. Pittman, Alabama, USA (61)

Irrigation and salts in California 1870-2000

For over a century California has been one of most productive agricultural regions on earth. It's fecundity is based upon irrigation of arid lands. The state has faced major problems with salts since the beginning of irrigation, particularly in the Central Valley.

Initially, the problem involved the presence of alkali in the soil. In the early years, Eugene W. Hilgard, the world-famed American "Father of Soil Science" unraveled the chemical mysteries of alkali at the laboratories and field stations of the University of California in the 1880's. He developed processes for the amelioration of alkali which are still in use. His student and successor, W.P. Kelly, developed by the 1920's the concept of "base exchange" of cations in the soil column, during irrigation, along with Gedroiz, de Sigmond and Hissink, to explain the movement of salts and their effects on soil and plants.

Another problem, the build up of salts in the soil became increasingly serious. As the various salts interacted and reacted differently under similar conditions and soils and irrigation waters are extremely heterogenous the chemistry proved complex. The source of the salts proved to be the irrigation water itself and mineral weathering reactions in the soil. By the 1960's and 1970's some basic scientific understanding of the process involved had been arrived at by a study of reaction kinetics and equilibrium processes. With understanding, hopefully could come remediation.

Yet another new salt problem then emerged. Salts flushed out of irrigated land had to go somewhere and the buildup of salt in the Colorado River, the Sacramento basin and other places created new problems that alarmed an increasingly environmentally conscious public. The buildup of selenium in the Kestorsen Wildlife Refuge, which maimed waterfront resident there, proved unacceptable to the public. Large quantities of water were diverted to correct this, and consequently much land had to be taken out of cultivation. It is apparent that in the future salt-laden irrigation water cannot be returned to drainage systems without removing the salts. A new area of research and technology is already developing.

40. Nadezhda Prokhorova, Russia (126)

The role of water resources in the history of Russia.

The history of Russia can not be considered without its water wealth. In the river floodplain with its rich silt, a man cropped and the new area assimilation was made along the Volga river: from the source to the outlet. At the end of the seventh century Russian geographical science had a broad information about water ways. In 1627 there was the first detailed description of the Russian area "Ancient Russian hydrography, contained the description of the Moscow state, rivers, lakes, channels"

During the Peter the Great rule water energy was used in the metallurgical and mining industry. The dams were built on the rivers and the water falling power was turned to the mechanic energy by using the simple hydraulically complex. Though, Russian methods of water energy using and hydraulically complexes were not the same as in Western Europe. There are some reasons of necessary building of high dams and reservoirs of large capacity in Russia. Besides, the stone dams were being built in Western Europe; in Russia there were always wooden ones, made of foliage trees.

In eighteenth centuries the economical development of Russia was impossible without wide river conversion and its using for shipment and wood driving. Many rivers became a cheap and comfortable ways of communication and they linked the distant areas and the center. For example, the Chusovaya river played a very important role in the Ural's industry development. In eighteenth, nineteenth century more than 50 Ural plans transferred their products by the river Chusovaya, the number of traffic was about 100 000 tons per year (at that time it was a large number).

Large geographical material and photos are presented in the report, where we can find the variants of the hydraulic buildings from the eighteenth century up to our days.

The great jump in Russian water resources using and learning took place in this century. Water industry is turned into the modern, technically equipped industry. For example in 1937 the detained water supply volume was 70 km³, in 1957 this figure was 125 km³ and in 1965 it was about 450 km³. Now, about 1000 km³ of water were gathered by the 100 biggest reservoirs.

In spite of the adoption of Water Code of Russian Federation in 1995 year, the problem of "water famine" exists in our country. Some reasons of this situation and the separate aspects characteristic of the water using safety is given in the report.

Special interest in the water fund using in Russia is presented in the period from 1960 to 1980 years. That time was the beginning and the end of the melioration building, experiments in the sphere of importing river flow between basins.

41. Martin Reuss, Virginia, USA (99)

Surface Water Hydrology and the "Big Dam Era" in the United States

Political and economic pressures heavily influenced the development of hydrology in the United States. As the country became industrialized and its population expanded westward, farmers sought ways to improve irrigation, while waterpower companies worked to improve their ability to measure water use. Flood control and navigation proponents developed new ways to measure river discharge and current rates. All sought better mapping of drainage basins.

The responses to these demands helped put hydrology on a far sounder scientific basis than had previously been the case. Yet, the focus on practical and often immediate applications raised questions about hydrology's claim to being a true science. Only in 1931, after much debate, did the American Geophysical Union establish a section on hydrology. Later in that decade, the federal government initiated a massive flood control program, partly in response to severe storms hitting the Northeast and partly to answer the need for public works during the Great Depression. The construction of large reservoirs and levee projects led to the development of storm studies, standard project floods, and better instrumentation. Much of this work involved close coordination between the Army Corps of Engineers and the Weather Service. Concepts such as standard project storms built on the earlier work of the Miami Conservancy District. The subsequent construction of large multipurpose dams during the "Big Dam Era" led to further advances in hydrologic instrumentation, theory, and application. Among many technologies, engineers looked to three-

dimensional models, lasers, computers, and satellite imagery to solve many hydrologic problems. The advances have been significant, although many questions remain.

42. Thierry Ruf, France (282)

Historical debates on ownership and control of water in South of France (Pyrenees-Orientales) in the 14th century, the 19th and nowadays on the same irrigation systems

In the South of France, the catalan region is well known for its irrigation sometimes compared to the Huerta of Catalunya, like Valencia. It is easy to demonstrate the historical parallelism : a very old creation of the first canals (the IXth century), an important development of the main canals in the XIVth century which gived to the valleys most of the spatial organization, a new phase of construction during the XIXth century linked to two movements, the demographic increase and the constitution of an hydraulic administration, and finally a heavy transformation of water regimes by the erection of a dam in the middle of the valley of "Têt".

In this communication, we will try to explain through the analysis of written rules what were the relationships between actors of the irrigation competition : ownership, control, sanction, water schedules, resolution of conflicts.

We may use the methodology to understand farmers communities who manage the commons (Elinor Orstrom, 1992) and compare through it three changes along history.

The first one is the competition of authorities to give rights to the villages communities when they built the canals and begin to use it (texts from 1305 to the middle of the XVIIth century).

The second one is the consequence of the french revolution and the tentatives to consider the formers rights like extinguished rights when users were organized in associations and common property rules since many centuries. This period ended during the XIXth century with the national law of 1865 which defines the status of "association syndicale autorisée" taking account of the catalan model of users associations.

The third change came with the reenforcement of the State policy after the second world war, and the adaptation of irrigators a new economic and technical context.

The main aspect that we will develop is the game between powers and legitimacy at each period. In the XIVth century, the users in the villages, the ecclesiastics, the lords, the Kings, the justice are dealing with water affairs, taking advantage of locals conflicts to adapt their behaviours. In the XIXth century, farmers defend the heritage of their rights but are fighting too the old possession of some landowners and oppose a great resistance to the private factories which try to catch water and to the administration which affirm to be the only one authority on water resources. In the last decades, farmers associations begin to coordinate themselves to manage not only the water of the dam but the exchanges of water and the management of water scarcity when it occurs. But they still refer to the oldest rights like a banner, an identity, a symbol opposed to the rationality of hydraulic engineers of the State or any foreign expert.

43. Zekai Sen, Turkey (40B)

Water Robotics During the Twelfth Century and Abou-l iz al-Jazari Case

Although water resources have been developing throughout the centuries for the service of different civilizations at many scales and regions its use in automation has been conceived only recently. However, research in the history of water from automation point of view leads to some unknown or hidden facts. In fact, starting from the old Greek period before the Christ and after about the twelfth century there are many researchers that have been trying to make use of water power for working some simple but effective devices for the service of human activities. Among these are the haulage of water from a lower level to a higher elevation by water wheel in order to irrigate agricultural lands. Heron during the Hellenistic period before the Christ, Vitruvius of the Roman Empire period are among the first workers who have tried to make use of the water power for usage in different human activities such as water haulage, watermill, water clock, etc.

The flood light of these works has been achieved by a Muslim researcher who lived in the twelfth century in the southeastern part of Turkey. He is Abou-L Iz Al-Jazari who have reviewed all of the previous researchers works from different cultures and then suggested his own designs and devices for the usage of water power in automation of admirable types. He even combined the wind power and water power through early designs of valves, pistons, cylinders and crank mills as will be explained in this paper. His works have been revealed from the ignored historical facts by German historians and engineers in the first quarter of the nineteenth century. Later, Hill (1975) as an English engineer has translated his Arabic written book into English showing the guidelines for the modern automation and robotics designs right from the twelfth century. This paper will give a brief summary of the early workers devices and much more developed Abou-l Iz Al-Jazari's designs in his original hand drawn pictures.

44. A.K.Sinha, India (322)

Palaeochannels as Riverine Monument from Thar Desert, Western India – Reotrospect and Prospect

Palaeochannels are such riverine geospheric features which harboured great human civilization in the past and have potentiality to help survive the present part of human civilization thriving in the regions of palaeochannels all over the globe if identified ,understood and managed properly. They are also being used to trace the history of ancient rivers.

The Study and information gained through interdisciplinary sources and techniques such as ancient literatures ,geological, hydrological , Archeological , palaeoclimatological and Remote Sensing reveals that today's disorganised palaeochannels are the relict of the past integrated river system along which mighty and great human civilizations thrived and which now became extinct due to tectonic and geomorphic activities; climatic vicissitudes ; and possibly due to anthropogenic activities as well.

As a part of a case study from the northern and western part of the Thar desert the paper also deals with the evolutionary stages of a set of palaeochannels from the region and highlights the good occurrence of groundwater in it of potable quality which if properly tapped may become a good source of water in this water scarce region to support ecological regeneration in otherwise fragile ecosystem.

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The object of this paper is to draw the attention of the Environmentalists and policymaker toward identification and delineation as well as protection and proper management of such 'Riverine Monument' not only in Thar desert of India but all over the globe as they not have good resource prospect only but are important in retrospect as well as they forewarn us if the present riverine environment are not managed properly we would have more such riverine Monuments.

45. M. William Steele, Japan (212)

History of the Tama River

The Tama River has its headwaters in the Okutama mountains west of Tokyo. From there it flows 138 kilometers, first as a rushing stream through a narrow valey, then spreading out and snaking its way through flatlands until it reaches Tokyo Bay at Kawasaki. The river is associated with the development of Edo-Tokyo, now the capital of Japan and one of the largest cities in the world. Until recently the bulk of drinking water for the citizens of Tokyo derived from the Tama River. Moreover, the river allowed for traffic between rural and urban areas; it provided water for agricultural irrigation and gravel for ferro-concrete buildings, roads and railway beds. Indeed, the Tama River is intimately linked to the development of the modern Japanese economy. The river is also linked with death and destruction. Floods were increasingly common in the 19th and early 20th centuries. In the 32 years between 1868 and 1900, for example, 22 were flood years. The Tama River was gradually placed under human control. Its course was straightened and its banks were reinforced with concrete. By the end of the 1920s plans were drawn to dam the river at its source. Construction was to begin in 1936; the new dam would be Japan's version of the Hoover Dam project then underway in the United States. The costs of war delayed the project and it was abandoned until after the war, finally completed in 1958.

Interestingly, having robbed the river of its rocks and dammed its waters and cemented its banks, there is now, at the beginning of the 21st century, a movement to restore the river to a more "natural" state. Influenced by the works of Donald Worster, I propose to write a history of the Tama River, from its origins to the present-day. I will place emphasis on the last 500 years and highlight areas in which river and people have interacted

My main field of research is modern Japanese social history. I am particularly interested in local history and hence my interest in the Tama River, which is close to where I live. I have written one study on the extraction of gravel from the Tama River: "The History of the Tama River: Water and Rocks in Modern Japanese Economic Growth," in *Asian Cultural Studies*, vol. 26, 1999, pp. 39-50. I am now proposing to write a more general history of the river.

46. Nils Roar Sælthun, Norway (328)

The Alta Hydropower Development: Hydropower versus environmentalists and indigenous interest groups - the great showdown

The Alta hydropower development and the bitter struggle around that scheme not only made a deep impact on Norwegian public debate, but also arose interest and engagement far outside the country borders. One reason for this was that besides all the classic conflicts usually found in connection with hydropower development, it also encompassed the rights of indigenous people, in this case the Sami people, and highlighted the issue of civil disobedience.

The case and the public debate lasted around 20 years, from the first plans by the around 1968 until the power plant was in operation in 1987, and the debate to some extent still lingers on. This is certainly much ado for a power plant with an annual production of 625 GWh - around 0.5% of the hydropower production in Norway. The production of the Alta plant has by the way become a new unit for energy production and consumption in Norway - one "Alta".

Some important milestones along the way:

- 1968: The Norwegian Water Resource and Energy Board publishes plans for development of the Alta River total production 1150 GWh
- 1974: The State Power Plants applies for development of 860 GWh
- 1976: Revised application for a reduced development, 710 GWh
- 1978: Stortinget, the Norwegian Parliament grants license for the development of 625 GWh
- 1979: Strong mobilisation against the plans. Sami activists hunger strike in Oslo. Start of the access road construction hampered by sit-down and chain-gang actions in Alta. Preliminary halt of construction.
- 1981: New start of road constructions. Large demonstrations and police actions in Alta, 900 taken into custody and fined.
- 1982: Folkeaksjonen - the most important action group for Alta dissolves itself.
- 1984: Work on the dam site and the power plant commences
- 1987: The plant in operation.

The following information is compiled from several sources, between others Ryvarden & Tømmeraa (1979), Dalland (1994), Olje- og energidepartementet (1978).

47. Massoud A.H. Saad, Egypt (144)

The history of Lake Mariut changing from a healthy productive to the heavily polluted basin in Egypt

The present Lake Mariut represents a vestige of an ancient much larger fresh water lake (Lake Mareotis) covered an area of 2400 km² and flourished in the Pharaonic and Ptolemaic times, with extensive Papyrus vegetation and very good fish production. From these early times until the 12th century A.C., the lake served also as an important navigation basin between the inland and Alexandria on the Mediterranean Sea. From the 12th century onward, several old Nile branches that used to feed the lake gradually silted up and the lake had been almost dry for 700 years, except during the flood period. In 1892, the irrigation system was recognized for agriculture in the country and the lake was used as a drainage basin.

At the beginning of the 20th century, the lake area was very large and then it has shrinked considerably, due to siltation and land reclamation projects. It was divided artificially into four parts and the area of the main part (Lake Proper) reaches now only 14

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km². Beside the extensive reclamation, the lake receives continuously large amounts of untreated domestic, industrial and agricultural wastes, following the progressive high increase in population, and became the heavily polluted basin in Egypt. Unlike the other Egyptian lakes, Lake Mariut was the subject of several limnological and pollution studies during the last 40 years to illustrate the severe man's impacts on its compartment (water, sediments and biota). This paper reviews and discusses the different pollution problems in Lake Mariut during the last four decades and suggests the appropriate solutions for its restoration for better management and utilization.

48. Mattias Tagseth, Norway (51)

Local knowledge in the 'mifongo' irrigation systems on the slopes of Mt. Kilimanjaro, Tanzania.

The Chagga people on the slopes of Mt. Kilimanjaro, Tanzania, continue to utilise a network of canals for irrigation and other purposes. This type of gravity-fed irrigation canals (*mifongo*) is a part of the cultural and technological heritage of the area. Moshi district has a high density of such schemes. Having been seen mainly as an obstacle in the process of development and in resource management, indigenous knowledge is now increasingly viewed as an important asset. Local knowledge in the area has been faced with a series of challenges, under which it changes. An initiative in water management following the rehabilitation of a hydropower plant at Pangani Falls is one of these challenges. There have been important changes in the farm system in the area through the last century, affecting the use of water. An increased reliance on agroforestry, and a diversification into vegetables are examples of these. The organisation of irrigation is varied, but the integration with other institutions at the local level is a common trait. The main objectives of my study of local knowledge in *mifongo* irrigation is to describe and analyse changes in water use, the relationship between the irrigation system and the farm systems, and also to analyse water tenure and the organisation surrounding the schemes.

49. Barbara Tellman, USA (299)

Water Development Projects and Invasive Species in the Sonoran Region

Invasive non-native species cause major environmental and economic problems worldwide. Invasive species tend to thrive especially well in disturbed areas, rather than natural environments, and some of the most disturbed areas are along watercourses. One leading causative factor in parts of the Sonoran Desert and adjacent ecosystems is change in hydrological systems as a result of human activity. These changes include dams, lessening of streamflow through diversion and groundwater pumping, introduction of water from distant sources, changes in flow regime because of channel cutting, and construction of artificial bodies of water such as stock ponds and lakes. paper will examine four case studies from the American Southwest to show both the relationship between water projects and invasive species of plants and animals and to illustrate the major ecological changes brought about by these invasions.

The case studies will include

- A. a major water project which transports water more than 300 miles from its river of origin,
- B. a watercourse whose hydrological regime has been radically altered by a dam,
- C. a watercourse whose regime has been altered by diversions, groundwater pumping, and channel cutting, and
- D. an area with stockponds near a watercourse.

In each case specific non-native species of plants and animals will be highlighted. The alterations will be contrasted with more natural situations in the present and historically. Finally, the paper will look at several proposals for managing these altered systems to encourage native species and discourage the proliferation of non-native species.

50. Lucio Ubertini, Paolo Buonora, Marco Ferrante, Italy (260)

The reconstruction of Rome floods basing on historical data and a hydraulic numerical model.

Many cities and towns, in Europe as well as in the rest of the world, arose close to rivers. The economical, social and historical interactions between these communities and rivers, being either resources or dangers in time, are widely studied in literature. In Italy many of these cities have been affected by flooding in the past or are in flood prone areas. In this paper the major flood events of the Tiber River in Rome are considered from both a historical and a hydraulic point of view. The cooperation between hydraulic engineers, hydrologists, and historians of the Italian Record Office allowed the reconstruction of the most important floods of the last centuries, that happened in Rome in 1598 and 1870.

The study of urban flooding requires different numerical models and risk analysis methodologies, compared to those used for non urban areas. From a hydraulic point of view, the flow propagation in a street network involves uncommon aspects in modeling a two-dimensional phenomenon. Hence, a particular numerical model has been implemented specifically for these purposes.

Historical data have been sought on the available documents, to define the river geometry and the street network. After the maps have been digitized, geometrical data have been derived and have been used as input for the hydraulic model. The results of the numerical simulations are shown and the flooded area extension has been compared with the historical data. The use of the estimated peak discharges for statistical purposes is discussed.

51. Gerardo E. van Halsema, The Netherlands (85)

Of Flumes, Modules and Barrels

A short treatise on how institutions, policies and technologies clashed during implementation of irrigation water control in the Indus basin, and the subsequent failure to establish equitable water distribution.

Analysis of the historical trajectory of irrigation development in the Indus-basin by the British colonial (irrigation) authorities lay bare the roots of some of the most pressing problems of water control and distribution in present day Pakistan. Contrary to popular believe, equity in water distribution has never been achieved within the Indus-basin systems through implementation of *Warabandi*. The developments in hydraulics and irrigation engineering came simply too late to eradicate the established

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inequitable water distribution completely. By the time E. S. Crump came up with a coherent water control concept in 1922, in which the discharge to tertiary units could be effectively controlled – both in allocation as in proportional delivery – through two new outlet structures of his design, the interests of both the administrative authorities as the privileged farmers were too strongly established to reform the allocation and distribution of water along the principle of equity. Although the implementation of Crump's plans greatly enhanced the water control the irrigation departments could henceforth exert within their systems, this capability was severely undermined by the failure to formulate an official water allocation policy and procedure for the initial sizing and maintenance of outlet structures; the consequences of which are still prevailing today.

This paper presents an analysis on how the initial lack in hydraulic knowledge shaped the development and establishment of water distribution practices in the irrigation systems of the Indus basin in the 19th century that tended to result in a skewed water distribution. In order to ameliorate the situation, the Canal & Drainage Act of 1873 was formulated, granting substantial discretionary powers to canal officers to intervene in the water distribution in lack of a coherent water control concept. By the 1920ies, notably after Kennedy's formula for stable channels and numerous developments in outlet technology, all the required hydraulic knowledge and means were in place to enable the formulation of a coherent water control concept and allocation policy. The introduction, and massive implementation, of Crump's Open Flume and Adjustable Proportional Module outlets will be presented as an attempt of the Irrigation Authorities to implement such a water control concept based on an equitable and proportional water allocation. A strict implementation along these allocation principles was, however, strongly opposed by both the Civil Authorities as farmers when the Irrigation Authorities tried to formalize it during a process known as *Chakbandi*. Subsequently it argues that as a consequence of failing to implement an equitable water allocation policy, the Irrigation and Drainage Act was not fully revised to reflect the newly acquired capacities and objectives of water control. As a result, the formal maintenance procedures remained inadequate to check and maintain the hydraulic integrity of the canals, facilitating thus the gradual deterioration of water control and the return of a skewed water distribution.

Theme D:

Narratives on the River and the Dam

This session will discuss the harnessed river in a social construction perspective. What stories do we tell about free flowing, or harnessed rivers? Should this history be written as a history of progress or as a history of failure? The narratives have varied from a river lost to the rebirth of a new river or the remaking of a new nature. The narratives have also been written in a perspective of distribution of power (The Conquered River) or in ecological perspective (The Devastated River). How will the stories that we tell about man and the river influence the way we interpret rivers in the 21st century?

1. Brian Black, USA (54)

Unity and Abstraction: Ethics and Modernity in the Riverine Technology of the New Deal"

Published in 1967, Ian McHarg's *Design with Nature* is credited with serving as a wake-up call to the design and planning community. The call instructed planners that an environmental ethos could and, in fact, must be incorporated into the human-designed landscape. Similar to the scientific-based treatise of Rachel Carson, Paul Ehrlich, Garret Hardin, and George Sessions, McHarg sought to alarm his reader by alerting them to the negligence of contemporary American life. "In order to endure," he writes,

"We must maintain the bounty of that great cornucopia which is our inheritance. It is clear that we must look deep to the values which we hold. These must be transformed if we are to reap the bounty.... We need, not only a better view of man and nature, but a working method by which the least of us can ensure that the product of his works is not more despoliation. Our eyes do not divide us from the world, but unite us with it. Let this be known to be true. Let us then abandon the simplicity of separation and give unity its due.

At the time, critics (including many environmentalists) viewed the conception of such human-centered "unity" as a pre-eminent example of the hubris of the modern mind. While there remain differences regarding the extent of humans' role as a manager of nature, contemporary environmental planners have come to accept McHarg's concept of natural unity as the basic structuring agent to their work. This, of course, mirrors scientific understandings of interconnectedness and complexity, including the ecosystem concept.

While McHarg's work remains a watershed in planning and landscape architecture, its conception had been brewing for at least thirty years previous to *Design with Nature*. McHarg's eloquent statement actually restated a common refrain of young minds of the 1930s. With new scientific understandings as its fuel, many modernists believed they could perceive the unity of the chaotic world around them. Human control was assumed to be a community good, and, for most, technology was to be the main tool of improving the unity of things. The confidence and zeal of the modernist was most apparent in the efforts at land-planning and development generated by the New Deal. In a recent interview, McHarg stated, "The new ideas of the 1930s brought an entirely new dimension to land planning." His idealism found its expression in a Harvard undergraduate course in 1937, entitled "TVA: Planning for Tomorrow." McHarg certainly represents an exceptional voice; however, he also represents a common, youthful attraction to the promise of the New Deal land planning that was experienced by many Americans, including Arthur Maass, the Harvard Political Scientist who offered the TVA course. It was his inspired student, McHarg, who would go on to influence patterns of human land-use over the next century.

I propose a paper that will explore in general the importance of ethics in the selection and application of river technology during the American New Deal. For most observers, the dammed river became a narrative of exploitation; however, this perspective fails to recognize the primary mission of the TVA landscape. Using ideas of Lewis Mumford and others, my analysis will depict modernist planning as an attempt to create the infamous "middle ground" between technology and the natural environment. The intensive use of technology in such pursuits has led scholars such as Samuel P. Hays to position such efforts without a clear connection to conservation. This has led many historians' failure to appreciate the significance of the New Deal in the evolution of modern environmentalism. Instead, many land-use activities of this period are considered solely in light of later environmental degradation to which such policies may have contributed. This analysis will argue that such demarcations are not black or white—technical or non-technical. Modernist planning often grew out of an environmental ethos based in science and new ecological understanding. While it possessed a dramatic reliance on technology and human intervention, the motivations and priorities behind the original undertakings are part of a gray area, best called "organic" planning.

The possibility of "organic" forms of technology is at the core of McHarg's concept of designing with nature. Though its historical legacy is mixed, TVA grows out of exactly these intellectual roots. This analysis will use TVA and New Deal river use as a case study of the application of technology in modernist planning. The emphasis, however, will be less in the physical application as in the intellectual roots of the planning. While the analysis will consider thinkers and planners including Senator George C. Norris and Arthur E. Morgan, emphasis will be placed on the individual making the clearest choice of whether to apply these methods or not: President Franklin Delano Roosevelt.

By exploring FDR's attitudes and personal convictions pertaining to planning and natural resource management, this analysis will place him as a leading voice and thinker of the modern era. Within this context, he will be seen clearly as a dynamic link connecting the conservation era environmentalism of Teddy Roosevelt and Gifford Pinchot with the modern environmental movement that would follow. Similar to ideas expressed by McHarg years later, FDR sought to manage the unity of the environment by abstracting specific units for careful, scientific scrutiny. These choices and the ethic that undergirds them possess an instructive lesson for the process of environmentally fashioning technology into the 21st century. It is a new take on a well-worn image of the exploited, dammed river that seeks to re-create a riverine landscape as a symbol of humans' attempt to reconcile relationships with nature and technology.

2. Matthew Evenden, Canada (173)

Fish vs. Power on the Fraser River

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The Fraser River, located in British Columbia, Canada, produces more salmon than any other in the world. It is Canada's third largest river in terms of annual flow. Unlike other large western North American rivers, the Fraser remains undammed on its mainstem. This paper seeks to explain why. Overlapping resource demands made the Fraser River a contested site of development politics in twentieth century Canada. Since the turn of the century, power interests surveyed the river's flow, sited dams and promoted development schemes. Fisheries interests, on the other hand, questioned the necessity of dams, supported fisheries research and organized anti-development coalitions.

Before the mid-1950s a number of dams proceeded on tributaries and major landslides at Hells Gate modeled the dangers of main stem development. Because of the concerted political lobbying of fisheries groups, the skeptical appraisal of fisheries scientists to development proposals and the legal and political authority of the federal Department of Fisheries and the International Pacific Salmon Fisheries Commission, major dam projects were defeated on the Fraser in the late 1950s. Delayed development on the Fraser helped to spur hydroelectric projects on other rivers in the province; the fish-power problem on the Fraser altered the province's spatial economy of power. Once development began on the Columbia and Peace Rivers, the Fraser was protected by implication. The study combines approaches from environmental history, the history of science and political economy. Research was conducted at eleven archives in Canada and the United States.

3. Donald C. Jackson, USA (113)

The Pastoral, the Monumental, and What Lies In-Between: Images of Dams and the Riparian Landscape 1900-1950

Drawing from the author's extensive collection of vintage photographs and antique postcards, this paper discusses how dams have transformed the riparian landscape and -- of equal importance - how pictorial images of dams distributed to and among the general public in the first half of the 20th century reflected and helped define perceptions of a so-called "second nature" created by dams. A wide range of dams -- from small-scale rural mill dams, to run-of-the-river navigation dams, to large-scale multi-purpose storage dams integrated into vast regional water supply systems -- will be considered. And the technologies range from timber-crib structures to earthen embankments to massive masonry constructs to precisely formed reinforced concrete buttress designs. Overall, this scope provides a means for addressing how dams could contemporaneously be viewed as relics of a pre-industrial past (The Pastoral), harbingers of progress in a modernizing world (The Monumental), and a melding of the two (What Lies In-Between).

The paper will primarily focus on North American dams. But views of European and Asian structures will be included to provide evidence of how the American experience is representative -- and not unique -- in terms of how dams were esteemed in the context of a modernizing society. An essential thesis of the paper is that no single narrative guides how societies evaluate the status and significance of dams within the environment. Rather, the point is to visually highlight and affirm how a continuum of narratives are necessary to convey how people perceive the value -- be it aesthetic, economic or ideological -- of dams in transforming the riparian landscape for ill, for good, or for something in between.

4. Mark Maguire, Ireland (109)

Powering the Nation: The Social History of Hydroelectricity in Ireland'

This paper addresses the important role hydroelectric developments played as monuments (in Lefebvre's sense of the term) in the Irish state. I will be focusing in particular on the example of the 'harnessing' of the river Shannon via the Ardnacrusha dam, which was built in the 1920s just after the Civil War cease fire. The history of this development is also a story of local resistance. In 1932 a violent conflict erupted on the banks of the Shannon when several families of net-fishermen protested against the decimation of their waters by the power station's turbines. The three-day long conflict was to become known in local historical consciousness as "the Battle of the Tailrace" and was notable due to the involvement of thousands of locals, the army and police. I will also look closely at the Ardnacrusha 'monument' itself: the dam stitched a modern sense of industry into the fabric of a nation purported to be rural and anti-modern. It was so successful in this regard that it became one of the most popular tourist attractions at the time, and it entered the cultural lexicon of the day via art, literature, journalism and, indeed, a carnival of life-like models that were brought from town to town across Ireland. This paper also addresses itself to other examples of hydroelectric development in Ireland, looking for differences and commonalities both historically and culturally.

5. Brigitte Boehm Schoendube, Mexico (98)

The Early History of a River: The Lerma River, Mexico

The largest river in central Mexico is the Lerma. It has played a significant role in the development of agriculture and complex settlement patterns over a large span of time. As far as I know, nobody has drawn the history of the river and here a first attempt is made to link its natural geography and hidrology to human activities and works and to societal achievements and failures since the prehispanic period to the early 20th Century. Relying on ethnohistorical sources and archaeological reports this narrative includes the outlining of authorities and cultural responses of differing groups over space and time, as well as of the river's integration or fragmentation in their views and perspectives.

6. Shapan Adnan, Singapore (278)

Flood Control as a 'Solution' to the 'Problem' of Flooding: The History of a Set of Ideas based on Water-People Relationships in Bangladesh

Over the course of the twentieth century, there have been changing views on whether flooding constitutes an unmitigated problem or an essential requirement for the renewal and sustenance of floodplain ecology. Correlatively, whether or not the technology of flood control is a 'solution' to the pre-conceived 'problem' of flooding has been the subject of an on-going debate at both the theoretical and practical levels.

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This paper would attempt to provide a critical assessment of the history of these ideas and debates by drawing upon the experience of Bangladesh (inclusive of undivided Bengal under British India). The analysis would trace the repeated definition and redefinition of the 'flood problem', beginning with the seminal work of Mahalanobis [1927] on the period 1870-1922, followed by the views of the Krug Mission [1957], Hardin [1963] and Thijssse [1964; 1965]. These ideas would be assessed in relation to the conceptions and outcomes of major flood control programmes, drawing particularly upon specific aspects of the Master Plan of 1964 and the Flood Action Plan (FAP) of 1989.

The conclusions of the paper would draw attention to the virtual lack of institutional memory within the conventional development apparatus, as well as the systematic neglect of the participation and traditional knowledge systems of the floodplain peasantry. These factors can be seen to have hindered the growth of a cumulative learning process in which ideas about floods and flood control could have been fruitfully tested and modified on the basis of evidence from actual experience. The analysis would also indicate how instances of mobilization and intervention by the affected people served to expose the limitations and preconceptions the 'modern' technology of flood control, thereby also contributing to scientific knowledge in a popular form.

7. Josef Smets, France, Germany (95)

The Management of Water in Two European Deltas: Rhine and Rhone, 18th - 19th Centuries.

Rhine and Rhone are the most important waterways in the West of Europe. Although they spurt out at nearly the same place of the Alps (St. Gotthard Massif), the first arrives in the Northern, the second in the Mediterranean sea. These two rivers cross several, but hardly different regions and not less different forms of climate. The last consideration had obviously a great influence on the regions and their populations crossed by each of the two rivers. But how great was this influence on the human life?

My purpose is to examine, in a first step, the relationship between the climate and the two rivers (Rhine and Rhone) and their affluents mainly in their delta zones. Concerning the Rhine, the study will be concentrated on the region from Bonn to Kleve, whereas the Rhone-river will be studied from Montélimar to Arles, at the beginning of the Camargue. These regions were exposed to many floods every year although the latter occurred at different moments in the year. Concerning the Rhine, the most dangerous season was that of the end of winter due to the melting in the Alps, whereas the Rhone became most dangerous in autumn due to the enormous precipitations in the Cévennes and in the South Alps living under mediterranean climate. My study will give a description of the greatest floods having devastated the two regions during the 18th and 19th centuries.

In a second step, the historian has to study the two societies and their attitudes facing up to the omnipresent water. How did they organize the daily life and how did they live with the water? Which strategies of protection did they develop during the 18th and 19th centuries? Which were the advantages and which were the drawbacks of the life near the two rivers? What role played the water in the local and regional economies? Thus, the study begins with questions concerning the domain of ecology before it treats questions concerning the domain of historical anthropology.

8. Erik Swyngedouw, UK (318)

Modernity and Hybridity. Water, Modernization and "Regeneracionismo": The Production of the Spanish Waterscape

Spain is arguably the European country where the water crisis has become most acute in recent years. The political and ecological importance of water is not, however, only a recent development in Spain. Throughout this century, water politics, economics, culture, and engineering have infused and embodied the myriad tensions and conflicts that drove and still drive Spanish society. And although the significance of water on the Iberian peninsula has attracted considerable scholarly and other attention, the central role of water politics, water culture, and water engineering in shaping Spanish society on the one hand, and the contemporary water geography and ecology of Spain as the product of centuries of socio-ecological interaction on the other, have remained largely unexplored. The hybrid character of the water landscape, or "waterscape," comes to the fore in Spain in a clear and unambiguous manner.

The socio-natural production of Spanish society, I maintain, can be illustrated by excavating the central role of water politics and engineering in Spain's modernization process. In the first part of the paper, I develop a theoretical and methodological perspective that is explicitly critical of traditional approaches in water-resources studies, which tend to separate various aspects of the hydrological cycle into discrete and independent objects of study. My perspective, broadly situated within the political ecology tradition, draws critically from recent work by ecological historians, cultural critics, sociologists of science, critical social theorists, and political-economists. My main objective is to bring together what has been severed for too long by insisting that nature and society are deeply intertwined. In the second part of the paper, I excavate the origins of Spain's early-twentieth-century modernization process (1890-1930) as expressed in debates and actions around the hydrological condition. The conceptual framework presented in the first part helps structure a narrative that weaves water through the network of socio-natural relations in ways that permit the recasting of modernity as a deeply geographical, although by no means coherent, homogeneous, total, or uncontested project. In sum, I seek to document how the socio-natural is historically produced to generate a particular, but inherently dynamic, geographical configuration.

9. John E. Thorson, USA (65)

The Missouri River: America's Original Highway West

During fall 2000, America's congressional budget process stalled as the result of a stand-off between powerful politicians from the Midwest. Was the debate over defense, tax policy, or education? No, the focus of the controversy was the future of America's longest river, the historic Missouri. The specific issues revolved around the decade-long effort by the Corps of Engineers to revise the Master Manual of reservoir operations in a manner that satisfies congressional purposes for the reservoir and navigation channel system, equitably distributes the costs and benefits of water development, and satisfies the requirements of the Endangered Species Act for protecting certain bird and fish populations along the river.

This paper will discuss the history and current controversies about the Missouri, including:

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- How did we get here?—Description of predevelopment conditions, development of navigation along the river, major flooding, Pick-Sloan Plan, failure to complete Pick-Sloan Plan, drought, listed bird and fish species.
- Endangered species and the Master Manual Review Process—Circumstances for species decline, the Corps of Engineers' Master Manual Review Process, conflict resolution attempts by states and tribes, U.S. Fish & Wildlife Services' rejection of consensus position and preferred alternative, ESA consultation process and biological opinion.
- Impacts of operational changes on Missouri River water users—How alterations in flows and the timing of flows might affect municipalities, public power, navigation (both Missouri and Mississippi commerce), and reservoir users, among others.
- Native American interests—Federal reserved right claims for consumptive and instream uses of water; tribal claims to hydropower or revenues therefrom; tribal claims to surplus reservoir lands; tribal roles in decisions affecting the Missouri.
- Future of the Missouri—What will be required for species recovery; what Master Manual process can or cannot accomplish; basin-wide restorative efforts; local, citizen-initiated restorative efforts; restoration funding; new water management institutions and decisionmaking processes.
- Closing—What does the American Missouri River experience suggest as to our environmental and water management policy and legal regimes?

Theme E: The Engineering of Water Systems – Engineers, Entrepreneurs and Bureaucrats

This session will examine the cultures, traditions and power of those designing and constructing water systems. It will, for example, look at engineers with reference to their aesthetic and technical influences, and their relationship to political power structures. It will also, for example, examine the entrepreneurial capabilities and goals of individuals, from private sector firms, or government departments, who conceived or guided the construction of water systems.

1. Eyvind Bagle, Norway (33)

Waterpower and the Industrial Revolution in Norway

The paper deals with water as source for industrial energy. It discusses the various energy options available to the budding Norwegian industry in the pre-electric era. The geographical focus is on the river Akerselva in the country's capital. This was the hotbed of Norwegian industrialization in the period 1845-1880.

The use of waterpower is described within its institutional framework, and contrasted to energy solutions elsewhere (e.g. the U.S., Germany, France, Switzerland). The main part of the paper is devoted to the technological basis for the utilization of the river as industrial engine. To a considerable degree it was fostered on pre-industrial power technology. Still the advent of the water turbine, the size of plants and means of regulation came to transform the river.

The ensuing conflicts over the use of water are presented. The river Akerselva runs straight through the city, and had since the 17th century been used for its drinking water supply. The upper parts was seasonally used for lumber floats. Traditionally fishing rights were valuable assets. The impact of industry on the traditional uses of the river are discussed.

2. David F. Duke, Canada (228)

Seizing Favours from Nature: The Rise and Fall of Siberian River Diversion

For much of the Soviet period schemes to divert the flow of several Siberian rivers to Central Asia were mooted, discussed, and ultimately rejected by Soviet planners and political elites. The very scale of these projects contributed to their seductiveness among Soviet-era planners in both Russia and the Central Asian republics; indeed, the schemes' appeal remains sufficiently strong today for some kind of diversion to be considered as a means to ameliorate the most severe environmental consequences of the Aral Sea disaster. Yet it is clear that the longevity of Siberian river diversion proposals in the Soviet period (plans were under official consideration from the 1940s until the mid-1980s) had more to do with perceptions of the relationship between humanity and nature in the USSR than it did to do with the realities of water management, economics, or engineering. This presentation shows that Siberian river diversion was attractive to generations of Soviet leaders, planners, and engineers because it was grandiose and tapped into the fundamental belief that the Soviet state could demonstrate its political and social fitness through a demonstrable mastery over nature – and nowhere could this mastery be better expressed than in taming the rivers of harsh and forbidding Siberia. It also shows that members of the Soviet scientific community were split over the economic, environmental, and engineering feasibility of river diversion, and that the reasons for the scheme's ultimate cancellation lay in economics and not, as some commentators have suggested, on a nascent environmentalism germinating during the early Gorbachev period.

3. Joshua B. Forrest, USA (171)

The Colonial Origins of Namibia's Water Crisis: Water Resource Administration and Racial Inequality in South West Africa

This paper suggests that the current water shortages which plague the majority of Namibia's rural populace principally reflect a history of colonial water decision-making that ignored both long-term groundwater preservation and the water needs of black Africans. I argue that water resource administration in Namibia reflected the historical continuity of German and South African colonial settlement, in that water sources were tapped to serve white farming, mining and urban interests in ignorance of black communal areas. Important differences in water resource exploitation as well as administrative culture between German (1895-1915) and South African (1915-1989) colonial regimes reflected relatively more adaptive and ecologically friendly water use on the part of the Germans, and a German cultural tradition of technical micro-management. However, the ultimate beneficiaries in both periods were white livestock farmers, for whom groundwater sources were exploited through aquifer drainage and underground access to natural water pools.

During most of the 1969-1989 apartheid period, South African bureaucrats controlled water management decision-making in Namibia, and they frequently came into conflict not only with black farmers but also with white Namibian water technicians. Minimal efforts were made to expand the provisioning of water sources in black African communal areas until the mid-1980s, when Namibia's national independence became imminent. In this analysis, I make clear that throughout Namibia's 95 years of colonialism, water policy decisions largely reflected political interests that embedded a structure of racial inequality in the administration of groundwater resources. This has left Namibia today facing a crisis of aquifer shortages particularly in predominantly black African regions. As a result, contemporary water administrators must now make difficult choices between righting racial wrongs and groundwater preservation.

4. Vince Gardiner, UK (46)

Aspects of Public Water Supply in Guernsey, Channel Islands, 1894-1945 - Engineers, Entrepreneurs, Ownership and Control.

This paper explores notions of ownership and control during two contrasting periods. In 1894, public water supply in Guernsey was being developed by a private water company, based in England, and using mainly ground water sources. By 1921 a Water Board controlled by the States of Guernsey was supplying water, increasingly from surface water sources. In examining the controversies which surrounded this change, this paper explores relationships amongst: engineers of the private sector company, consulting engineers employed by the company and the States, and local legislators and natural scientists. It also explores:

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political power structures within which the water supply system developed; the role of the media in influencing opinion; the existence of pressure and single-interest groups such as rural and urban populations, and horticultural growers; the discourses of science and tradition against which debates were conducted; and the entrepreneurial capabilities and goals of key individuals. This is then contrasted with water supply in Guernsey during the German Occupation, 1940 - 1945, when water was supplied by the Water Board as a commodity for the public good, but used by the occupying forces as an essential military resource, not only for consumption by troops and associated civilian workers, but also for growing crops, and in construction of the Atlantic Wall. It is concluded that water was necessarily construed as a commodity outside normal economic circumstances, and that the continuation of supply required a plethora of difficult decisions to be made concerning the competing demands for diverse but finite resources, including oil, electricity, engineering materials and personnel. A series of delicate balances was established: between competing demands for resources; between demand and supply; between collaboration and co-operation; between opposing ethical and moral stances; and between continuance and collapse of the supply.

5. Virendra Kallianpur & Wong Yunn Chii, Singapore (190)

Water as a Symbol of Power: A Study of Hydraulic System of Gôlkonda, Hyderabad (1512-1587 AD)

The relationship of man with water, one of nature's primary components has been complex and multi-faceted. This paper examines the historical relationship of water and power in the case of Gôlkonda, a centre of trade and commerce in Deccan India during the 16-17th Century.

The study of the water supply system of Gôlkonda Fort reveals the importance of water and its symbolic significance as power. Water was a strong form of ephemeral power in this land of extreme heat and water scarcity; its availability and non-availability exerted a significant pressure on the populace.

The power of water as display and spectacle is also examined in the context of the city's cosmopolitan population, created by a large ingress of foreign nationals. In particular, the paper reveals the water-work innovations that enabled this display of power and richness in such luxuries such as gardens, fountains and elaborate baths. Knowledge of these environments is drawn, for the first time, from direct fieldwork and archaeological reconstruction of the site.

Finally the impact of water technology on the colonisation of the Hindu land of Gôlkonda by the Islamic Qutb Shâhi dynasty is presented with the purpose of illustrating the critical role of water and water works in the power and politics between the rulers and the ruled.

6. Prakash Kumar, USA,India (238)

Flood, Engineers, and the State: History of Technological Innovations in Modern South Asia

This paper examines efforts to control floods in the historical context of pre-independence India. The efforts to control floods and garner river water for useful purposes are located in three different centers of authority and initiative, those of the engineers, bureaucrats, and rural people. The efforts toward flood-control were shaped both by techno-scientific factors and by a multitude of sectional, financial, and institutional factors in British India. This paper analyzes the extent to which the historically contingent factors facilitated and constrained those efforts.

The paper will focus on two interrelated themes – the demand for flood-control and irrigation and the strategies for controlling floods through techno-scientific measures. How did the technocrats, bureaucrats, and common people perceive the problem of floods and form strategies to control them? Who tried to innovate, who did not, and why? What were the elements of 'resistance' in the adoption of techno-scientific innovations for flood-control? I have examined documents in Indian archives to explore these themes.

The results of this paper will be relevant to policy-makers in India who wrestle with the problem of devastating annual floods in India even today. Both national government and international-aid agencies invest vast sums of money in the efforts to make flood-control measures effective in India. The questions posed in this paper will be of interest to agencies sponsoring those measures.

7. Jean Manore, Canada (79)

Rivers as Text for Canadian History and Culture

The genesis of this paper occurred during a casual interview with an American journalist who commented that Canadians are paranoid about their water. Accepting that that may be true, the question for me then became: Why? Margaret Atwood has argued that the principal pre-occupation of Canadian writers has been the idea of survival. Northrop Frye has opined that the principal question for Canadians was not "who am I" but "where is here?" For English Canadians, both those conclusions have come out of the belief in the harshness and alienness of the land. But do these understandings of Canada apply to water, more specifically to rivers, features of Canada as equally important as the land?

There is voluminous literature available in Canada that speaks of rivers and their importance to Canadian development and heritage. Consider Harold Innis' work on the fur trade and Donald Creighton's *The Commercial Empire of the St. Lawrence*. While these authors represented rivers as transportation networks, among other things, H.V. Nelles, in his *Politics of Development*, has examined the use of rivers as sources of hydro-electricity and noted the almost mystical quality given to rivers by engineers and entrepreneurs, who believed that through human effort, rivers could be transformed into agents of prosperity. Conversely, and more recently, other scholars, such as James Waldram, have condemned the hydro-electric developments as they have often degraded the environment and destroyed Native communities. Finally, there are scholars such as Patricia Jasen, who has discussed rivers in terms of their "wilderness" values.

Thus, while Atwood's and Frye's interpretations cannot be dismissed, these examples indicate something about Canada's history that they perhaps have missed. Rivers, as implied by the studies listed above, are communications networks that connect communities to each other and to the land. This is not to suggest that rivers cannot be threatening forces as well, but in being communications networks, rivers have also offered historically more to Canadians than simply survival. If this is the case, then

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perhaps the operative question for Canadian national and cultural development is not "where is here?" or "how do we survive?" but how do we communicate?

Investigating the importance of rivers as communications networks, both practically and symbolically would tell us much about the principal themes in Canadian history including Native/settler relations and issues of gender, region and ethnicity. They would also raise questions about the state of Canadian culture and identity given the increasing mechanization of rivers through hydro-electric and irrigation systems. What would be the effects on our cultural identity if we were to sell our water to the United States? What do rivers, as means of communication, mean in the age of the communications revolution? By studying rivers as communications networks, I hope to reveal the importance of rivers as a foundation for Canada, both in terms of development and culture and demonstrate the need for a new approach to studying Canada, that is, by studying the history of rivers specifically and water in general.

8. H.V. Nelles & C. Armstrong , Canada (232)

Power and Flow: Hydro-Electricity, National Parks Policy and the Redesign of the Bow River in Alberta, Canada

In writing the narrative of the river and the dam, the environmental history of the Bow River in Canada shows there is a good deal of middle ground to be explored between the Conquered River and the Devastated River perspectives. In order to render more efficient an ill considered hydro-electric investment built on a seasonal mountain river, the Calgary Power Company attempted in the first half of the twentieth century to redesign the Bow River to meet its needs. Essentially that involved building upstream storage reservoirs to hold back summer runoff for release in winter, and diversion projects to maximize the hydro-electric potential of the river system. The headwaters of the Bow River lay, however, within Banff National Park, the crown jewel of the Canadian parks system. This paper will examine the half century of struggle and accommodation between parks policy and the hydro-electric industry. It will study the configuration of social and political forces that in a federal system formed at different times around this conflict, and identify the key factors that determined outcomes. Finally it will explore some of the intended and unintended consequences for the river, its ecology and its communities, of a dramatic change in the seasonal pattern of flow. The Bow River might be said to have been conquered but not fully controlled or destroyed; its nature had changed.

9. Florence Padovani, China (60)

A Chinese Way of Harnessing Rivers - The Three Gorges Dam as a Case Study

My paper is going to study one of the most controversial issues of the late 20th century in terms of the role of water. The Three Gorges dam has been recently publicized all over the world. Pro and cons have been debated about the consequences of such an enormous construction work. Going beyond this debate it is necessary to put this topic in the perspective of Chinese history and political view towards water conservation. The two main rivers of China, the Huanghe and the Changjiang, have both a long tradition of being harnessed. Historical records and literary pieces remind us of the importance of the issue as far back as antiquity. The first emperor of the Xia dynasty named Da Yu (is said to be in power in 2207 BC) is famous for having mastered the floods. He is introduced by the historian Sima Qian as the one who protected his people from floods by subjugating the spirits of the waters.

The second part of this paper is going to analyze the situation today in the Chongqing municipality with the implementation of the Three Gorges dam. It is located at the border between Hubei province and the municipality of Chongqing. The goal is to harness the Changjiang, China's longest river and the third longest in the world. It crosses China from west (its source is in Tibet) to east, flowing into the China Sea (north of Shanghai). To put the Three Gorges Dam in perspective should avoid any kind of proselytism and help to understand better the issues relating to the Changjiang.

10. Kenneth M. Persson, Sweden (237)

Transfer of piping technology to Malmö and the Öresund region in the 1600th century

In the beginning of the 1600th century, Malmö had grown to Denmark's second biggest town - only the capital Copenhagen was bigger. The population has been approximated to 4000. Malmö was at this time a relatively wealthy town with a growing civil service. The water supply situation was complicated.

Since the wells of Malmö were shallow and close to the shore, they were often influenced by salt water. The intrusion problem was pronounced when canals surrounding the town were constructed and when the castle was erected about 1540. The need for water in Malmö with ca 4000 inhabitants and numerous of domestic animals 1550 can be assessed to 50.000 litres a day, a quantity which the shallow wells seldom could produce. The water shortage grew gradually worse and finally the situation led to a decision in the town council to develop a safer water supply. The solution was a 2000 metre long double wood pipe, which was dug down below ground level. A pond was constructed as a raw water reservoir by damming up a small creek south-west of the town centre.

The project started according to the protocols 1581, but was not finished until 1588. During the last years of the project, a man named Jörgen van Soest Rendemester (Master of piping) was paid for engineering work, and subsequently engaged as maintaining engineer for the water distribution. Soest is a small town between Hilversum and Amsterdam in Holland. The technology transfer of water engineering from the Netherlands to other parts of Europe is known from among other regions Denmark and England. The paper will discuss how knowledge of water piping has been transferred from the centre in Holland to the periphery in Malmö and how the distribution system was maintained and financed during the 1600th century.

11. David A. Pietz , USA, China (184)

Engineering the Waters in 20th Century China

In 1927, the Chinese Nationalist government embarked on an ambitious "reconstruction" program designed to secure wealth and power for a reunified China. The goal of reconstruction was to centralize - to build an administrative bureaucracy to centralize policy-making and coordinate resources for economic reconstruction. A showpiece item within the reconstruction agenda was to control the Huai River. It was a task, in part, motivated by historical precedent, and centuries of accumulated ecological deterioration.

The Nationalist government established the Huai River Conservancy Commission to stem flooding and to advance industrial development. The institutional foundations of the Huai River Conservancy Commission suggest a centralizing and modernizing regime based on a faith in technology, industry, and international cooperation. These themes were reflected in the recruitment of technical experts trained in modern hydraulic engineering from foreign and domestic training institutions; in engineering plans premised on hydroelectric generation and modern transport to serve industrial development; and in technical assistance from the League of Nations.

Implementation of the Nationalist government's engineering plans was, however, mitigated by reluctance from local institutions to assist in the organization of human and material resources necessary to carry out Huai River conservancy projects. The hydraulic challenges, institutional arrangements and goals, and center/local tensions of the Nationalist period provide a historical precedent to the more contemporary effort by the People's Republic to address ecological deterioration in the Huai River valley.

12. Edvin Rap & Philippus Wester, The Netherlands (235)

Engineering Success: Irrigation Management Transfer and the Hydraulic Bureaucracy in Mexico

Water management in Mexico was radically reformed in the 1990s by Irrigation Management Transfer (IMT), leading to the turn-over of more than three million hectares of government irrigation districts to water users' associations. The Mexican IMT policy has been widely heralded as a success, and has served as an inspiration to many other countries. How and by whom this success was engineered has received little attention and especially the role of the hydraulic bureaucracy has been left unquestioned. This is surprising because the IMT policy appears to be a radical rupture with the historically strong control of the Mexican hydraulic bureaucracy over the irrigation districts.

This paper analyzes how policy actors such as hydrocrats, water users, politicians and international lending agencies articulated the IMT policy, and how it was transformed from a policy idea in the early 1980s to an internationally celebrated success around 1995. Throughout this period the policy was contested from different quarters as it traveled from a small circle of senior policy actors to ever-widening circles of diverse actors, such as governors, regional bureaucratic staff, large farmers and small farmers. These 'trials of strength' transformed the characteristics and meanings of the IMT policy but also resulted in the hardening of a policy package and the increasing momentum with which it expanded outwards. We conclude that IMT was fed by the hydraulic bureaucracy's concerns with autonomy and control over essential bureaucratic domains, resource flows and irrigation infrastructure and served to reconstitute the hydraulic bureaucracy through a double definition of water users and a new, modern water bureaucracy. The value of our novel approach to the historical study of IMT is that it shows how policy transformations are effects of political and bureaucratic practices, in which policy actors engage in their institutional reproduction through the articulation of policy reforms.

13. Daniel Speich, Switzerland (168)

The Role of Discourse in Hydro-technical Projects. A Case Study of the Linth Scheme in Early 19th Century Switzerland

Between 1807 and 1823, the first large-scale hydro-technical structure in Switzerland was built, designed to secure river transportation, to produce arable land and to protect the local population from floods. The project is well documented and often referred to as the "first national enterprise", even though the Swiss national state was still a utopian dream at the time. Within this national discursive context, the project is still today generally assessed as a success and even ecological criticism pays homage to its creators. My paper will focus on the question, in what way talking about water was essential for successfully regulating it. I will argue that in the course of planning as well as in the phase of realization of the project, the different actors did not agree upon a common frame of interpretation for the problems at hand. In the absence of central state power the four interested cantonal governments neutralized each other's political aims, while educated hydrotechnicians and local farmers drew upon fundamentally different concepts of nature. I will show, that this controversial situation was resolved by connecting technical and economic aspects to moral issues such as solidarity within a common nation. The result was a homogenized discourse on the Linth scheme, which later proved to be useful in the process of nationally unifying Switzerland.

14. Marko Stenroos, Finland (207)

Managing Water supply and Public utilities in Finland 1876 – 1918

In late 19th century Finland was a rapidly developing industrial country. New innovations in industrial production offered a lot of job opportunities. Cities began to grow very fast and same time modern urban infrastructure was developed. Modern infrastructure included e.g., gasworks, electricity works, waterworks and public means of transportation. These and other investments needed financing and there was discussion whether these services should be private or public.

However, there was a discrepancy. Unlike waterworks which were publicly owned gasworks, electricity works and public means of transportation were mainly managed by licensing procedures. When the cities took over utilities, they had to invest a lot of money. These infrastructure investments formed half of the total investments of the cities. 30% of the infrastructure investments were accounted by water works.

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When choosing the strategy for water works the city councils expressed the opinion that everybody should have a right to get pure water. However, suburban areas were not connected to these networks and were left without pure water. Pure water was the prerogative of the economically powerful groups living in the city centre. Evidently the interest of the cities ended at the city limits. Suburban areas had no opportunity to get a pipeline, because the city councils were of the opinion that it is not economically viable to construct suburban pipelines.

Theme F: Institutional Frameworks for Solving the Disputes in Conflict Waters

2. Yacob Arsano, Switzerland, Ethiopia (93)

The Nile Basin: Predicaments of Upstream-Downstream Cooperation, Prospect for the 21st Century

The Nile basin is the most dominant geopolitical feature of northeastern Africa. The riparian states have pursued unilateral and conflicting approaches to the utilization of the shared water resources, avowedly influenced by their respective national interests. The political expression of these national interests has resulted in controversies and tense relationships among the riparian nations. All throughout the twentieth century, however, the downstream countries held the monopoly of the use, basing their claim on "historical and natural rights" doctrine. The upstream nations not only repudiate the downstream claim but also in reaction to it they hold to "riparian" doctrine. The bottom line of the dilemma is between cooperation and keeping the status quo.

Unlike many river basins elsewhere in the world the Nile basin has no legal or institutional arrangements. In the absence of such institutional or legal mechanisms it is likely that the prevailing controversies will further aggravate mistrust and tension between upstream and downstream nations. It can be further hypothesized, thus: (1) A basin-wide cooperation will depend on a mutually acceptable entitlement and equitable benefit sharing among all riparian nations. (2) A stable cooperation between upstream and downstream countries, in turn, hinges on mutually acceptable mechanism based on legal and institutional framework.

In-as-much as the twentieth century was characterized by the unmitigated hydraulic anarchy will the new millennium shed light of cooperative enterprise whereby all Nile riparian nations enjoy the benefit accruable from their shared natural endowment. The presently on going, but still nascent, "Nile Basin Initiative" (NBI) is hoped to bring some positive results if it succeeds in helping produce principles, terms and institutions acceptable to all Nile riparian states. This author aims to examine the geopolitical environment, specific predicaments, the long standing upstream-downstream dilemma and prospects of cooperation in the Nile basin.

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The presently on going, but still nascent "Nile Basin Initiative" is hoped to bring some positive results if it succeeds in producing procedures and institutions acceptable to all Nile riparian states. The present author aims to examine the sources, characteristic features and the geopolitical environment of the long standing dilemma of cooperation in the Nile basin.

3. Torbjørn Damhaug, Norway (327)

Experience with the World Bank's Water Resource Management (WRM) Strategy for Sub-Saharan Africa

The author was a member of the task team responsible for the preparation of the World Bank's strategy for Management of Water Resources in Sub-Saharan Africa. The strategy, which was finalised in 1996, is based on the principles of integrated WRM that were laid down at Dublin and Rio conferences in 1992. Since the mid 90s, the strategy has served as a guiding tool for the water sector operations of the Bank and other external support agencies like UNDP, Nordic Development Fund (NDF), and a number of bi-lateral donors. The paper summarises the main principles and interventions of the Bank Strategy and experience from its implementation.

In general, the integrated water management approach has added considerable value to the Bank's water sector involvement in terms of stronger focus on sustainable resource management as part of utility and infrastructure investments. Yet, many of the WRM initiatives have not achieved the anticipated results on the ground and it seems like new initiatives rarely benefit from lessons learned from previous projects. The paper also addresses some observed insufficiencies of the current approach, focusing on the various players involved in water management in development assistance; their roles, expectations, capacities, communication and interaction during project preparation and implementation. The main international actors comprise the World Bank, other funding agencies, and consultants, whereas key actors in the partner countries are the development co-operation authorities, water management institutions, water user interest groups, and the public. Some key aspects include the need for realistic ambition levels, real local ownership of, and commitment to, the WRM interventions, the actual capacity of the Bank, its partners, and associated consultants. Moreover, the paper deals with constraints inside the local executing agencies related to leadership, incentive mechanisms, and enabling of young local talents. Other aspects are the effects of donor competition and excessive use of the workshop carrot. The paper suggests alternative approaches for further elaboration to meet the identified challenges.

4. Joseph W. Dellapenna, USA, Middle East (57)

The Nile as a Legal and Political Structure

As long as there have been communities sharing water, there have been disputes over how the water was to be shared. The Middle East, an enormous dry region stretching from Marrakech to Samarkand, has had one of the longest experience of such controversies. Today, many of the river basins within the region illustrate the effectiveness and limitations of both customary international law and treaty law in resolving such problems at the interstate level. The Nile basin already exemplifies the successes and failures of that process. Several of the states sharing the Nile basin have already in place an advance but incomplete treaty regime. The states sharing the Nile basin, supported by UNEP and other institutions, have undertaken to attempt to negotiate a new, comprehensive regime for the waters of their shared river. The Nile thus already exists as a legal and political structure as well as a natural hydrological system. This paper will consider examines the law affecting the national communities sharing the Nile basin and the possibilities of revising and perfecting that legal and political structure.

5. George E. Gruen, USA (169)

Sharing the Waters of the Tigris-Euphrates Basin: Can the Parties Move from Conflict to Regional Cooperation?

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Turkey has long played a crucial role in the hydropolitics of the largely arid Middle East. This paper examines how Turkey's massive Southeast Anatolia Project (GAP in Turkish acronym) on the Euphrates and Tigris Rivers has brought Ankara into conflict with downstream Syria and Iraq. These Arab states demand a greater share of the rivers' flow and fear that when the GAP's \$32 billion network of dams, hydroelectric plants and large-scale irrigation works is completed, the quantity of water reaching them will be greatly diminished and its quality seriously degraded. The current regional drought and rapid population growth exacerbate the problem. After reviewing the legal, political and economic arguments advanced by the parties, the paper discusses the effect of recent mutual efforts to improve Turkish-Syrian relations on prospects for achieving a permanent water agreement.

Ankara has since the mid-1980s proposed to supply surplus water from exclusively Turkish rivers, such as the Seyhan and Ceyhan, that flow into the Mediterranean to its water-starved Arab neighbors. The economic, technical and political factors involved in the current negotiations to sell water from the Manavgat River to Israel, Jordan and the Palestinian Authority, as well as to Cyprus and Syria from other rivers, will be examined and their potential contribution to regional peace and economic cooperation will be assessed.

6. Jesse Hamner & Nils P. Gleditsch, USA, Norway (214)

Shared Rivers, Water Scarcity, and Interstate Conflict

There are more than 200 river systems in the world shared by two or more countries, often without enforceable water-sharing agreements. Many of the rivers run between countries with a history of conflict, where water plays an important part in the economic life of the country. On this basis, many have predicted 'Ewater wars'. This study is built on a dataset that adds both historical and current information on boundary-crossing rivers to the Correlates of War contiguity dataset. Earlier work indicates that a shared river does increase the probability of militarized disputes and armed conflict over and above mere contiguity, although this risk factor is weaker than the effect of contiguity itself. In this paper, we extend the earlier work to see if the conflictual issues in the shared-river dyads are indeed related to the scarcity of water, and whether "hydro-cooperation" through time reduces the likelihood of violent interstate conflict.

7. Magdy Hefny, Egypt (94)

Assessing the Nile 2002 Conference Series: Consensus Building and Lessons Learnt.

This is the eight year of "The Nile 2002 Conference Series". I found that it is time to have a candid assessment of the initiative and its contribution to consensus building, as well as to draw some lessons that might be useful to learn and apply to all Africa river basins. The idea of the Nile 2002 Conference series was conceived in a conference held in Cairo in 1992. The Governments of the Nile Basin countries as well as, different funding agencies in general and Canadian Development Agency (CIDA) have supported the idea in particular. The Nile 2002 Conference Series is designed to be held in each of the Nile Basin countries in sequence. It has started in 1993 in Cairo, Egypt and will continue up to 2002. The Conference took place in the following countries of the Nile Basin, as follow: Cairo, Egypt 1993, Khartoum, Sudan, 1994, Arusha, Tanzania 1995, Kampala, Uganda, 1996, Addis Ababa, Ethiopia 1997, Kigali, Rwanda, 1998, Cairo, Egypt 1999, Addis Ababa, Ethiopia, 2000. The two last conferences are intended to be held in 2001 in Nairobi, Kenya, and then in Congo in 2002.

It is my intention, in the period ahead, to study in details various papers presented at the Conferences, with the aim of finding out how much convergence and divergence of views over issues succeeded? The study will be confined to non-technical issues, i.e. socio-political, economic and institutional issues. It is intended also to deal with this initiative in the context of ongoing work within the "Nile Basin Initiative" (NBI) launched in 1997. The NBI is now institutionalized and taking concrete steps towards developing a comprehensive framework for cooperation on the Nile.

8. N. Kliot, Israel (273)

Institutional Framework for the Jordan River Basin and the Israeli-Palestinian Transboundary Water Resources

The purpose of this paper is to present a framework for sharing the scarce water resources of Israel, Jordan and the Palestinian Authority with the possible future affiliation of Syria and Lebanon – the other co-riparians to the Jordan River. The Jordan and its tributary, the Yarmuk, is shared by Lebanon, Syria, Israel and Jordan and most likely by the Palestinians. The common water resources are very modest: the Jordan provides 450-500 million m³ of water, the Yarmuk, 400-450 million m³ and the shared mountain aquifer, which is shared by Israel and Palestinians has 679 million m³ of water.

The current patterns of utilization show that Israel uses all the water of the Jordan, about 35-50 million m³ of water from the Yarmuk and about 72% of the mountain aquifer's water. Jordan is using about 30% of the water of the Yarmuk while Syria is using about half of the volume of the Yarmuk. All the above water resources are over-exploited.

Though many plans were proposed for integrated-cooperative utilization of the river basin, none was carried out and the river became an arena for a bitter conflict and to violent border incidents. There are only partial agreements or institutional frameworks for managing the common water resources. The Israeli-Jordanian Peace Treaty of 1994 addressed matters related to water resources shared by the two countries – mostly by the Jordan-Yarmuk and the parties agreed on seasonal quantities of water to be allocated to each and on other measures of joint efforts to manage the common water resource. However, Syria and Lebanon are not partners to it and are not obliged by it. The Israeli Palestinian Agreement on water and sewage of 1995 is also a partial agreement. In this paper institutions for the joint management of the Jordan-Yarmuk and the Common aquifers in which all co-riparians will take part will be presented.

9. Malee T. Lang, Thailand/Denmark (314)

Fallacy of "Sustainability" of the Management of the Mekong River Basin

Ever since the formation of the Mekong River Commission in 1995, the notion of "sustainability" has been used indiscriminately and strategically by policy makers and development planners as the vision of how to manage the Mekong.

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Indeed "sustainability" in the planners' perspectives, which is connotated with large scale development projects, hydropower in particular, is both misleading and detrimental. It has far-reaching implications for the long term social development and ecological integrity of the Mekong basin, where 60 million of its inhabitants rely upon its resources.

The Mekong River Commission (MRC) has been functioning under the 1995 Agreement on Cooperation for Sustainable Development of the Lower Mekong River Basin. The MRC, comprised of members from Cambodia, Laos, Thailand and Vietnam, has received continuous support and technical assistance from the UNDP, which has played a key role in the reformation of the MRC, the development planning for the Mekong region as well as the drafting of present water usage rules. Though originated in completely different periods, both the MRC and its predecessor, the Mekong Committee, have shared the same vision to manage the Mekong. The Mekong Committee was formed in 1957 in the cold war era where American engineers had strong influence in its work in the design of the river projects. Modelled on the Columbia River Basin's development, the blueprint envisaged a grandiose plan to build a cascade of seven large hydro-electric dams on the mainstream of the Mekong River. However, the full victory of communist regimes in the Indochinese states in the 1970s and subsequent civil wars have for decades prevented the Mekong blueprint to materialize. Notwithstanding the principle of "sustainability", the MRC conceptualises a scheme of 12 "run-of-the-river" projects on the Mekong's mainstream. All electricity output is targeted for export to the growing economy of the Thai market. Like its predecessor, the MRC carries on the same development paradigm based on intensive resource extraction to fuel economic growth.

Employing the notion of "sustainability" has, therefore, been an effective and powerful tool for policy makers to gain control over access to the untapped resources of the Mekong – all of which is at the expense of a 60 million culturally-diverse population living along the banks of the Mekong and its tributaries. This paper addresses the fundamental flaws of the top-down styled "sustainability label" promoted by the MRC, policy makers and their supporters, and suggests a reform for the MRC to incorporate a true platform for public participation within its framework. The principle of equitable share of water and the issues surrounding; conflicting views/interests and motivations among member states and the local people's initiatives to the use of Mekong resource will also be discussed.

History of Water, Sanitation and Health

In this session studies of water and health will be presented by a broad focus on water borne diseases and their vectors. We also call for papers that deal with the relationship between epidemics and water and how societies have worked to secure clean water to stem epidemics. This session will also deal with changes in water quality, and how these changes can be seen related to social developments. We also call for papers discussing the understandings – both contemporary and historical – of the concept of clean/polluted water.

1. Jared N. Day, Pennsylvania, USA(140)

Shifting Science, Shifting Responsibility: Oversight Agencies, the EPA, and the Setting of Drinking Water Standards in the United States, 1970-2000.

Since the creation of the USA's Environmental Protection Agency (EPA) in 1970, federal officials have struggled to strike a careful balance between politics, good science and feasible environmental policy. The EPA's Science Advisory Board (SAB) created in 1976 has been one of the central oversight agencies involved in assuring that environmental regulations retain a high degree of scientific integrity. Scholars such as Bruce Smith in The Advisors and Shiela Jasanoff in The Fifth Branch have examined the SAB's creation and early history with particular focus on the activities of the SAB's Clean Air Scientific Advisory Committee through most of the 1980s. However, since these studies, the SAB has taken on many more responsibilities, including, in 1986, overseeing the science involved in the setting of America's drinking water standards.

This paper will focus on the effort to set scientifically sound and feasible drinking water standards from 1970 through the 1990s, emphasizing the role of special scientific oversight agencies, including the EPA Science Advisory Board's (SAB) Drinking Water Committee. This analysis will trace the role of oversight organizations in setting drinking water standards from their initial placement in the National Academy of Science in 1974 and continue with their controversial transfer to the SAB in 1986. The paper will examine the controversies that evolved around the SAB through the 1990s as the Drinking Water Committee developed a clear set of procedures as well as a distinct relationship with the EPA's policy-making body. This paper will analyze the records of EPA's Office of Drinking Water, the reports from the SAB's Drinking Water Committee, and personal interviews with officials from both of these agencies.

2. Matthew Gandy, UK (45B)

From Municipal Managerialism to Neo-liberal Fragmentation: Recent Developments in the New York City Water Supply System

The period between the completion of the Croton Aqueduct in 1842 and the city's fiscal crisis of 1975 marks a phase of remarkable stability in the history of New York's water supply. The Nineteenth Century saw a decisive shift from private to public water provision in order to allow for new levels of efficiency and coordination. A series of tensions were played out between not only public and private interests but also disparate bodies of technical expertise and rival political machines. During the twentieth century some of these disputes were resolved with a move towards the greater consolidation of fragmentary interventions to form powerful regional systems of management and control. With the fading of the New Deal ethos in the 1970s, a new set of political, economic and cultural developments began to shape the evolution of regional water policy. Recent changes are distinctive in a number of respects: the emergence of new sources of environmental risk such as cryptosporidiosis; the development of greater degrees of public scepticism towards technical and scientific expertise; the weakening of city power in relation to regional political developments; and above all, the intensity of the neo-liberal challenge to the fiscal autonomy and ideological legitimacy of an effectively regulated and adequately funded public water system.

3. Tina Schmid & Jonas Hallström, Sweden (177)

The Pipe-Bound City and Its Spatial Development. The Historical Development of the City and Its Water and Sewer Networks – Linköping, Sweden, ca. 1870-1920

In the late-19th century, the modern European city came to epitomize progress and modernization, and to many city planners the ideal was a fully technological and networked city. However, the spatial extension of e.g. the water and sewer networks reflects not only the features of late-19th century engineering and decision-making, but also the development of social structures, sanitation, as well as the metabolism of the city.

The aim of this study is to describe and analyze the correlation between the spatial and political development of the city and the water and sewer networks. The actual object of study is the administrative center in the county of Östergötland – Linköping – which is situated in the southeast of Sweden. The evolution of water supply and sewerage was a complex process, and we will pose questions such as: What were the main reasons for building water and sewer systems in Linköping in the 1870s, and how were they financed? What technical solutions were promoted and by whom? Who had access to the water and sewerage (e.g. the affluent inner-city residents as opposed to the suburban), and how did accessibility change as pipes were extended? How was the expansion of the water and sewer networks related to the topography of the city (e.g. swampy areas), the health of the city (e.g. areas with a high morbidity or mortality rate) and the social structure of the city (e.g. bourgeois areas versus working-class areas)?

The method used will mainly be the application of GIS (Geographical Information Systems) to the historical analysis of the urban environment. In order to be able to answer the above questions, we will adopt GIS, so as to be able to visualize and compare otherwise very disparate factors. The study starts in the 1870s, when the city installed fresh water pipes and the first drainage and sewer pipes, and the development of the pipe networks for both water supply and sewerage is studied and put in the context of the city's spatial development until about 1920.

4. K.J. Ives, UK (300)

Edwin Chadwick: His Role in the Great Sanitary Awakening

The Great Sanitary Awakening was a phrase used in 1883 to describe Edwin Chadwick's influence on the development of water supply and sanitation in England during the 19th Century. Edwin Chadwick was born in Manchester in 1800, and trained as a lawyer. He was not enthusiastic for the practice of the law, but he had an office very close to the slums of the City of London. His observations of the lives and conditions of poor people, and after visits to local hospitals, his enthusiasm was turned towards improving the sanitary conditions of the 'labouring classes'. He believed in the preventability of disease, and launched his great sanitary crusade that would last another 60 years. He was 30.

The 1836 Registration Act of Parliament required records of the causes of disease, for remedies and for prevention.. But in 1837 this Act and others concerning health were affected by epidemics of influenza and typhoid attributed to stinking wastes and stagnant pools. Chadwick believed in the 'miasmatic theory' of disease (spread by vapours), which was proved, he claimed, by the smells of rotting waste and accumulated filth in cesspools, and from domestic and trade wastes.

Chadwick opposed the doctors who were little interested in preventive medicine, by supporting the cause of public (today environmental) health. In Chadwick's view, attention to light, air, drainage, access to pure water, and removal of stinking wastes were of paramount importance. He drew attention to these through the politically important Poor Law Commission. This was the beginning of the momentous Report of the Sanitary Conditions of the Labouring Population (1842). The Government refused to support it as it criticised powerfully the London Water Companies, the Metropolitan Commission of Sewers, local administration and the medical profession. He was allowed to publish the Report under his own name, but this made him many enemies in Parliament, which destroyed his own ambitions in politics.

He persisted in his criticisms of local inadequate organisation for the cleansing of streets and courtyards, and the poor provisions of pure drinking water. Chadwick remarked that 'it was fortunate for the working classes that they possessed a preference for beer', mainly applied to men, as women drank tea (thereby boiling water) but the children drank water at the pump. In spite of this Chadwick and many others clung to the miasmatic theory of disease, rejecting the work of Dr Snow on the waterborne spread of cholera, and the developments in medical bacteriology.

Chadwick concerned himself with sewer design, maintaining that small circular pipes were better than larger egg-shaped ones. This brought him into conflict with the civil engineers. He observed that civil engineers required education in 'Sanitary Science' and doctors needed instruction in public health and hygiene. These ideas came to fruition after his death, through his Will, when in 1896 the first courses in these subjects commenced at University College London. Right up until his death in 1890, Chadwick had persisted in his 'Sanitary Idea' producing a stream of pamphlets and public lectures on the subject. A 1983 BBC television review of Chadwick's life, claimed that Chadwick's efforts in his lifetime. saved more lives than all the doctors put together.

5. Tor Are Johansen, Norway (34)

Water-borne Epidemics: Political, Medical and Technological response in Oslo 1850-1900

During the nineteenth century Europe repeatedly was struck by cholera epidemics, taking thousands of lives. Poor inhabitants of densely populated industrialised cities suffered the most, and the medium of transmission was usually tainted water. Typhoid fever was another water-borne disease that terrified the population of nineteenth century European cities.

Oslo was struck by severe outbreaks of cholera in 1833, 1853 and 1866, and the inhabitants of the Norwegian capital were frequently hit by typhoid fever. The city had experienced a rapid population growth partly due to the industrialisation process that took part from around 1840. Both population growth and death rates were higher in Oslo than in any other Norwegian city.

The paper will show how the theory of miasmas – the belief that foul smells caused disease – influenced the measures taken by doctors and local authorities to fight epidemics, and how these measures were changed when new knowledge on the spread of disease prevailed. It will argue that the local Health Board, initiated by the central authorities in 1860, came to be an important institution – especially after 1867, when a doctor with a contagionist view became the commission's new leader.

Finally the paper will show how technological change in the water-supply system in 1860 unintentionally reduced the typhoid rates in the city. Replacement of the city's old wooden pipes by a new waterworks with cast iron pipelines was followed by a rapidly decreasing number of patients with typhoid fever. After an outbreak of typhoid fever in 1874, the Health Board understood the cause of the epidemic and took effective measures to prevent further spreading.

6. Muhammad Akram Kahlowan & Muhammad Azam, Pakistan (106)

Issues and Challenges of Drinking Water Quality, Sanitation and Helath in Pakistan

Pakistan is a developing country. The present population is 139 million, which is increasing rapidly at a growth rate of 2.6 percent. The rural and urban ratio is about 2:1. However, the proportion of the rural population is decreasing gradually as a result of urbanization and industrialization. With rapid trend of urbanization and high population growth, the cities are expanding at a faster rate. This haphazard and mushroom growth has created serious problems of safe drinking water supply, sanitation, and health. The drinking water demands in urban as well as rural areas are drawn both from groundwater and surface water sources, which are generally exploited through shallow open dug wells, hand pumps, tubewells, and from canals where groundwater is brackish or not available. In deserts and semi hilly areas, the stored rainwater is being used for drinking purpose without any treatment. In mountainous areas, spring water is the main source of drinking water. The coastal areas and saline zones are facing serious water supply problems. In these areas, the adoption of costly option of desalination of water is very difficult. The drinking water quality is poor and does not meet World Health Organization (WHO) standards. It has been verified by the Pakistan Council of Research in Water Resources (PCRWR) through conducting water quality surveys in urban and rural areas.

Poor sanitation condition both in urban and rural areas is another concern of the country. Sewerage systems are limited to some parts of a few cities. Urban population not connected to sewerage system depends on septic tanks, soakage pits or overland flow

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into storm drains. The domestic and industrial effluents are directly discharged into the nearby river, canal, etc. without any treatment. Such practices are not only creating health hazards but also causing long-term environmental degradation, especially pollution of groundwater water, which is the primary source of potable water supply. The groundwater level in many cities is also declining due to heavy withdrawal. In some cases, raw sewage is used for irrigating the agricultural crops. Consequently, there is substantial decline in the quality of public health. Increased incidences of water borne diseases have surfaced on account of contamination of water supplies and use of untreated sewage. The health situation will further deteriorate as a result of expected high population growth, inadequate municipal sewage collection and treatment facilities, and greater use of untreated urban and industrial sewage for irrigation. This paper presents the existing situation of urban and rural water supply and sanitation and highlights the issues and challenges being faced by Pakistan in this regard.

7. Roberta J. Magnusson, USA (78)

Water and Wastes in Medieval Towns

The rapid growth of cities in the high middle ages created a water crisis. The increase in domestic and industrial consumption was coupled with an increase in the production of urban wastes: not only was the quantity of water from traditional sources often inadequate, but the increased levels of pollution meant that its quality (even by medieval standards) was unacceptable. Although medieval Europeans lacked a scientific understanding of the role of waterborne pathogens in the transmission of disease, there are indications that they were aware that ingesting polluted water could result in illness.

The generation of urban waste products increased along with the demographic and industrial expansion of twelfth and thirteenth-century cities: the more vigorously a city grew, the more acute the problem of waste disposal became. River pollution had four main sources: domestic

rubbish either dumped there deliberately or washed in from the streets, animal dung from streets and stables, sewage, and occupational wastes. Well water was liable to be contaminated by the practice of disposing of wastes in rubbish and cess pits, which typically honeycombed the yards of medieval tenements. In London, for example, numerous measures were enacted in the attempt to keep city streets clean and control the most egregious sources

of water pollution. Property owners were responsible for keeping their street frontages clean, and the city employed special "scavengers" to remove rubbish from streets and other open spaces. Dung was taken in special boats and dumped in the middle of the Thames, where the current was strongest, in order to protect the purity of water closer to the riverbanks. Even if all sanitation ordinances had been strictly observed, however, the quality of water in the Thames and permeable gravels would have been compromised by practices that were officially condoned, such as drains and latrines which discharged their effluents directly into the river.

The quality of river water was compromised, not because medieval civic officials were insensitive to hygiene, but because watercourses were irreplaceable components in sanitation systems that aimed, above all else, at keeping the streets reasonably clean. While municipal officials continued to issue proclamations against the more egregious sources of river pollution, the problem of providing a clean water supply was tackled more successfully through the adoption of a technological solution. Medieval cities addressed the conflicting demands of water supply and waste disposal by the creation of artificial intake systems. Beginning in the thirteenth century, some British cities began to build piped water systems, which conveyed clean water to public fountains. The technology of these urban water systems was derived from monastic exemplars, and some towns, such as Exeter, Southampton, and Bristol, were able to enter into agreements with urban religious houses to sponsor joint water systems.

The successful adoption of a civic water system required the development of administrative mechanisms to finance, oversee, and maintain the system. In addition, citizens had to learn how to use the new technology appropriately. Municipal authorities found that they had to develop social controls to protect fountains and pipes against damages and inappropriate uses, and to settle disputes between competing users. The experience that medieval administrators gained in their attempts to improve urban sanitation and provide citizens with clean water supplies proved to be important steps in the overall development of public services in Western Europe.

8 Francis Mwaura, Kenya (132)

Eutrophication, Algal Toxicology and Community Health – Emerging Human-Water Conflicts in Kenya

Water and man relations in Africa, particularly Kenya were quite cordial until the 1960s. Thereafter, rapid growth in human population has created a great demand for various kinds for natural resources, which has caused numerous landuse and land cover transformations particularly within catchment areas. The expansion of human settlements, urbanization and agriculture has increased the input of inorganic and organic wastes in the freshwater, which escalates the problem of cultural eutrophication. Cultural eutrophication promotes algal blooming which can cause the production of harmful toxins to humans, livestock and wildlife. The effects of these changes in freshwater resources include reduction in the quality of community health, high medicare costs, reduced profitability in livestock husbandry and loss of species diversity.

A number of reservoirs and lakes in Kenya were sampled for nutrients and algal toxins. The highest concentration of phosphorus and nitrogen occurred at the beginning of the wet season. This was found to cause regular algal blooms dominated mainly by cyanobacteria, especially *Microcystis* and *Anabaena*. The blooming was found to correspond closely with increasing concentration of algal toxins particularly microcystins and endotoxins. The toxins maybe responsible for the rising mortality in livestock around the reservoirs and water birds such as flamingos in the rift valley lakes. The possible implication of these transformations on the quality and quantity of freshwater resources and community health is discussed and suitable mitigation measures recommended.

9. Rita Pemberton, Trinidad & Tobago (72)

Water and Health in 19th Century Trinidad

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Water undoubtedly contributed to the scenic beauty of this island which stimulated artists and writers and impressed many visitors to these shores. It however, proved deadly to many of the residents as there was no central system of water management in place and there was little understanding of the relationship between water and the many diseases that plagued the island in the period. Up to the present time, there has been no analysis of the impact water has had on the history and development this island though water issues did provide, and continues to provide, a challenge to present day administrators. This paper attempts to initiate the process to fill the void in an issue which has been of central importance to the health history of this island. It seeks to trace the method by which a system of water supply for the general population was developed in this former British plantation colony.

With a focus on the fevers and the fluxes, the paper examines the epidemic eruptions of the 19th century and traces their impact on the attempt to provide a supply of potent water for the population by the end of the century. The paper discusses the approach to water supply that was prevalent during the plantation and post emancipation eras to show how these contributed to the high incidence of disease and helped the colony to earn the reputation as "the white man's grave". It examines the mortality rates which resulted from water borne diseases and the impact of the prevalence of disease on the increased attempts to provide a supply of pure water for the population during the second half of the century. The findings of the various committees formed for this process are discussed. The paper concludes that the prevailing ideas of social development that characterised slave societies precluded the initiation of a system of water management and permitted the high level of disease presence in the colony. Faced with the growing fear of the deadly disease and with a better understanding of the sanitary idea, winning and supplying pure water became a priority of the colony's administration.

10. Eva-Marita Rinne, Finland (303)

Perceptions of Safe Water in Rural Yoruba Communities in Nigeria

Various perceptions of safe water are examined by household usage in rural Yoruba communities. The data is derived from two fieldwork phases (April-June of 1998 and November-December of 1999) in Ile-Ile town of Osun State, Nigeria. The qualitative data consists of 32 in-depth interviews, 30 Focus Group Discussions among men and women, participatory observations and systematic observations (time-charts of 16 women). It is assumed that the specific context of the Yoruba culture and the rural livelihoods form a basis for safe water definitions of the local knowledge. Issues of interest include how people evaluate household water, ways of ensuring water safety and the rights and limitations connected to the water practices in the community. Also of interest in the study is what women and men actually regard as water-related problems as well as their perceptions of the implications of contaminated water. Finally the relevance of these definitions to health issues prevailing in rural communities is discussed. The results imply multiple dimensions constituting the conception of safe water and the relationship between water and health.

11. Katherine Wentworth Rinne (USA/Italy) 162)

Clear water, Grey Water, Black Water: Creating an Hydraulic Infrastructure System for Rome, 1570-1650

Hydraulic engineers in baroque Rome exploited the continuous, gravity-flow water supply of three aqueducts - the Acqua Vergine, the Acqua Felice and the Acqua Paola. They developed a sophisticated hierarchy of water distribution - from clear water, to gray water, to black water - from drinking, to industry, to sewers. This new hydraulic infrastructure facilitated changes in the physical and economic landscapes by increasing the number of water-based industries in neighborhoods far from the Tiber and by increasing specialized distribution of water resources to people, animals and industry. It also promoted public health with a dedicated drinking supply, encouraged the construction of new sewer lines to flush excess water and neighborhood waste, and encouraged the paving and embellishment of piazzas which housed the new ornamental fountains.

From 537 until 1570 the Tiber River was Rome's major water source for all uses. Rome had only a handful of, fountains in 1570. However, by 1650 there were over 40 new ornamental public fountains, many with drinking spouts or taps for filling water jars. Run-off water (acqua caduta) was carefully channeled through a sophisticated distribution network to other single- or multi-purpose fountains, including additional drinking fountains, animal troughs, and industrial fountains, and then diverted to orchards or used to flush the sewers. While the Tiber was still vital for shipping and milling (through the 19th century), many economic activities migrated away from the river to the piazzas and hills where new baroque fountains were located. Once the major commercial artery of Rome, the Tiber became a figural and literal backwater, as it was superseded by a tectonic infrastructure of aqueducts and fountains. This paper will elucidate how this new hydraulic infrastructure, with its multi-functional re-use of public waters, influenced the development of individual neighborhoods and proliferation of water-based industries in baroque Rome.

12. Owen G. Roberts, Wales, UK (185)

Lake Vyrnwy to Ty Nant: Perceptions of Purity and "Selling" Welsh Water, 1880-2000.

The paper will draw on research conducted as part of the Aberystwyth University (Department of History and Welsh History) project on the history of water. It will argue that there has not always been agreement or consensus, even among experts, on what constitutes a healthy supply of water. There were in the nineteenth century many conflicting interpretations concerning the effect of different types of water on health. Some European towns, such as Llandrindod in Wales, became popular and fashionable spa resorts, but debates raged over the effectiveness of such waters in promoting health. Drawing on ideas that well and spring water was 'naturally filtered' by the rock and that it received essential health-giving minerals from the earth, it was also commonly asserted that underground sources were healthier and more suitable than mountain water as drinking water for towns. Upland sources were often dismissed as 'peaty storm water'.

Debates over new upland water schemes promoted by municipal corporations were crucial in reshaping this discourse during the late nineteenth century. In promoting such grand engineering projects as the Vyrnwy and Elan reservoirs, the cities of Liverpool and Birmingham had to prove that their investment would bring tangible benefits to the health of their citizens. Arguments

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between the advocates of different types of water were profoundly influenced by issues of ownership, control and power politics, but were conducted in the language of public health. Such debates were of vital importance in changing ideas about Welsh water and health. Subsequent municipal publications, which celebrated the achievement of bringing mountain water to cleanse the industrial city, served to reinforce an idea of Welsh water as being one of the most pure and healthy in Britain. Celtic myths and powerful images of purity were used to change popular perceptions about water from the Welsh mountains. The paper will conclude by examining how notions of purity which were shaped in the nineteenth century still influence ideas concerning Welsh water. Examples will be drawn from the marketing strategies of the Welsh bottled water industry today.

14. Gregory A. Ruf, USA, China (222)

Water Pollution, Health, and Environmental Management in China

This paper will address relationships between pollution and health in China's growing water crisis. China's per capita freshwater resource base is the second lowest in the world. Rapid economic growth in recent decades has contributed to a deterioration of both supply and quality of China's water, posing consequences for agricultural output, labor productivity, human health, and mortality. In the 1990s, the state government made water pollution a top environmental priority, adopting numerous legislative and regulatory measures to confront the problem. Nevertheless, unrealistic growth targets, competing interests of different government agencies, and weak enforcement of existing regulations continue to hamper pollution control and abatement efforts. Studies suggest that more than half China's population lacks access to clean drinking water, and roughly one-third of China's monitored waterways are deemed unsuitable for human contact.

A significant amount of wastewater discharged from urban industries fails to meet government standards, and most of that from rural industries (widely regarded as a major source of pollution) continues to go unmonitored. Local governments are often reluctant to fine or close polluting factories that provide important tax revenues. Moreover, domestic and municipal wastewater is often discharged untreated into lakes and rivers, despite treatment plants and protocols. In addition, wastewater irrigation is commonly practiced, although evidence suggests links to cancer, birth defects, and death. Reviewing the scholarly literature on water pollution and water-related health concerns in China, this paper will assess the state of China's freshwater resources, and the relative health threats posed by agricultural, industrial, and municipal/domestic waste.

15. S. Shanmuganandan, India (310)

Water Supply, Sanitation and Waste Disposal in a Changing Urban Environment: A study of Indian Sub Continent in a Historical Perspective

Water is a prime natural resource and a basic human need. It is estimated that out of the total precipitation of around 400 million hectare meters per year in India, the surplus water resources carry as 1.768,000 million cubic meter. About 50% of the water resources can be put to beneficial use because of topographical and other constraints. The ground water potential available per year is 4,22,900 million cubic meters and out of these only 1,00,000 million cubic meters is being exploited at present. The availability of water is highly uneven in both space and time. Fourteen major rivers of India share 83% of the total drainage basin contribute 85% of total surface flow and house 80% of the total population. The total urban population of India accounts 23.73%. The urban growth of Class I cities registered 60.8% of the urban population; Class II cities 11.5% and Class III 14.3%. The Classes I, II and III accounted for 86.3% of the total urban population. The decadal urban growth rate for the country as a whole was 46.02%.

Programmes for water supply and sanitation in urban areas have made progress but the rate is slow the urban population without access to potable water and sanitary waste disposal is increasing in number. About 72.7% of the urban population were covered by protected water supply and in the case of sanitation the overall coverage was 28.4%. The present study attempts to analyze the status of water supply, sanitation and waste disposal in an historical perspective in view of the rapid urban population growth and deteriorating environmental quality of urban environment of major cities in India. The study envisaged providing a comprehensive overview of these essential necessities and also explained the regional and intra regional variation in the above parameters in relation to demographic, environmental and socioeconomic dimensions. The study also explained the number of cities of different states of India in relation to waste water disposal in different sectors of water use, sewage system and sewage treatment in the urban environments of major cities of India. Based on the findings of the study, the study derived a conceptual framework for sustainability and economic development.

The study was based on the secondary data collected from various published sources related to urban growth, population characteristics, water supply, sewage system, and sewage treatment and waste disposal. The data were analyzed with the help of multivariate and descriptive statistical tools. It was observed from the study that the urban water supply coverage was well below the annual growth rate at 1.7% and did not keep pace with the population growth in major urban areas. The progress in total water supply coverage in the country since 1970 in both urban and rural areas was almost 2.5% annually. In the case of sanitation, an estimated average of 27 per cent was noticed in urban areas. An estimated 395 million population or about 58.7 % of the total population were without safe water supplies; 363 million in the rural areas and 33 million in the urban. It was also understood that 94 % of the country's total inhabitants are without an adequate and sanitary means of excreta disposal.

16. Patricia G. Sippel, Japan (213)

Keeping Running Water Clean in Japan: What Went Wrong?

When Japan embarked on a course of full-scale modernization in the second half of the nineteenth century, it had in place sophisticated and highly regulated systems of water supply and waste disposal. According to some historians, these practices were unsurpassed in the contemporary West. Customs of diet and hygiene, community mores regarding the use of water, and strictly enforced laws produced high levels of sanitation that were reflected in low mortality rates and low incidence of infectious disease. Tests of Tokyo drinking water in the 1880s by British researchers showed, for example, low levels of bacteria; at the same time, many regions of Japan boasted fresh water that was pure and delicious.

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Within decades, however, this tradition of clean and regulated water had been compromised. By the 1890s, for example, waste from the Ashio Copper Mine in Tochigi Prefecture north of Tokyo was being dumped into the Watarase River, resulting in serious, long-term damage to human health and the natural environment. The Ashio incident was the first recorded major case of industrial water pollution, the first in a series that continued into the post World War II era.

This paper seeks to offer an understanding of why centuries of custom and law were so easily compromised under the pressure of industrialization in Japan. Focusing especially on the Watarase River, it will examine changes in practice, regulation and values that allowed the degradation of river environments in the modern era. It will also comment on recent attempts at the national and regional level to reverse the decline and maintain healthy systems of running water in Japan.

17. Joel A. Tarr, USA (49)

Critical Decisions in Pittsburgh Water Supply and Sewage Disposal: The Contemporary Effect of Historical Decisions

Today the city of Pittsburgh and the Pittsburgh region are confronting serious problems relating to river pollution and sewerage. These problems have a direct historical base. This paper, therefore, will explore four major and related decisions in Pittsburgh water supply and sewage disposal, and discuss the basis for the decisions and their consequences. The decisions are:

- The decision to build a combined rather than a separate sewer system in the city of Pittsburgh.
- The decision to draw the water supply from the neighboring rivers, especially the Allegheny, and to filter the water in order to control typhoid fever, rather than to draw supplies from a protected upcountry source.
- The decision to resist the 1910 orders of the Pennsylvania Secretary of Health to treat the city's sewage and to change the sewerage system from a combined to a separate system.
- The decision in the 1950's to treat the sewage of Pittsburgh and that of neighboring communities by creating a county-wide Authority - a proposal that encountered many political obstacles.

These decisions will be analyzed from the perspective of three major themes: technological choice; public health risk-based decisions; and political and institutional barriers.

18. Frans van Poppel, the Netherlands (24)

The Effects of Water Supply on Infant and Childhood Mortality: A Review of Historical Evidence

The provision of clean water is mentioned as an important factor in many studies dealing with the decline of mortality in Europe during the late nineteenth and early twentieth centuries. In developing countries too, improved water supply is assumed to have a strong impact on mortality. When studying the effect of water supply on public health, researchers are confronted with many methodological problems. Most of these also apply to historical studies of the subject. We review the evidence from this historical research, taking into account the methodological problems observed in contemporary impact evaluation studies, and we use more refined data from the Dutch city of Tilburg, enabling us to overcome many of these shortcomings. Finally, we discuss some factors which may explain why we failed to discover an effect of the availability of piped water on the level of childhood mortality.

In November 1980 the United Nations General Assembly declared the 1980s the International Drinking Water Supply and Sanitation Decade. It was anticipated that guaranteeing 'reasonable access to safe water' to all inhabitants of the world by 1990 would be followed by significant improvements in health and social conditions (WHO 1992:106). This ambitious task has not only increased the pace of the provision of improved methods of water supply, it has also stimulated research in which the effect of water supply on public health is evaluated (Lindskog and Lundqvist 1989:10). Students of medical and demographic history have long discussed the influence of sanitary reforms, in particular improved water supply, on the reduction in mortality in the nineteenth and early twentieth centuries. According to McKeown (1976:121-123), the decline in airborne diseases, due to nutritional improvements, had been much stronger than the decrease in water- and foodborne diseases, due to advances in the purification of water and sewerage disposal. The role played by municipal sanitation thus has only been a secondary, reinforcing one. Demographers, economic historians and historical geographers have tried to put McKeown's hypothesis to a rigorous test by turning their attention from the national level to the local level of the municipality, the location of the principal agencies responsible for preventive health measures such as improved water supply and sanitation. Their research was based on large sets of local data relating to a variety of factors which could, in principle, have an impact on mortality. In evaluating the effect of water supply, they made use of much more refined statistical techniques than McKeown did. Moreover, their studies were no longer restricted to the special case of Britain but focused on other European countries as well.

19. Eric Zusman & Zhu Tingju, USA, China (225)

The Implications of Institutional Reform in The Yellow River Basin

Water shortages in China's famed Yellow River Basin have become a problem of increasing domestic and international concern. In the early 1990s, the growing severity of the shortages led to a policy debate over the most effective solution to water scarcity in the region. The diverse array of policy proposals that emerged from this debate not only reflected the severity of the shortages but also hinted at the lack of hydro-solidarity in the basin. This disunity is critical because it is arguably the core reason the shortages continue to be such an intractable problem. The organization charged with comprehensive water management in the basin, the Yellow River Conservancy Commission (YRCC), lacks the institutional leverage to effectively coordinate water distribution. Meanwhile, provincial governments and other functional bureaucracies with a stake in distribution decisions lack institutional incentives to cooperate with each other. Before any policy proposal is effectively implemented institutional reform is imperative. Thus, in the late 1990s, the quest to find an effective policy approach has been accompanied by a new debate over the appropriate course of institutional reform in the Yellow River Basin.

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Recognizing the need for institutional changes, two paths of reform have been suggested. The first supports raising the administrative rank of the YRCC so that it can effectively unify water management (*tongyi guanli*) in the basin. The second proposal advocates creating an autonomous consultative body with voting representatives from the eight provinces in the basin as well as a single central government representative to coordinate water management decisions. The purpose of this paper will be to construct an analytical framework for comparing the effectiveness of "*tongyi guanli*" reform with the "autonomous decision making body" reform. The paper will argue that in the short-term the immediate gains from raising the institutional rank of the YRCC will outweigh those of creating a separate management agency. The paper will also argue, however, that in the long-term the creation of separate autonomous organization offers the greatest promise for permanently remedying the lack of unity in the basin.

Water, poverty and social development

This session will deal with development of the modern megalopolis and the water and sewage question and how clean water can be made available for the poor. Important changes are taken place in the distribution and control of water for household consumption. In some big cities the water issue has caused political turmoil, even street-fighting. How does the privatisation wave in water distribution affect social relations, political systems and the water supply system? How does lack of water and poor distribution systems affect development and development in rural areas of the so-called "Third World"?

1. Ibidun O. Adelekan, Nigeria (151)

Socio-economic Implications of Water Supply in Nigerian Urban Centers: The Case of Ibadan.

Adequate water supply is a critical issue in Nigerian cities as it is in the rural areas. This is largely due to the high rate of population growth and inadequate water supply networks within the cities. By the year 2015 it is estimated that 55 percent of Nigerian population would live in cities. This rapid rate of urbanization underscores the need for reliable and sufficient supply of safe drinking water, which is lacking in most Nigerian cities, as the institutional framework developed is not adequate enough to address the problem.

This paper evaluates water development in Ibadan, the largest truly indigenous urban center in sub-Saharan Africa. Using quantitative and qualitative data collected from field survey as well as secondary data the problems of water supply is examined and the impacts on the residents especially the low-income groups evaluated. Results show that less than 30 percent of households enjoy fairly regular supply of water from the municipal source in their homes. Others depend largely on water from private wells, boreholes, public taps and commercial water tankers. In most cases social conflicts ensue in the process. The burden on women is especially great as they spend hours in search of water. Consequently, their productivity is impacted negatively as majority engage in water-demanding food processing activities for income generation. This has significant effect on the incidence and risk of poverty and on the health status of most low-income households.

2. Patricia Avila Garcia, Mexico (167)

Urban Poverty and Conflicts over Water in Mexico

The purpose of this paper is to analyze two categories of conflict over water in poor neighborhoods of cities in Mexico: a) disputes that lead to collective action; and, b) conflicts related to hydro-politics, including the absence of policies or changes in regulations and in the agencies in charge of water management. In the first case, conflicts center primarily on the relationship between the State and the urban poor. Topics to be analyzed range from collective behavior and isolated protests over water services with no organizational base, to movements that attempt to recover control of water through urban groups that suggest new relationships with the State for water management. In the second case, conflicts do not center on the State but, rather, on actors in poor neighborhoods where water is a scarce and strategic resource the control of which is a basis for local power. This can be examined at two levels: a) where the State plays no role in water management and poor vicinities lack such services; and, b) where new forms of management are introduced in poor areas, such as privatization, public/social co-management and self-management.

3. Esteban N. Baltazar, Colombia (267)

Quality of Life and Quality of Water in Colombia

El punto de partida de esta investigación es el problema de la medición de la pobreza y su relación con la calidad del agua, en Colombia para medir el grado de pobreza y para asignar recursos públicos se utiliza indicadores como el NBI (Necesidades Básicas Insatisfechas), sin embargo este indicador tiene limitaciones para de bienestar solamente toma en cuenta el acceso al agua (acueducto) y no mide ni observa la CALIDAD DEL AGUA al que tienen acceso.

Por otro lado, Colombia tiene la mayor cantidad de fuentes hídricas pero por el contrario tiene una mala calidad del agua para el consumo de las personas. Esta contradicción debe ser un problema del desarrollo social que exige el diseño de una política pública de la CALIDAD DEL AGUA. Para demostrar la importancia del tema en Colombia se realizar investigaciones, entre otros factores, con estimaciones confiables de la magnitud de la calidad del agua en las viviendas y cuantificar la totalidad de población que está afectada por este problema.

El Objetivo de este estudio es realizar estimaciones de la calidad del agua y su relación con la calidad de la vida para cada una de las regiones, departamentos y municipios de Colombia.

Para ello se construirán indicadores sobre la base de conceptos nuevos como el Índice de Condiciones de Vida (I.C.V.) del Departamento Nacional de Planeación – Misión Social y el Índice de Calidad del Agua del Instituto de Hidrología, meteorología y estudios ambientales – IDEAM - y utilizando información del Censo Nacional de Población de 1993 y de la Encuesta Nacional de Calidad de Vida 1997, en tales fuentes de información que hasta ahora no se habían utilizado para ese propósito de investigar la calidad del agua.

Posteriormente, con el objeto de poder identificar regiones y grupos vulnerables de acuerdo la calidad del agua en los cuales se concentran éstos problemas. Estos indicadores de la calidad del agua se asociarán con los niveles de vida (ICV) y con los de pobreza de los hogares (Línea de pobreza – ingreso monetarios), y otras características socioeconómicas del hogar, tales como la educación, calidad de la vivienda, acceso a otros servicios y calidad del suelo.

Los resultados de estas relaciones y asociaciones permitirán llegar a conclusiones relacionadas con los distintos tipos de niveles de vida dependiendo de la calidad del agua y por ende a sugerencias en torno a la política pública de la calidad del agua en las regiones de Colombia.

4. Jan-Olof Drangert, Sweden (309)

Going Small When the City Grows Big – New Options for Water Supply and Sanitation in Rapidly Expanding Urban Areas.

The paper looks at the development of water management options in urban areas and their relationship to population growth. A study of the developments of water and sanitation management in the rapidly expanding town of Kisumu on the shore of Lake Victoria in Kenya was conducted in 1988-2000. The aim was to describe and analyse actual developments in the water sector and to foresee what prospective development could be identified in the light of its rapid population expansion.

The small town was growing at moderate speed up to the end of the colonial period and, if no external forces had been active, little would have been achieved. However, the infrastructure was developed as part of a colonial plan for expansion. The municipal council managed to supply water to and collect latrine buckets from a large portion of the town-dwellers.

The post-colonial period after 1963 is one with rapid population growth and progressively poorer social cohesion in the community. Heavy stress on the municipal council has made it failed to provide water and sewage services. The residents have "gone small" when the city grew and the majority of Kisumu residents live in houses on small plots with dug latrines and a well.

From having been an individual enterprise to cater for water needs, the International Water Decade made provision of water a public activity world-wide. We are now witnessing a return to local solutions, but this time delivering water on a commercial basis. In some rapidly growing peri-urban areas alternative organisational forms are emerging to cater for the provision of water and disposal of foul water. Such arrangements will require good rapport between professionals and urban residents in order to function smoothly.

5. Gro V. Dyrnes & Boris Maranon-Pimentel, Norway/Mexico (216)

Changes in the Local Availability of Water and Allocation of Groundwater Rights in Mexico.

Mexico is facing serious problems as a result of overexploitation in its groundwater resources. With the accelerating scarcity of groundwater in the beginning of this century, institutional changes resulted in a strong centralisation of the groundwater management and further a prioritising of water supply for huge urban zones. Take the transfer of water from the aquifer in the Valley of Ixtlahuaca to Mexico City where, the decision was taken by the Mexican Government, leaving out possibilities for discussion on regional or local levels. The extractions have strongly diminished the availability of water in the area without any recognition of local rights to the "lost" water.

In the early nineties, Mexico launched a new wave of institutional change which is pursuing a liberalisation, de-concentration, and decentralisation in the management of water resources. On groundwater, there is a process of creating, within each aquifer, user-groups and markets for water-rights. In the case of Ixtlahuaca there seems to be evidence that the presence of an powerful and external actor as Mexico City will make this process more difficult and further that it is most uncertain if eventual changes will improve the local availability of water.

In our work we will discuss two important aspects of these changes:

1. The tendency of reduced water availability for groups with limited resources when water rights are reallocated, due to the presence of Mexico City and also due to a fast process of urbanisation and industrialisation in this region.
2. Difficulties with organising local management in the presents of an external actor with strong political power.

6. Jaqui Goldin, South Africa (300)

Policy Versus Praxis: Problems and Solutions in the Water Sector Theory

Management Systems in the water sector in South Africa are undergoing radical changes. This paper will explore some of these changes and their implications for water distribution, control and access.

The paper examines the interfaces between policy and practice and explores the effects that the National Water Law in particular has on water management discourses. It scrutinises the legislative framework proposed for good governance in the water sector and the problems which face the State as these management systems are transformed. The paper will look at the role Trust has played in acting as a 'glue' to facilitate or obstruct good governance practices. It will examine the changing role of Trust and where new relations of Trust are being constructed in the water sector. The paper argues that the role of Trust has played a crucial part in determining how the organisation of management systems is arranged. The research refers to Seligman's notion of trust and power and to Putnam's exploration of Trust as social capital, as well as Luhman's notion of risk and trust. It will argue that issues of inclusion and exclusion are useful concepts in understanding the tensions between policy and praxis in this transformation process. The research uses Selznick's concept of formal and informal co-optation in examining membership and stakeholder representation from the Water User Association through to the Catchment Management Committee, (the precursors of Catchment Management Agencies who have been designated to control and manage water in Catchment Management Areas). Agnus Heller's concept of Shame is explored and its interface with Trust.

The work of Gustavo Esteva, James Scott and Arturo Escobar inform understandings of global versus local knowledge systems. The research explores this debate as it relates to the construction of institutional arrangements for water and looks at knowledge regimes and the power of dominant language systems to control and manipulate access to water within this context.

Method

Empirical work takes place in Catchment Management Committees, Stakeholder Forums and Water User Associations where the role of the State and organs of State is challenged. The extent to which these organs support or undermine the democratisation process and issues of ownership and control of water resources is explored. The paper will look at the historical role of man and

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water in this area from precolonial through to the colonial era, the apartheid regime and against the backdrop of a new South Africa. It will critically assess the changing position of rural citizens and how they came to be deprived of their access to water.

Findings

Catchment Management Agencies cannot be representative of citizens because of the historical inclusion/exclusion and dominance of knowledge regimes in this sector. The gap will not be bridged in the short time needed to put forward National Water Strategies. Therefore Catchment Agencies, are manipulated by present knowledge regimes and do not truly reflect the legislative requirements as laid down in the National Water Act. They are however, new institutional bodies which will govern and co-ordinate activities previously controlled and managed by the State. How much are 'new' institutional arrangements being constructed in the spirit of the National Water Law and how much are these stakeholder interest groups maintaining existing power relations and reinforcing old elites. In so far as they co-opt approved experts and do not bring in new local expertise are they reflective of new forms of governance practices.

7. David Hemson, South Africa (307)

Rural Women and Water in South Africa

More than any other issue the delivery of clean water to the rural poor has been made the hallmark of transformation by the post-apartheid government. Speech after speech has spelt out the pledge to provide what is promised by the Constitution "access to water" and this has been reinforced with the Water Services Act, 1997. The now historical Reconstruction and Development Program pledge to provide 25l per person from a standpipe within 200m has, together with the pledge of one million houses within five years, represented for many the most concrete promise of delivery. In particular women were targeted as the beneficiaries of the policy both in terms of representation on water project steering committees and through easing the burden placed on them in the rural areas to provide water to their households.

But studies have revealed very slow progress in improving the participation of women within the water sector internationally and locally. Water and sanitation projects are more sustainable when women have ongoing responsibility for their operations and maintenance as they are more committed since they are adversely affected by project failure. Although policy aims to end the marginalised position of women in the management of water supply and sanitation, there are major gaps. Water policies, thus have to have a gender-based approach to ensure sustainability. This paper examines the contradictions in policy implementation, more recent changes in policy, raises serious questions about the statistics of delivery and reflects on the empowerment of rural women. Water delivery and management in South Africa is affected as elsewhere by the trend towards involvement of the private sector, privatisation in all its various manifestations, and austerity in delivery. The performance of the Department in accelerating delivery, the key promise of the new Administration, is examined from a perspective of women's empowerment.

Although the rules applying to Project Steering Committees by NGOs and DWAF include a target of a third of representatives being women, there are still major problems in ensuring that women have a decisive role in the management and operation of these schemes. The central problem appears to be the gap between water committees and the emerging forms of local government in the area. The form of local government emerging in the rural areas gives a privileged position to traditional authorities and generally is deeply patriarchal and tends to exclude women from the critically important levels of participation in the management of projects.

It appears that although women's participation is becoming enforced at the level of project steering committees (although not in the ranks of those employed in operations and maintenance), the higher levels of political representation do not reflect the fact that women represent 50% of the electorate. It is reported that women are under-represented as local government councillors: 29% of the proportional representation seats went to women but only 11% of the ward seats. It is unclear what the proportion of women in rural local government is, but the general opinion is that it is far lower than these figures.

A higher level of participation of women's councillors in rural local government would help challenge the contradictions of policy which is placing the heaviest burden of water and sanitation delivery on rural women.

A conference of practitioners, people's representatives, and NGOs in the field of water delivery recently met to demand a lifeline tariff of 50l per person per day (i.e. free). The government has responded with a proposal to provide 6l monthly free. If there is a vast acceleration in the delivery of rural sanitation, the burden on women would be reduced and the survival and continued health of our rural children much improved. Such a campaign would, however, involve a challenge to the existing patriarchal order of rural society.

8. Margarita Ilieva & Iliya Iliev, Bulgaria (267)

The Water and the Transforming Agriculture in Bulgaria

Well-known in theory and practice is the relationship between the use of water by agriculture and the agricultural output. Considering the specific natural conditions of the country, the irrigation as an element of the intensification of farm production in Bulgaria turns to be very important. This importance will grow in the future because a temperature rise and an increase of droughts are likely to occur as a result of the global climate changes.

A certain impact on the changes of the irrigated lands and on the utilization of irrigation facilities in Bulgaria has the deep economic crisis (towards the end of the 1980s and during the first half of the 1990s) and the process of transformation in agriculture which, compared to the remaining South-European countries in transition, is characterized by its more radical changes in the ownership and the organization of production.

Taking into account the regional features of the processes and phenomena under investigation, an attempt will be made by the authors on the basis of the statistical, comparative, balance, graphic, cartographic methods and the analysis and synthesis, to clarify the influence of some conflicts (e.g. the restriction of irrigated areas and the aggravated shape of the irrigation equipment and the growing needs of irrigation; the restored private property on land and the ownership of the irrigation network, etc.) on the

development of agriculture. Finally the measures, aimed at the improvement of irrigated farming and the water management, will be accentuated.

9. Maiha Khan-Tirmizi, Pakistan (257B)

Gender, Poverty and Water: Inclusion and Exclusion in Pakistan

Access to land and water is vital for subsistence of poor households in the rural areas of the so called "Third World". An individual's access to resources is dependent on their gender, and is different for men and women of the same socioeconomic status group. Women's rights and access to natural resources depends heavily on what they are and are not allowed to do in the broader context. Women's access to resources has a powerful effect on reducing the incidence and risk of poverty and improved health amongst poor and vulnerable households.

Most of Pakistan is an arid climatic zone, and subsistence is heavily dependent on water supplied through its vast Indus Basin irrigation system. For many of the rural communities, this is the only potable and reliable water source and is used for all productive and reproductive tasks. Yet women, throughout the country, have no role in the management of the irrigation system, and as a result, no voice in water allocation decision making.

This paper will be divided into two parts. The first part will examine the nexus between rights to water resources and poverty. It will detail the gendered division of rights, responsibilities, and access to water resources that exist in the Pakistan. The second part of the paper will present an analysis of the reasons for exclusion of women from irrigation management. It will use the experiences of two grass-roots level initiatives of inclusion to build the case for giving women a voice in irrigation management.

10. Carmen Ledo, Bolivia, The Netherlands (250)

Inequity and social exclusion in the access to water in Cochabamba-City, Bolivia

The general objective of this research is to study the relationship between spatial-temporal urban development processes and social changes during the period of the seventies to the nineties and the identification of the patterns of water use and the spatial distribution of urban poverty.

The hypotheses concern: (a) Urban stages; (b) the urban development and job/opportunities there; and (c) the identification of the patterns of social and spatial exclusion.

Important aspects of the study are:

1. Urban themes, Urbanisation, Spatial Model and Urban Structure; Urbanisation and sustainable city; Sustainable Human Development; Housing Conditions and Water Values
2. Development of instruments, spatial modelling related to multivariate methodological approach and application of a Geographical Information System (GIS) for urban planning, evaluation of the instruments and the monitoring.

The empirical part will be based on the creation and development of a set of databases, drawing on data already collected in different surveys such as National Population and Housing Census (1976 and 1992), National Demographic and Health survey of 1994-1998 (ENDSA) and the latest National Labour Samples of 1996-1997 and specific interviews. The elaboration of these data and the application on the theoretical framework of the research project will follow six specific steps: organising databases; inspection of data; selection of variables; elaboration, construction or manipulation of new files; testing hypotheses with the aid of a multivariate approach; integrated multivariate results with geographical information system; and writing conclusions.

The conclusions will focus on identifying the main variables at various spatial scales that influence to determine spatial opportunities and challenges in the provision of water and sanitation in Cochabamba. Emphasis will be on the development of a framework to identify critical variables, and to elaborate processes and methodologies to integrate considerations of spatial scale with the concept of sustainable urban development. The research will also concern the urban morphology dynamics (through time), which is a general term depicting any change that occurs in the process of urbanisation or urban development. It involves not only the evolution of urban morphology, but also the change of spatial structure within a city. The study of urban dynamics goes also one step further, including the comparative analysis of urban form and structure 'across space' and 'through time'. Methodology, therefore, will be developed for dealing with both the 'spatial' and 'temporal' dimensions of urban changes.

11. Tania Lustosa & Luis Capucha, Brazil, Portugal (262)

Water, Poverty and Social Development in Rio de Janeiro and Lisbon

The present document compares the access to water supply and sewerage disposal, and their interrelationships to other types of deprivation faced by poor households, in two periods of time, and in two metropolitan regions with the same cultural background, but from different continents - Rio de Janeiro and Lisbon. We believe that in spite of the unprecedented growth in the number of studies of poverty and in the efforts towards its eradication, the increased inequalities caused by the effects of globalization in the labor market, demand a more comprehensive approach to poverty (in which material and social deprivation should be taken into account concomitantly to shortage of income). Within society, different social groups have different relations to fresh water supply and sewerage disposal, as they do to other aspects of well-being (material and social assets). Therefore, water related indicators represent an important tool in poverty identification and characterization.

Trying to bridge the existing cleavage between the way industrialized and less developed countries approach poverty (absolute versus relative/subjective), we adapted the Unsatisfied Basic Needs Approach (proposed by the Economic Comision for Latin American and the Caribbean - ECLAC - to Latin America) and the Eurostat Household Panel's guidelines to European countries, in the search for a more comprehensive analysis of the interrelationships between factors conditioning poverty, where access to water plays an important role.

Combining monetary and non-monetary indicators (household per capita income; access to water and sewerage disposal; household congestion; educational achievement and labor force participation of household breadwinners; and household children's educational achievement), using data from the Brazilian Household Sample Survey (PNAD-1992 and 1998) and from the Portuguese Panel, we found that unsatisfactory water supply and sewerage disposal are material hindrances, not necessarily

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matched by other types of deprivation, monetary or not, as showed in previous work (Lustosa & Figueiredo, 1990; Lustosa, 2000). It is precisely because the identification of the factors conditioning poverty is not straightforward, that a more comprehensive approach, taking into account labor market conditions, and the historical evolution of the water/poverty relationships in society, is necessary for the improvement of social action. The international comparison of these different metropolitan regions contributed positively to a better understanding.

13. Manzurul Mannan, Bangladesh (186)

Water, River and Culture: The Violence of Modernization in Delta Bangladesh

This paper deals with the violence of modernization in one of the largest delta societies of the globe. Delta Bangladesh had experienced two disastrous floods in 1988 and 1998, which were unknown to its living memory. The flood scenario is worsening day by day. Added to the flood, Arsenic problem threatens the human existence in the delta. Further, with global warming a large portion of delta might go under seawater. People believe that these disastrous phenomena are the outcome of "nature's revenge" against the violence imposed on it by Modern and Western planners. Although water is the lifeline to society, the modernization of delta did not start from developing an understanding of the nature of seasonal water flows in the regional rivers. On the contrary modernization impose exogenous Western theories and practices, which eventually are causing more crises to delta. Modern planners with the influence of Euro-centric modernization impose engineering and technological solution to transform delta ecology and fishing ground into agricultural and industrial societies. They try to discipline wild rivers and undermine the development of river communication that evolve historically in favor of road and rail communication.

More than 215 big rivers with its numerous arteries of tributaries, canals, small rivers have contributed to the formation of the Bengal delta. Over the five thousands years, Bengali developed deep cultural knowledge on rivers and water resource management. The indigenous knowledge on river is constructed on gender line, i.e., male and female and expressed at three composite levels: "Sky-river," "earth-river" and "under-earth-river." These three levels must be used in harmonious way. Disharmony in the system causes disaster, i.e., modernization induces a process to destroy the cultural knowledge of delta, river and ecology. For example, when "under-earth-river" is disturbed, people suffer from arsenic. When industrial wastage, fertilizer, pesticides disturb "earth-river," it causes loss to fishery resources and pollute drinking water. When "sky-earth" is disturbed with the depletion of ozone layers, it changes the weather pattern and threatened the human settlement at delta. Over all, delta Bangladesh is a disaster prone country. The poverty of Bangladesh is partly attributed to economical reasons, but it largely results from man made ecological disasters like floods, droughts, desertification, etc.

This paper calls for finding a fit between modern technology and cultural knowledge of the people. The linear Euro-centric modernization only deals with "earth-river" to the direct detriment to "sky-river" and "under-earth-river." This narrow approach rests on the modernization assumptions of reducing population growth, which could be tackled by increasing agricultural output and creating job opportunity by establishing industries. However, such policy over the period did not reduce poverty. This paper argues that poverty might be reduced significantly if planning starts from the historical, social and cultural construction of water and rivers of the delta. Technology and engineering solutions could reduce poverty only when modernization works within the frame of cultural knowledge and adapts to it.

14. Joseph Mullen, UK (205)

The Role of Water Resource Control in the Impoverishment and Development of Uwanda, Tanzania 1898-1976

This paper examines the role of water resources, local governance and social relations in Uwanda, a poor famine-prone remote area of South Western Tanzania. It contrasts pre-colonial, colonial, and post independence ujamaa regimes in relation to the control of water resources and water-related products and their roles in livelihood frameworks.

Three kinds of water resources will be examined: Ivuna salt lake, Mkulwe fish lake, and the locust breeding grounds of Lake Rukwa. Archaeological evidence from Ivuna, outlining iron age cultivation patterns will be surveyed. The communal ownership regimes of salt production and its socio-economic function in ensuring food security through local trading networks in pre-colonial society will be studied. The appropriation of the salt lake by European companies and the undermining of the water control authority of the Mkulwe chief by missionaries laid the foundation for the economic and ideological impoverishment of the area. This process was reinforced by forced migration under both German and British administrations, often with the active collaboration of missionaries.

The political philosophy of ujamaa during the period of 1969-1975 led to the restoration of communal ownership and management of the salt lake and contributed to the establishment of controlling interest by local peasants in fishing rights. Poverty was stalled temporarily, through a more equitable distribution of economic resources linked to water.

The paper argues that the social control of critical water resources in subsistence economies is closely related to local governance, asset distribution and prevailing cosmic idea systems, all of which are substantially undermined when integrated into metropolitan and global trading networks.

The research is based on personal interviews with key informants, prolonged participant observation and documentary research including, inter-alia district books and mission diaries.

15. Mary W. Mwangi, Kenya (118)

Children's Perceptions of Water and Sanitation in Selected Slum Areas of Nairobi, Kenya

Access to safe drinking water and adequate sanitation remains a major challenge for families living in Nairobi's slum areas. Despite the emphasis on community participation in the management of water and sanitation in these areas, children are rarely involved in community based water and sanitation projects. Involving children in all aspects of water and sanitation management is crucial in improving the health of slum dwellers.

A paper based on a study of children's perception of water and sanitation in selected slum areas of Nairobi will be submitted. A predominantly qualitative approach will be used to investigate children's perceptions of water and sanitation. The impacts of the

ongoing water rationing programme on children and the role that children can play in water and sanitation management will be examined. Child focussed data collection methods (e.g. Art and Narratives) will be used.

16. Rengarajan Parthasarathy, USA, India (196)

Poor and Access to Water: Evidence from Irrigation Management Transfer Program in India

Though poverty alleviation is an explicit motive for governments in developing countries to transfer irrigation management (IMT) to farmers, they are implicit in equity goals. These initiatives also have dual aim. Reducing public expenditures and improving water distribution. The latter aim is inspired by the widely observed deplorable state of infrastructure, low recovery subsidized water rates, water deficits, and water losses and logging. Thus poverty concerns are implicit in the goal to improve distribution. This paper explores this assumption to disentangle the processes through which benefits from IMT would benefit poor farmers. Specific questions are: How do poor farmers participate in the process of IMT; in Water Users Associations (WUAs), repair and maintenance activities and water distribution? What is the impact of IMT on access to water?

'Poor farms' include tenants and male and female-headed households based on size of land holdings. These questions are answered and compared for two contrasting approaches adopted in Gujarat and Andhra Pradesh states of India. In these states upgrading of irrigation infrastructure and creation of WUAs that are responsible for repair and rehabilitation (R&R), operation and maintenance of the canals, water distribution, and fee collection are underway. An important aspect under the new system is water rights, but they appear to confirm the rights of landholders. However, the key to successful operation is related to the kind and degree of participation by users. Topdown versus bottomup approaches are also found to create different contexts for participation and the initial arrangements influence the establishment of norms of participation and long term impacts on poverty.

17. C. Ramachandriah, India (246)

Inequities in Urban Water Supply. A Study of Municipal Towns in Andhra Pradesh, India

Availability of clean water is one of the most essential requirements for human beings to carry on life with required hygiene levels and dignity. Water thus becomes an essential input in the quality of life, as it is deeply involved in the life processes of living matter. Non-availability of adequate quantity of water coupled with its poor quality is causing immense damage to the lives of people in developing countries. It has been documented that out of 37 diseases that are responsible for most deaths in these counties, 21 are related to water and sanitation. Such diseases are causing an estimated 4 million infant and child deaths each year. In India, water and sanitation related diseases are causing about 1.5 million deaths of children under 5 years of age. And about 200 million person-days are also lost every year due to such ailments. There are a number of evidences of pollution of water bodies, growing water scarcity and rising water conflicts.

The present study deals with the status of water supply in 89 municipal towns in Andhra Pradesh, a southern state in India. On the basis of population, the municipal towns are grouped into three size classes of I, II and III, and also across regions within the state, for analysis in per capita levels of supply. The study also covers a few towns as micro level studies. Issues relating to pricing of drinking water by the state government and some recent trends of growing water business by private companies have also been discussed.

The bigger size towns are able to provide higher levels of water supply as compared to the lower categories. At regional level, towns in the relatively developed region are able to supply more water. Towns in the backward and drought-affected areas suffer from a double disadvantage of lower supplies and higher shortages. The small and medium towns continue to lag behind in providing this vital service. The uniform pricing policy for water for similar grades of municipalities throughout the state is working to the advantage of well-off sections in the towns. The study, therefore, argues for a differential pricing of water based on living standards across and within urban centres. With increasing entry of big players into water business, there is a risk of the State withdrawing slowly from this sector which will prove detrimental to the poorer sections. For overall social development, public control of water supply assumes greater significance in view of the recent judgement of the Supreme Court that clean drinking water is a fundamental right under Article 21 that guarantees right to life in the Constitution of India.

18. Chamhuri Siwar, Malaysia (247)

Water, Poverty and Social Development: Case Study of Langat River Basin, Malaysia

The paper is aimed at highlighting issues pertaining and relationships between water, poverty and social development in the Langat River Basin, a river basin adjacent to the Klang Valley, an urban conurbation which hosted the capital city of Kuala Lumpur and other urban centers.

The Langat River Basin provides water for its population for domestic as well as agriculture uses. However, rapid industrialization, urbanization, infrastructure development and commercialized agriculture-livestock and fisheries enterprises are threatening the water quality and ecosystem health of the Langat Basin.

The poor and the low income groups are negatively impacted by the water pollution, affecting their production and income levels and their health. The poor also contributes to environmental degradation and stress on the Langat Basin. Squatter settlements along the Langat River contributed towards deteriorating water quality and waste disposal and management problems.

This paper examines the link between poverty, water and socio-environmental issues, using an integrated ecosystem health approach. The ecosystem health of the river basin will be evaluated and strategies will be recommended towards sustaining the river basin in the long run, encompassing economic, social and environmental dimensions. The economic-social dimensions will look at ways to alleviate poverty, improved quality of life towards sustainable livelihood.

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19. Chan Sophal & Sarthi Acharya, Cambodia (249)

I am presently relocated to Cambodia. I am engaged in a number of development issues here, in my capacity as Research Director at the Cambodia Development Resource Institute.

Since we are working on issues related to ecology and poverty here, specifically in the context of floods, forests and repeated inundated areas, please let me know if this topic interests you. Surely our interest is to share what the development challenges are, and we are doing, in this part of the world. You perhaps know that Cambodia has just emerged from a 30 year war, in which all local institutions (social, administrative, others) have been seriously disturbed. Excessive floods have affected food security, while the farmers are unable to invest or even get together in the absence of land title deeds, and the government has no money.

20. Francis Wilson, South Africa (258)

A sound in the Clouds: The Political Economy of Water in South Africa

(follows)

Freshwater and the Coastal Zone – Integrated and Ecological Management

1. David N. Barton, Norway / Costa Rica (154)

Rapid Valuation of Environmental Impacts - Benefit Transfer Approaches Applied to Water Resource

Management. A number of non-market valuation methods have been developed which may be used to integrate the costs and benefits of environmental impacts and mitigation measures in traditional economic welfare analysis. Because most of these methods are costly and time-consuming, welfare estimates from previous studies are often used in the evaluation of new projects, in what has come to be known as “benefit transfer”. As non-market valuation of environmental impacts gains acceptance, benefit transfers are increasingly practiced by development aid agencies and their consultants.

If a consultant proposes a method which is both quick and cheap, how dirty is it? The paper reviews the reliability of the most popular benefit transfer approaches, relative to conducting original non-market valuation studies, from water resource management projects in developing countries. Empirical results are reported from several field studies conducted by the author in Costa Rica on households' and visitors' willingness-to-pay for avoiding sewage pollution of local coastal water resources. The size and causes of transfer errors are examined when benefit transfers are conducted between Costa Rica and Portugal, and between different sites within Costa Rica. The paper provides decision-makers working on water pollution issues with an evaluation of the uncertainty of economic valuation in benefit-cost analyses of waste water treatment measures.

3. John Hassan, UK (44)

The Rescue of English Coastal Waters and the Role of Environmental Pressure Groups, 1957-2000

In the middle of the last century the *New York Times* (18 August 1957) observed that 'Britain is fast becoming a jewel set in a sea, not of silver, but of sewage'. By the 1970s global environmental anxieties began to be displaced down on to more local problems, including coastal pollution, but in the early 1980s the state of British coastal waters was still appalling. Suffering decades of under-investment, even now relatively small expenditures were being devoted to raising water quality to the level demanded by public opinion, the consumer movement, and EC environmental laws¹. In 1979 only 27 coastal waters were designated bathing beaches in the UK for the purpose of the Bathing Water Directive, and of these 13 did not even achieve the European standards at least once between 1979 and 1981². Eventually these and other forces did exert significant pressure on the political establishment and the water industry. A massive investment programme was inaugurated about 1990, and some £3 billion was spent on upgrading coastal sewage treatment works over the next decade. From 1997 government ministers even more explicitly committed Britain to achieving very high standards of coastal water quality. These initiatives have had an impact shown, for example, in rising level of compliance with EU directives³.

This paper will trace changes in the way English society has viewed the natural heritage of the coast over the last half-century. Resignation over the inevitability of pollution in an industrial society, misplaced faith in the sea's supposed infinity and boundless capacity to absorb and purify waste, and confused and ill-informed attitudes about the health risks of coastal pollution gave way to different perspectives later in the twentieth century. It came to be believed that this natural asset required careful management and conservation if it was to discharge the economic, cultural and ecological functions that were vital to human society. The paper will give particular attention to the role of played by environmental pressure groups, including the militant direct-action organisation *Surfers Against Sewage*, in changing public and governmental attitudes towards coastal water quality.

4. E.J. James, India (71)

Management of River Basins in Relation to the Coastal Wetlands – Case Study From South-West India

Recognising the importance of the management of river basins in relation to the coastal wetlands, the Vembanad-Kol wetland system of the south-west coast of India was taken up for a case study. The Vembanad-Kol wetland system and its ten associated drainage basins cover a total area of about 16,200 sq km. In six of the ten basins, the demand within the basins often exceeds the utilisable yield, thereby restricting the inflows to the wetland system. There are three completed and five partially completed major-medium irrigation projects in these river basins, which have a total storage capacity of 1,345 Mm³ to cater to the irrigation requirements of 1,00,000 ha. The nine hydel projects in the river basins contribute to 1400 MW of the installed capacity.

The Vembanad-Kol wetland system has several functions and values. This water body contains the flood waters and saves about 3500 sq km thickly populated coastal area of 3 districts of Kerala from flood damages. Rice cultivation is practised in the polders covering a total area of 100 sq km in the Kuttanad belt - the rice bowl of Kerala – of the Vembanad and most of the area of the Kol; the yield of rice from the wetland is 4-6 times more than the uplands. Prawn culture is also popular in several areas of the wetland. The wetland along with the lower reaches of the rivers draining into it serves the purpose of inland navigation. The Vembanad supports the third largest population of water fowl in India during the winter months. Ninety-one species of resident/locally migratory and 50 species of migratory birds are found in the Kol area. The local production of fish from the Vembanad accounts for 5000 tonnes; almost same quantity of prawns is also available from this wetland. Agriculture and fisheries in the wetland are considered to be conflicting values. This wetland system also serves as a sink and transformer for the agricultural and municipal wastes discharged into it. The wetland has great value from the point of view of water sports; the famous boat race of Kerala takes place in the Vembanad backwaters.

The major management practices in the river basins, aiming at the wise use of the Kol, should concentrate on augmenting the lowflows during the summer crop period and prevention of floods mainly during the south-west

monsoon period. One of the irrigation projects, presently under construction, is intended exclusively for enabling the cultivation of rice during summer in the Kol. There are two important aspects to be given stress: (i) develop a scientific operation policy for the reservoirs in the basin; and (ii) provide water from the reservoirs for drinking water purposes in the wetland. In order to manage the floods, it is suggested that: (i) more storage facilities may be created in the river basins; (ii) appropriate drainage channels have to be constructed; and (iii) proper barriers are required to prevent sea water intrusion. The proposed regulators at two locations have to be constructed to prevent excessive salinity intrusion. The application of agro-chemicals has to be reduced; this is important to keep up the ecological status of the wetland and to save the habitat of a large-scale avian fauna. The potential for improving agro-fishery systems has to be looked into.

In the case of Vembanad wetland, lowflow augmentation measures and flood protection are expected to double the rice production. The Thanneermukkom barrier, intended for arresting salinity into the rice fields, has adversely affected the prawn, clam and estuarine fisheries activities. The operation of the barrier has to be scientifically done. The use of agro-chemicals has to be reduced and the domestic/municipal wastewaters entering into the wetland have to be initially treated. It is both economical and ecologically safe to go for one summer crop of rice and one crop of prawn every year. The development of inland navigation and tourism has to be initiated without causing problems to the health of the ecosystem. By adopting appropriate catchment treatment measures, sediment load into the wetland can be considerably reduced.

The case study has clearly brought out the necessity for introducing appropriate management strategies in the river basins to achieve wise use of the coastal wetlands of the humid tropics.

5. Robert Kabumbuli, Uganda (316)

The Lake Victoria Crisis: A Conflict Theoretical Approach to the Nature, Society and Water Relationship

This paper is presented to the Nature, Society and Water Project as a proposal for the August 2001 Water Conference in Bergen. It is a presentation of the concepts and ideas that I would like to expound at the Water Conference, in which the major theme will be a critical analysis of the intricate relationship between society and nature in the context of water resources in Murchison Bay, Kampala. Presentations in the conference paper will be based on the presenter's field study of Murchison Bay.

Historically, all societies have depended on the availability of fresh water for their survival and development. Water is a vital component in the development and health cycle of society. In Kampala, Murchison Bay is the most important source of fresh water for the population. In addition, as a part of the bigger Lake Victoria, the bay serves other purposes to the community such as being a source of food, employment and transport. Murchison Bay is also the major receptacle of drain water from Kampala, and also receives a lot of liquid effluents from the various human economic activities. Swamps (wetlands) traditionally filter most of the run-off and waste water that flows into the bay. However, society is through various economic activities encroaching on and depleting these wetlands, hence pollution of the lake. That society needs to put the bay and its surrounding wetlands to various though contradictory uses is an irreversible fact. The environmental and health benefits of the lake and the wetlands are in competition with the basic survival and economic uses.

A conflict of interests and ideology therefore arises between the various actors and stakeholders. It is the intention of the study to find how best this conflict could be utilised in the process of restoring a new and orderly relationship between nature, society and water.

6. Petter Larsson (329)

Lake Victoria and Kampala – History of man and water

Lake Victoria is a large and important natural resource for the growing city, Kampala, in Uganda. The city is depending on Lake Victoria for drinking water, as a recipient for wastewater and as an important source for fish protein. Although commercial fisheries have developed over the last 40 years to the benefit of the national economy and protein production, other changes in the same period has reduced many of the qualities of the lake. Lake Victoria, also the area around Kampala, has not been managed as a limited resource. It is so huge that it has been recognised as not fully exploited with capacity to handle increasing utilisation. However, now the limit is recognised and hypotheses of the causes for the changes are several. These are based on local, regional and international influence. The paper gives an overview of possible reasons for the development, anthropogenic as well as natural.

7. Mohan Munasinghe, Norway (35)

Sustainable Water Resources Management and Planning (SWAMP) Framework

This paper shows how water has played a crucial role in socio-economic and natural systems, throughout history. Recently, water resources have emerged as a key element of sustainable development. The availability of freshwater depends on the hydrological cycle. Among current users of water, agriculture accounts for the largest share, followed by industry and households. The paper examines water quality and health impacts, especially the billions of cases of largely preventable water-borne diseases in developing countries caused by increased contamination and inadequate water supply and sanitation services. Current water uses and management issues are described. The increasing competition for scarce water resources is discussed, including the continuing decline in the share of irrigation -- hitherto highly subsidized. The major sources of freshwater (ground- and surface-water), the problems arising from current use, and specific issues associated with health, marine and transboundary aspects are set forth.

The growing future needs for agriculture, industry and households are described, as both economic activity and population expand, and formerly unserved users demand new supplies. While the benefits will be substantial, especially for the poor, the future costs of harnessing ever scarcer new water sources will rise rapidly -- especially in water-scarce areas. This process will exacerbate the already serious shortfalls in investment, as well as other weaknesses such as poor sector efficiency and inadequate prices.

The three main elements of sustainable development are economic, environmental and social. The key role of sustainable water resource management and Planning (SWAMP) within this broader context, and the more specific delineation of economic, environmental and social issues associated with water use are summarized. Sustainability is a transdisciplinary integrative approach for making water management more sustainable, that systematically takes into account, multiple actors, multiple criteria, multiple levels of analysis, multiple constraints and so on. Successful development can be achieved only by a rational and systematic integration of water-related economic, social, environmental and technical considerations within the broader framework of a sustainable development strategy and national macroeconomic policy making. The recent emergence of transnational and global environmental concerns suggest that water resource analysts should develop an even wider perspective. More research, policy and implementation experience is crucial to internalize environmental and social impacts and adopt a holistic and consensual approach to resolve water management issues. Pragmatic new policies, technological advances, and a renewed commitment to social and environmental concerns are providing the opportunities to create a fresh impetus for reforms. It is argued that water sector managers should take advantage of this new climate to identify sustainable water development strategies and options -- including privatisation and more effective use of market mechanisms, pricing policy, non-price policies, and a greater role for recycling and water loss reduction. Several emerging technology options are reviewed. Finally, the main conclusions are summarized. Practical examples are presented throughout, to illustrate theoretical and conceptual issues.

8. K. Shadananan Nair, India (139)

Managing the Freshwater Resources in a Tropical Coastal Zone Stress on the freshwater resources associated with population growth is a matter of concern in coastal regions of many developing nations. The State of Kerala in south - west India is a good example. Even with heavy rainfall and numerous freshwater bodies, historical data reveals that the State has been experiencing periodical water shortages in several years.

Kerala lies parallel to the Arabian Sea, with a length of nearly 700km and a maximum width of 100km. Its western coastland covers nearly one-third the total area and is heavily populated. In the beginning of the latter half of the last century, industries based on seafood and coconut encouraged migration and exerted more pressure on water resources. Coconut husk retting gradually degraded the quality of surface and groundwater, making water unfit for direct domestic use. Bore wells promoted intrusion of saline water. Rivers in Kerala originate in the eastern highlands and flow through the coastland to the Sea. Many factories opened in the post-independent pollute rivers en route, worsening situation in the coastland. However, construction of dams controlled seawater intrusion in lower reaches of rivers in summer.

Present study assesses the changes in surface and groundwater and water availability in the coastal zone during the last century. Changes in water balance have been estimated based on the method introduced by Thornthwaite (1948). Human impacts on water resources have been taken into account. Considering the past and present situation and future trends, suggestions for the better management of the resources have been given.

9. B.M. Sahni, India (208)

Freshwater Development in Coastal Areas with Interfacing User-Interests Scenario: Some Case Studies

Sustainable and environmentally sound development of groundwater and its effective management for catering to the ever-increasing needs of this important hidden resource for inter- and intra- user interests is becoming more challenging by the day. In coastal areas, the threat of saltwater intrusion into the aquifers and possible deterioration of quality of water abstracted due to uncontrolled upconing of saline groundwater under abstraction wells further adds to the complexity of groundwater management in those areas.

Three case studies from coastal districts of states of Gujarat, Maharashtra and Andhra Pradesh of India are presented in the paper highlighting the historical development of the seawater intrusion in response to increased demands for domestic and industrial water supply as well as for food production by irrigation and the effects of conflicting user-interests on the effective water allocation among different stakeholders.

While the major causal factors for the seawater ingress in Gujarat are low natural recharge, overexploitation of groundwater due to adoption of modern water extraction technology by farmers with availability of liberal loans from government and industrial growth, in Thane District of Maharashtra basically it is the intensive pumping of groundwater associated with high rise buildings under urban development and industrial development projects, and in coastal Andhra Pradesh it is the lack of canal irrigation facilities which necessitated heavy dependence on groundwater resulting in seawater intrusion.

Possible options and strategies for addressing the problems in each of the above cases are discussed in the paper like appropriate site-specific technical solutions, regulatory mechanism, legislative measures, capacity building and using social pressures. The inadequacy of the legislative provisions which have been introduced from time to time to facilitate groundwater management especially in the coastal areas and the steps needed to strengthen the framework for regulation and control mechanism as well as to provide teeth for effective implementation are brought out in the paper. Also, one simple and cost effective *Doruvu* technology

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locally developed for skimming of freshwater in coastal areas of Andhra Pradesh is discussed which has potential for adoption under similar conditions elsewhere.

Theme J: Regional Waters in a Historical Perspective

The conference will organise parallel sessions on water issues in a regional perspective (Asia, Middle East and Africa, Europe, America). Regional characteristics and different experiences and possibilities of human exploitation of water resources will be highlighted. The aim is to stimulate regional research collaboration and improve transfer of knowledge on man–water relations.

1. Samer Alatout, USA (333)

Imagining hydrological boundaries, constructing the nation-state: A "fluid" history of Israel, 1936-1948

This paper tells the story of two historical processes that are thought of as distinct and separate. First, starting from the mid-1930s, the object of hydrological research in Palestine shifted from the study of local and regional water resources and rock structures to the study of the "national hydrological system of Palestine" which, as a result, became a scientifically legitimate category for research. Since then the task became one of identifying the limits and boundaries of this hydrological system. Second, the conceptualization of Zionist political action in Palestine also witnessed a shift: different interpretations of the meaning of "Jewish National Home," the ambiguous category constructed in the Balfour Declaration of 1917, crystallized by the end of the 1930s around one interpretation—the construction of a Jewish nation-state in Palestine. Here, the task became one of identifying the boundaries of the proposed state.

The two processes are usually thought of as distinct, occurring in separate fields of action, one in science and the other in politics. Upon further investigation, however, links between knowledge about water resources and Zionist political action become apparent and demand more attention. It was partly by imagining Palestine as a connected hydrological system that imagining a Jewish nation-state in Palestine gained legitimacy and, by the same token, it was only by imagining the nation-state as the only 'normal' expression of Jewish political life, that research on a unified homogenous hydrological system of all of Palestine was possible. Further, and maybe most important, the boundaries of both the hydrological system of Palestine and the Jewish nation-state followed similar spatial patterns. The extension of one was legitimized by the extension of the other.

2. Daphne Biliouri, Wales UK (294)

Paradise lost: the strategic perspective of water distribution in Central Asia

My suggested paper would be on the development and use of water resources in the Central Asian region. The current situation regarding the use and distribution of water resources (mainly the Amu Darya and Syr Darya rivers) amongst the five Central Asia states is attracting international concern due to the political climate that exists in the region. Additionally, unlike in other regions of the world where the main concern is water scarcity, Central Asia provides a unique case where the issue of water arises more as a case of water distributions than supply. The questions that are raised is whether there is a clear and equal division of water supplies amongst all the Central Asian states and what stance has the international community taken on the issue?

One of the main issues that needs to be addressed is what policy has been implemented by the national governments, regional authorities and other actors [such as international organisations and non-governmental organisations (NGOs)] in relation to the usage of water for agricultural purposes and as drinking water. The fact that the majority of the water has historically been used for irrigation in order to enhance cotton production in the region has provided a unique case and raises the issue of how the drought in Tajikistan has contributed to a diverse approach by the national and regional authorities.

Finally, I will also address the aspect of water as a security issue and if there a possibility for the division of water resources to lead to a conflict amongst the Central Asia states. If not within the region, could China's claims for diversion of water from Central Asia to its western region result to an international dispute over water.

This last section will examine different scenarios and how they may evolve, pinpointing potential concerns for the future of the region and what needs to be done at present to avoid their escalation.

4. Mark Cioc, USA, Germany (243)

Seeing Like the Prussian State: Re-Engineering the Rivers of Rhineland and Westphalia, 1815-1914

This paper will examine the various rectification projects that gave rise to the modern profiles of the Ruhr, Emscher, Lippe, and Erft, all tributaries of the Rhine river in the industrial heartland of Prussia's two Rhine provinces. The Prussian government, working closely with industrialists, engineers, urban planners, and water-management cooperatives (Ruhrtalsperrenverein, Emscherengenossenschaft, Ruhrverband, Lippeverband, Erftverband, Talsperrenverband Eifel-Rur) transformed the region's rivers into a vast artificial plumbing system. Prussia's supremacy over the Rhine and Ruhr (and after 1871 over the German Empire) helped impose a unity of purpose "from above" on water management in the Rhineland and Westphalia, but that purpose was commercial and economic development, not protection of the river basins and riparian habitat. As a consequence, four major Rhine tributaries were re-engineered and otherwise manipulated to such an extent that they lost all the characteristics of free-flowing streams and became instead a part of a faucet-and-toilet industrial system. Large dams were constructed to capture runoff from the Sauerland and Bergisches Land. These dams were devised to provide freshwater for urban and industrial use, and to keep the Ruhr running high even during dry spells. Meanwhile, the Emscher and Erft were turned into open-air sewers for use by the coal, iron, steel, chemical, sugar beet, and other industries, and the Lippe was designated as the main feeder stream for the region's canal network.

The Rhine's current nickname—"Europe's sewage dump"—captures well the long-term consequence of these practices: what the Prussia state "saw" when it looked at its river systems in the 19th century was an opportunity for economic growth; what it overlooked was the fact that 19th-century engineering practices all but destroyed the riparian habitat, creating the half-dead polluted rivers of North Rhine-Westphalia today.

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5. Chennat Gopalakrishnan, Hawaii, USA (277)

Private Gain at Public Loss: the Political Economy of Water Allocation and Use in Hawaii

The political economy of water allocation and use in Hawaii is almost entirely the product of a pattern of land ownership unique to the state: oligopoly. A careful scrutiny of the evolution of the laws and institutions governing the ownership, allocation and control of Hawaii's surface – and ground waters provides compelling supportive evidence to this thesis.

Approximately 25% of the land in Hawaii are owned by seven large corporations. These big landowners have a pronounced vested interest in the control of Hawaii's waters, since they own most of the sugar plantations and virtually all the pineapple plantations in the state. Sugar and pineapple are both heavily irrigated crops. The sugar industry alone applies 278 million gallons of water per day (mgd) to the canefields, roughly 19% of the freshwater consumed. Sugar and pineapple together use about 24% of the total freshwater in Hawaii.

Our study, based on extensive data from primary and secondary sources spanning a 70-year period, shows a clear link between Hawaii's oligopolistic landowners and the state's political machinery responsible for deciding crucial issues of water ownership, control and appropriation. This "alliance of convenience" has resulted in a number of disquieting consequences. These include: the painfully slow passage of a State Water Code (finally enacted in 1987) defining and stipulating rules and regulations governing water use, largely due to political pressure and legislative inaction; a pattern of water use not grounded in the principle of the "highest and best use" of a resource; exceedingly slow adoption of water quality standards and water conservation measures; protracted litigation (in some instances as long as 30 years) between the sugar companies, other water users and the state; and the deliberate discouragement of the emergence of water markets and water pricing. The paper probes these themes and appraises their impact on the evolution of water rights and water institutions in Hawaii.

The paper is organized as follows. Hawaii's oligopolistic pattern of land ownership and its impact on and implications for water use are explored in the first section. This is followed by a discussion of the political economy of water in Hawaii deeply embedded in corporate control. A further elucidation is presented in an exhaustive case study of water allocation in the next part. The legal framework governing the ownership, control and appropriation of water in Hawaii is then critically appraised. The final section sets forth specific suggestions for charting the future course of Hawaii's water development in an economically and socially optimal fashion.

6. Saibou Issa, Cameroon (90)

Access to Lake Chad and Cameroon-Nigeria Border Conflict

From c. 50,000 years BP to nowadays, the shoreline of Lake Chad receded, being today forty times less than what it was in the past. However, from time immemorial, the Lake Chad basin attracted migrants. As drought was progressively draining the adjacent areas, Lake Chad became an oasis within an arid region; its premises became a place of refuge. Britain, France and Germany, the colonial masters of the region wanted to control the lake for strategic reasons. In 1964, the riparian States of Lake Chad – Cameroon, Niger, Nigeria and Chad – founded the Lake Chad Basin Commission (LCBC) to manage its common resources. The deepest waters and the dampest lands were located in the southern part of the lake, mainly in the Cameroonian territory. After the 1972-193 and 1983-1985 Sahelian droughts, the Nigerian irrigation projects were stopped; people coming from areas, especially from neighbouring Borno State of Nigeria immigrated in the Cameroonian Darak zone. In 1987, the Nigerian army occupied the Darak zone, thus creating a border conflict. This paper tries to establish the relationship between water control, the nature of colonial boundaries and the present Cameroon-Nigeria border conflict.

8. Martine Lejeune, Belgium (13)

(Re)creating Living Rivers, The Case of the Border Meuse

The Border Meuse Nature Development Project: For 50 km, between the Dutch town of Maastricht and the Belgian Maaseik, the Border Meuse forms the Netherlands' border with Belgium. It is a narrow, almost forgotten deeply incised stretch of river lying much lower than the surrounding fields. Thanks to human intervention in the past centuries, the Border Meuse is constricted between steep banks and for a large part of the year hidden from view by fields of corn. The villages along this stretch have effectively 'turned their backs' on the river. There is no navigation and the water rushes along over banks of gravel.

Here, a large-scale nature development project is being carried out. At the heart of the Border Meuse Nature Development Project is what appears at first glance to be a contradictory combination of gravel extraction and nature development. The gravel extraction technique will differ completely from the one used up to recently. Instead of deep dredging, which results in deep gravel pits, shallow extraction will take place over a wide area. The whole area will be lowered, allowing the river to exert its influence and to shape the landscape. After a while a typical river landscape will emerge and the Border Meuse will acquire a new, natural appearance. In addition the river will be able to handle large volumes of water more easily, restricting flood damage.

Pilot projects: To show to people what the regenerated natural environment along the Meuse will look like, WWF started, from 1991 on, a number of pilot sites. In these sites the river can exert its influence, natural grazing is practised and people have free access to the areas. Visitors and specialists can experience nature in an unusual way, a huge amount of experience is built up and there is a large scale monitoring programme. In the meantime other organisations are invited to do similar things, while adults and children can enjoy the new landscape (by means of guided visits and nature classes).

On both sides of the Border Meuse you can find dozens of pilot projects, which together cover several hundreds of hectares of 'new nature'. As a result of huge information campaigns, lots of people have come to know the Border Meuse and the nature development project. Every year thousands of visitors are being shown around in the new nature reserves and several thousands more come on their own. Together they induce a lot of new economic activity.

10. Mamaa Entsua-Mensah, Ghana (18)

Traditional Management of Water Resources in West Africa

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Many of the rivers in West Africa originate from highlands in the sub-region. Senegal and Niger Rivers, take their source from the Fouta Djallon Mountains of Guinea. The Volta basin is fed by rivers that originate from Burkina Faso. These are the Black, Red and White Voltas and the Oti River with Pendjari as its major tributary. The Benue and Lagone Rivers originate from the Mandara mountains of Cameroon whilst some of the tributaries of the Zaire River start from the highlands of Angola. Many river systems in West Africa are also accompanied by floodplains that form extensive internal or coastal deltas and wetlands. There are also important natural and man-made lakes and other small water bodies.

Traditionally, water in West Africa was free and not sold. It was believed to have powers of purification and to shelter spirits which have to be honoured in order to obtain their blessing. These spirits are believed to be capable of withholding rain and drying out rivers, streams and reservoirs when they do not receive the requisite offerings and sacrifices, thus water was carefully managed. Unfortunately these beliefs are no longer upheld in many communities.

Access to the water resource may be both national and international. There are migrations of fishers within and between countries. The ethnicity of fishers involved in a long tradition of fishing includes the Bozos and Somonos (Mali), Houssa (Nigeria and the central delta of the Niger) the Ewe and Fanti (Ghana, Benin and Togo). They operate in other regions by often having an agreement with the local traditional chief or Master of Waters in order to gain access to the fishery resources of the water body. There are also bi-lateral agreements between countries sharing a river basin for mutual access to the water resource. An example is access to hydroelectric power from the Volta Lake granted to neighbouring countries. In sharing the same water resource within a river basin, conflicts may arise between individuals or countries. The various developments on the White Volta by Burkina Faso will have adverse effects on the hydrology of the river in Ghana.

This paper reviews the traditional management of water in West Africa in terms of collective ownership, the influence of religious authority, the decline of traditional management, conflicts that arise in sharing the same water resource across countries and some modern approaches to water management.

11. Irene Maver, UK (272)

Water Provision, Urban Improvement and Community Identity: the Experience of Edinburgh in the Nineteenth Century

Water and the epic story of water supply projects, can be a highly revealing symbol of community identity, even national identity. Efficient water provision is indelibly associated with progress and modernity; a theme that was pervasive in nineteenth-century Scotland, at a time when the nation was experiencing one of the fastest urban growth-rates in Europe.

This paper focuses specifically on Edinburgh, and how the quest for the city's water supply was significant in shaping a distinctive urban self-image. In the 1800s Edinburgh had unique status, both as Scotland's capital and as a community which was undergoing a major scheme of urban improvement in the prestigious New Town. Understandably, 'a plentiful supply of good wholesome water' was deemed a prime necessity in the New Town, and appropriate arrangements for water provision were consolidated from 1819.

However, Edinburgh's new water supply represented more than the achievement of practical technology. It became bound up with the improving ethos that had radically transformed old Edinburgh. The eighteenth-century city was remembered as 'a picturesque, odorous, inconvenient, old-fashioned town'; an uncomfortable nether-image that continued to haunt the city's rulers. As this paper shows, the inter-connections between regenerative water and urban improvement became an important part of Edinburgh's development, revealed by the intense and often controversial debates about the best use of water resources up to 1900.

13. Benedict P. Michael, Tanzania (75)

Lake Victoria's Survival Options to Existing Threats

Lake Victoria, the largest freshwater mass in Africa, has been undergoing threats of totally losing its socioeconomic and ecological potential to the millions of people in Tanzania, Kenya, Uganda, Sudan and Egypt who take it to be one of their major lifelines.

There are several stories being forwarded by marine, fishery and environmental experts to prove the claim of this threat. For example, there is the story of the Nile Perch, which was introduced in Lake Victoria in the early 60s and turned to be an unequalled villain and predator, devouring all the other fish species in the lake. It is believed that more than 250 species in the lake, a local economy and an ecological system, which took centuries to evolve, are being threatened by this monster. In the complex process of evolution the variation of species is considered to be the secret to survival. This monster's behaviour is therefore seriously interfering with this evolutionary process of life in the lake. This presumably signals an alarm for an imminent "Dead Sea" in Africa.

According to some experts, Lake Victoria's "death" is linked to the decline or elimination of the smallest species of fish, - especially those which feed on algae and various organic materials. This decline has resulted in the algal bloom, which further results in the increased utilization of oxygen. The excessive utilization of oxygen is complemented by more oxygen being used to oxidize the uneaten organic materials. Thus there is a sudden deficiency of oxygen in the lake, leading to the suffocation of the remaining fish species (including the Nile Perch itself!). There are constant reports from fishermen finding hundreds of dead Nile Perches and other fish species floating along the lakeshores. Other experts also claim that algae bloom in Lake Victoria could be linked to factors like increased siltation during rain seasons, pollution, high turbulence and temperature changes.

There is also the story of lake pollution, which is persistently accelerating, unchecked. There are two sources of pollution going on in Lake Victoria, ie. Point sources and Non-point sources. These sources bring into the lake various pollutants eg. Organic and inorganic substances, toxic substances etc. These pollutants change the ecological characteristics and the quality of the lake. The Tanzanian side of the lake is a case in point; especially the shore lines surrounding Mwanza municipality. This municipality has about 40 industries ranging from textiles, leather, fish, and oil to soap industries. Discharge from these industries is directly disposed into the lake without treatment. Some of these industries discharge toxic wastes making the lake water disastrous for any kind of domestic use.

The mushrooming unplanned human settlements in this municipality are the chief sources of organic wastes in the lake. The use of fertilizers and pesticides by farmers around Lake Victoria constitute the non-point pollution sources.

One thing that is clear to most concerned well wishers of this freshwater body is that there are cheap and effective options of dealing with all of these threats for its survival. These include setting and enforcing legislative guidelines for water utilization and control; re-enforcing the existing environmental

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policy guidelines; applying available technology to treat the industrial effluents to at least minimum standards; promotion of public awareness on the need for conservation of this precious national heritage; carrying out of Environmental Impact Assessment whenever planning or implementing any project which has a potential influence to the environment; strict control of wastes generation from mining, agriculture and fishing activities around the lake and constant monitoring of the lake environment to ensure observance of the laid down regulations.

14. D.M. More, India (86)

Water History of an Arid Region - Marathwada (India)

Marathwada is the part of Deccan Plateau which forms the major geographical unit of Western India and has a long political history where democratic principles are being practised and respected over several decades. People are used to be conscious about the relation between water and society thus establishing a long historical legacy in the field of water management.

The third longest river of the country viz. Godavari drains through this region. But most part of Marathwada falls within an arid and tropical climate. The average rainfall is around 600 to 700 mm. The terrain is undulated and the soils are shallow. Despite the physiological odds, Marathwada had been the flourishing zone till the 14th - 15th century. It will be worthwhile to know the causes of its prosperity and factors leading subsequently to its backwardness.

The Marathwada has a geographical area of the order of 65000 sq. km. The culturable area is around 4.8 M ha. The average rainfall is 600 to 700 mm. with variability over 30%. The annual evaporation exceeds 2000 mm. The relative humidity is around 50% and the temperature varies from 30 to 45^o C. The per capita water availability varies from 1000 to 1200 cum and the corresponding figures for per hectare are 2000 to 3000 cum. The present population may be around 15 million. The entire thus falls in water deficit zone and 40% of it is severely drought prone. The area is therefore known for its extreme aridity, hot climate and acute deficiency in water availability.

Marathwada has a long and chequered history to its credit. There are evidences, which show the existence of pre-historic and proto-historic culture in the minor basins of the tributaries of Godavari. Marathwada is the region, which witnessed the dawn of civilisation for the first of all. Small republican states such as Ashmaka, Mulaka, Kuntal, Rishik appeared on the political horizon of Marathwada long before the advent of Mouryan Empire in 300 B.C. The mention of all the above states can be found in Mahabharata and Ramayana (3000 B.C.) The only reason behind their glorious state is none but their advancement in the methods of water conservation and accomplishments in water harnessing. Majority of them flourished in minor valleys of the principal river i.e. the Godavari. Only the Mulaka was in the hot land of River Godavari, the ancient *Pratishthan* (Modern Paithan) being the capital of the Mulaka. The existence of *Kundas* (water tanks cut in rocks and tanks and *Barwas*) (a masonry lined stepped wells), found all over the territory in large numbers could be cited as examples of water harvesting devices belonging to the pre-historical period. This was followed by the prosperous period of Mouryan Dynasty. The famous treatise '*Arth Shastra*' authored by Kautilya (the great statesman known as Arya Chanakya and mentor of the King Chandragupta Mourya) is depicted through illustrations about various techniques of water harvesting such as building reservoirs, canals etc. rules and regulations for its management and allied disciplines.

The long-lived dynasty of the Satvahanas rose to power in the 3rd century B.C. which by integrating all the then existing republican states formed a formidable empire stretching from the Narmada in the north to the Cauvery in the south. They ruled this vast territory for more than 4 centuries and theirs was a prosperous empire, which acquired not surprisingly an international recognition by the Greeco-Roman World. There are ample evidences from contemporary literature as well as material culture that the Satvahanas were having very close relations with the Western World. The basic reason behind this prosperity was their agricultural surplus. Agriculture was the basic industry during this Satvahana's Era and they were very proficient in its practice. The agricultural prosperity is governed by the abundance of water and to achieve this objective they, therefore, promoted a large number of water conservation and harnessing devices in the form of tanks either excavated in rock or by constructing earthen bunds. The tradition of having at least one water body (a village tank) for every village has been prevalent in this region since the pre-historic era. The activity of building of reservoirs had become very popular in the Satvahanas period as it had been elevated to the status of an act of religion. These water bodies were the gifts of rainwater harvesting wisdom cultivated in those days. In Sanskrit, a reservoir / water body is known as '*tadag*' and we have evidences to show that all types of reservoirs (from smaller to major ones i.e. '*Raj tadag*') were constructed during that era. The famous *Raj tadag* Reservoir now renovated and renamed as Harshul could be seen today functioning efficiently since ages in the precincts of 'Khadaki' i.e. today's Aurangabad - a famous historical city in vicinity of which the world famous caves of Ellora and Ajantha are sited. So, theirs was the first economically sound dynasty, which strived to conserve maximum water both on surface and below the surface.

Satvahanas were succeeded by the Vakatakas who ruled from 230 to 550 A.D. They too sustained the occupation of their predecessors and promoted activities of water conservation and evinced interest in its harnessing. The evidence of a large reservoir named 'Sudarshan Tank' in the proximity of Washim (now a district place) - their capital place - could be cited as an example of creating large water body and putting it to multiple uses perennially. The availability of natural rainfall over a short period of the year (30 - 45 days) was converted into a perennial source through water harvesting wisdom.

They were further succeeded by the Rashtrakutas with their capital at Kandhar (now a *taluka* place) located on the bank of the river Manar - a tributary of Godavari. They had constructed a network of water tanks deploying the locally available earth material catering to the supply of water to a fort and city area around and also for irrigation purpose. A tank named as 'Jagtung Samudra' is still extant functioning for the last 1400 years. Thus, Rashtrakutas were a step ahead in promoting water conservation. Their period witnessed a change in the method of worship. Large number of big temples attached to a small or big well or a *baraw* were built during their tenure.

The Rashtrakutas were followed by the Yadavas who ruled the entire area on south of the River Narmada over a period of about 450 years with their capital at Deogiri located in highly hot and arid climate. The Yadavas were the last powerful dynasty as far as ancient dynasties of Marathwada are concerned. Their downfall occurred at the close of the 13th century and the country was overpowered by the foreign invaders thence on.

Rainfall has been very meagre over here. However, by evolving a large number of devices of rain water harvesting such as chain of tanks, weirs, under ground channels and so on, they not only overcame the difficulty of water shortage, but also became the most powerful kingdom during the period. They had attained self-sufficiency and affluence in agricultural produce and they were used to trade with other countries through water surplus. Such structures could still be witnessed even after a period of over thousand years, widely spread all over the entire territory in general and in Marathwada Region in particular - the latter being chosen by them as their political stronghold. This region was thus made water abundant in spite of its hilly configuration, scanty rains and arid climate. A network of small tanks, small water tapping wells numbering in thousands in city areas at many places like Biloli, Beed, Aurangabad are few of the noteworthy examples of the historical wisdom in water management of this region. The 'Fort of Naldurga' in Sina Basin and the 'Treasure well' near Beed in Godavari Basin are fitting examples in the world of creating a perennial water source by diverting the river course and

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harnessing the rich sub-soil water respectively. The sculptures from caves of Ellora and Ajanta and other places also exhibit prosperity through affluence in water. The water supply to the moat of the hill-top fort of Deogiri through a twin earthen ware pipeline by rainwater harvesting over an adjoining hill by way of constructing a long masonry wall along the hill foot and collecting surface drainage in a collecting chamber could be cited as an example of an exemplary attainment in the field of rain water harvesting and pipe hydraulics. Water supply to the inhabitants through the underground channels running several kilometres by tapping the sub-soil water of the percolating strata underneath was really a marvel to be quoted as an example of skill in handling open channel hydraulics. The beauty of these underground channels, locally known as '*nahar*' is their 'zero maintenance' and 'zero control' style of working. Such network of underground channels could be evidenced at several historical places like Aurangabad, Tisgaon and so on. The purity of water was maintained by transporting water through underground conveyance system and linking water bodies with the religious and cultural tenets by constructing temples side by side. Each Fort acted as an ideal water conservation device. The hilltop forts like Deogiri and several others were made affluent in water by harvesting rainwater in tanks carved in rock. Such devices were named as Moti tanks, Moti means 'Pearl'; water as pure as a pearl was the respect they had inculcated for water.

What comes to the surface is that history of water in this region is far more spectacular than its social and political counterparts. There can be no hesitation in stating that the requisite technology of harnessing water and putting it to various uses exploiting local wisdom had been well developed with people's participation right from developing the requisite modalities to its day-to-day management. The rulers during the various dynasties had played a role of facilitator and promoter. It was people managed development and therefore it became sustainable. The height of engineering was, the people in groups had undertaken works of excavating underground tunnels both through soft and hard strata transferring water from one sub-basin to another by chiselling rock, taming the river by diverting its flow in a desired manner, seeking women's participation in water management, using water energy for driving water mills and making use of the fort moat as a safety device also and so numerous to mention.

The Marathwada - a region of stones and rocks - known for scanty rains and arid climate - the factors not conducive for agriculture ruled the vast territory by imparting sustainability in prosperity over centuries together through the exemplary wisdom in water management. During the later period of foreign invaders, the region saw a gross neglect towards this well developed skill in water harvesting and management. The role played by people managed system was taken over by the then rulers. The objective was not the welfare of the society. The sole intention had been to amass the revenue for their self-aggrandizement. This naturally led to the decline of wisdom in water management practices and thus the region is relegated to backwardness. On the strength of the foregoing, we can conclude that those societies which had maintained a harmony between water and the requirement of mankind at different times became not only successful but had also been in sustainable prosperity. Those who disregarded this strategy were fated to a sad failure. The paper elaborates various facets of the historical wisdom in water harvesting and management techniques in context of the case study and pinpoints the factors leading to prosperity and its decline subsequently.

15. Suzana M. Padua, Brazil (274)

Environmental education and sustainable development alternatives – key elements for the conservation of the Atibainha water reservoir in São Paulo State, Brazil.

One of the most important water reservoirs in Brazil, known as the Cantareira system, has millions of people and industries that depend on its quality and abundance for survival and for sustaining the largest gross internal product in Brazil. The Atibainha River reservoir is part of this system and for a number of historical and geographical reasons is still largely surrounded by the Atlantic Forest, which once dominated the landscape of most of the country's coastal region. Only 7% of this ecosystem has survived and its rich biodiversity makes it invaluable for conservation, but despite the beauty and natural importance of regions where there are remnants of Atlantic Forest, it has been a challenge to hold back the growing human impact pressures common everywhere.

In the case of the Atibainha reservoir, which is near the capital of São Paulo, one of the largest cities in the world, the situation is critical. The region's natural beauty has been attracting weekend houses and other development projects, all with serious consequences for local environments and social structures. These financial alternatives have seduced many impoverished landowners to sell their properties and leave the region or become employees on land that used to be theirs. Such new trends have caused serious deforestation and have begun to threaten the water quality of the reservoir considered the best in the state.

In order to seek viable solutions for these challenges, a group of environmental educators promoted, in February of 2000, a participatory forum with many segments from the local surrounding communities. During two days, people were able to identify and list local problems, potentials and dreams for the region and ways of getting there. In this process sustainable development and environmental education have become inseparable and both the benefits for local people and the protection of the natural environment are prioritised. The group of conservationists that helped promote the forum was in charge of organizing and offering a series of courses to respond to the expectations raised. The themes included ecotourism, organic agriculture, bee keeping, environmental education, handicrafts and regional cooking. This process of strongly linking environmental education to sustainable development practices to protect an important water reservoir through the involvement and empowerment of local people, will be described in more detail during the conference.

17. Anabel Sanchez, Mexico (183)

1944 Water Treaty between Mexico and the United States: Present Situation and Future Potential

The Treaty between Mexico and the United States for the Utilisation of Waters of the Colorado and Tijuana Rivers and of the Rio Grande signed in 1944 allocated water and created the International Boundary and Water Commission (IBWC). Actually water issues in this border have outgrown the jurisdiction of the IBWC. Since 1945 the population congregated along the 2,000 mile Mexico-United States border have quadrupled in size. Population growth has been accompanied by an upward trend in border industrialisation. Economic development has meant intensive patterns of water consumption. While the IBWC has continuous water allocation related support services, its contemporary agenda is occupied with urban support services and water quality problems.

For centuries rivers and wells had been the source of water in the border region. With the turn of the century, the growing urban centers along the Rio Grande, where the river becomes the international boundary, started increasingly to depend on groundwater. This situation was not specifically addressed in the 1944 Treaty even further opportunities for functional expansion outside current treaty authority are limited. Nevertheless transboundary groundwater had been addressed through the Minutes. Under Minute 242, signed in 1973, it is interesting to note that since 1973 despite some discussion, there has been little real progress toward such an agreement. The inherent tension between a management approach that is historically oriented toward the distribution of water resources along the border and emerging water problems have forced the Commission into a more visible and contentious regulatory role.

18. Philip V. Scarpino, USA (191)

Great Lakes Fisheries: International Response to Environmental Crisis, 1890s-1960s

Canada and the U.S. share sovereignty over the Great Lakes, which contain about one-fifth of the fresh water on earth. By the late nineteenth century, the Great Lakes attracted and stimulated industrialization and urbanization, which placed increasing, contradictory demands on the lakes to provide transportation, fisheries, a range of clean-water uses, and a sink for domestic and industrial wastes. Human demands on the lakes and clashes over their use and development were magnified within the confines of a large, interdependent, and essentially closed system. Precipitous decline of the fisheries provides a lens through which to examine the larger environmental history of the Great Lakes. This paper will focus on attempts to understand, control, and regulate the declining fisheries of the Great Lakes between the appointment of an international commission in 1893 and the passage of a Convention on Great Lakes Fisheries in 1954. In so doing, the paper will answer two key historical questions: (1) How and why do we account for fluctuations in populations of fish? (2) How and why do we account for fluctuations in attitudes towards those stocks of fish? Analysis of these questions sheds light on international attempts to regulate and control the largely unintended and unanticipated consequences of use and development of the lakes. The management and regulation of fisheries in bodies of water that straddle international borders is not unique to the Great Lakes; hence, the paper will contribute to a larger professional conversation about the environmental history and contemporary management of water resources that cross international boundaries.

19. Singh, Karori, India (281)

Water Resource Management in Sri Lanka Dynamics and Implications

Sri Lanka is a classic example of the "hydraulic civilization" which had developed in the ancient period. Such a civilization evolved around the Water Tank Systems in the Dry Zone of the island-nation. The Wet Zone was sparsely populated and covered by thick forests. The natural increase in population and growing demand for food made it imperative to expand the cultivable land through clearing the forest area over a period of time. When Europeans took over the island the Water Tank System was well developed and scientifically managed and, therefore, the island was self-sufficient in fulfilling the people's need during those days. Subsequently, the influx of people from neighbouring countries and natural increase in population has pressed the demand for cultivable land. British rulers evolved a systematic land development policy, which had adversely affected the traditional water resource management pattern. Moreover, the population density has shifted from Dry Zone to the Wet Zone during the colonial period. The colonial policy has substantially contributed to the "Centric Development" and food shortage in the island. The problems of poverty, unemployment and landlessness have increased during the latter phase of the Colonial rule and, therefore, the national independence movement was organized around issues of water resource utilization and irrigation systems. By realizing such a situation, the colonial rulers initiated several colonization and irrigation schemes. Such irrigation and colonization schemes remained very important component of the national development policy in the post-colonial period. However, the nature, scope and pattern of such schemes became a political issue in the electoral competition in the democratic polity. An ambitious plan has been devised and implemented for the diversion of major river system towards the Dry Zone since 1970's. This has become a major development project known as Mahaweli Development Scheme assisted by international funding agencies like World Bank and Asian Development Bank. It was aimed at solving the problems of poverty, unemployment and landlessness. The Paper, therefore, is an attempt to examine the dynamics and implications of the Mahaweli Development Scheme, which is the largest irrigation scheme ever, introduced in the history of the island-nation.

The Paper reveals that the dynamics of the implementation of the Scheme has reinforced diverse collective narratives and historical memories, which, in turn, strengthened the demand for separate "homeland" by Tamil stock of the population. It examines how the utilization of river water has contributed to the national development and social unrest in the form of worst kind of ethnic conflict in the World today. The Paper concludes that water resource utilization has substantially contributed to the reduction of poverty and unemployment. Simultaneously, it has also aggravated the divide of various kinds in the society. The analysis draws some important lessons for utilization of water resources in an old and plural society like that of Sri Lanka in other parts of the World.

Theme K:

Water and Civilization. Why History is Vital to Reframing Current Water Policy Debates.

The point with this session would be to reflect on how and why history is important to current water policy debates. The panel will include water policy practitioners with expertise in history of water and historians, and be led by the editor in chief of Water Policy, Jerome Delli Priscoli.

1. Barry Newell & Robert Wasson, Australia (148)

Social System vs Solar System: Why Policy Makers Need History.

In this paper we argue that, because the behaviour of coupled natural/social systems is history-dependent and difficult to predict, water policy development requires a systems approach with a strong experimental flavour.

Our discussion centres around a comparison of the dynamics of social and physical systems. Simple physical systems, such as the Solar System, can be regarded as equilibrium systems that can be modelled deterministically. They have few controlling variables and we can predict their behaviour reasonably accurately. Thus, the ancients could detect patterns in the movement of celestial bodies and so develop a useful knowledge of astronomy; and we can compute reliable tide tables and navigate spacecraft with precision and apparently without history.

We are, however, forced to manage our natural resources in a context where our ability to predict is strictly limited. The behaviour of coupled natural/social systems is controlled by a large number of variables, many of which are subject to random fluctuations. Furthermore, such systems typically are not in equilibrium. They are prone to positive feedback effects, where small perturbations can grow into major movements. As a result, their long-term behaviour and reaction to management intervention is history-dependent and cannot be modelled deterministically.

In our attempts to manage water resources, where system response to policy initiatives is characterised by long time-scales and uncertainty, we cannot ignore the "experiments" carried out by our predecessors. In such circumstances, our ability to construct effective policy depends critically on how well we can detect and interpret the signals from the past.

2. Katrina Proust, Australia (127)

Salinity: failure of New South Wales to learn from India

It can be argued that history has long had a role in policy formation in water resource management. In this paper I will outline how planners failed to include an historical perspective in the design and development of the Murrumbidgee Irrigation scheme in Australia. The Murrumbidgee Irrigation scheme was the first large-scale irrigation project in Australia. Located in southern New South Wales and opened in 1910, it was the largest government-funded undertaking of its kind in the world at that time. Under the influence of 'the practical engineers of the day', the scheme's designers were pre-occupied with water delivery. Little attention was paid to the important issue of how best to apply water for agricultural purposes. There was a serious lack of attention to the soils and hydrology. Within only a few years of the scheme's operation, rising water tables (leading to waterlogged soils and salinity) were threatening its viability as an agricultural enterprise. During the last quarter of the nineteenth century a number of British engineers came to the Australian colonies via the Indian Irrigation Department. They had worked on major irrigation works in Punjab and North-Western Provinces of Upper India where they gained experience in bringing water to a landscape long affected by salt. By 1880 a vast body of knowledge of the problems caused by irrigating salt-affected lands was available from the British experience in India. Nevertheless, this experience was not translated into practical scientific knowledge and applied in New South Wales.

Association

The association was founded at the "Water in History: Global Perspectives" conference at Aberystwyth, UK, in the summer of 1999. It became clear, at this conference, that there were a great many historians of water, or historians with an interest in water, or policy makers with an interest in history. These come from a wide range of academic disciplines and public and private institutions. It also became clear that this group could benefit greatly from the establishment of a network designed to provide a cross fertilisation of ideas and experience, which could illuminate the complex processes shaping water resource use, and reveal interrelated aspects or historical contingencies and precedents.

Water history touches upon and informs many areas, including economic business and political history, the history of science and medicine, history of technology, development, environmental sciences and geography. The history of water resource use can be a deeply political one. Conflicts over the control and use of water have ranged historically, and continue to range across local, institutional and international boundaries. The aims and ideologies of those directing the control of water resources are often complex and controversial. In recognition of this the IWHA seeks to provide a forum for the widest possible debate, free of political or institutional influence or control.

Membership:

It will not be possible to subscribe for IWHA Membership before the IWHA conference in Bergen, Norway, 10.-12. August 2001.

Click [here](#) for conference details.

Past events:

'Water in History' - A Global Perspective. A conference held in Aberystwyth, Wales during 1999 that gave birth to the IWHA. Click on the following links for [abstracts](#) and a [schedule](#) of the proceedings

Useful links:

**NASA-Conference 20-22 September 2001, Voss, Norway.
(Nordic Association of South Asian Research)**

<http://www.svf.uib.no/sfu/nasa>

Nature, Society and Water at the University of Bergen, Norway

<http://www.svf.uib.no/sfu/nsw/index.shtml>

Nile Basin Programme

<http://www.svf.uib.no/sfu/nile>

Water issues pages at SOAS, London University

<http://www.soas.ac.uk/geography/waterissues>

World Water Council's World Water Vision Project

<http://www.watervision.org>

History of water in the city of Rome

<http://jefferson.village.virginia.edu/waters>

Stefan Deconinck's water pages

<http://allserv.rug.be/~sdconinc/waternet>

Agricultural History Society

http://www.iastate.edu/~history_info/aghissoc.htm

US Bureau of Reclamation History Programme

<http://www.usbr.gov/history/>

Marc Reisner, 'Cadillac Desert'

<http://www.pbs.org/kteh/cadillacdesert/home.html>

Donald C. Jackson, 'Building the Ultimate Dam'

<http://www.lafayette.edu/~jacksond/ultdam.html>

Water Resources Center Archives, Berkeley

<http://www.lib.berkeley.edu/WRCA/>

African Water Pages

<http://www.africanwater.org/entry.htm>

World Commission on Dams

<http://www.dams.org>

'The Sea and the Cities' - history of water on the Baltic rim

<http://www.valt.helsinki.fi/staff/sklauril>