Theme 5:Sustainable water resources management

SUSTAINABLE DEVELOPMENT THROUGH GROUNDWATER MANAGEMENT: A CASE STUDY ON THE BARIND TRACT

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Abstract：The Barind Multi-purpose Development Project (BMDP), since its birth in 1985, has become a model of sustainable rural development project in Bangladesh. The project maintains technical soundness by ensuring a high level of water use efficiency and minimum well spacing. The project runs on full O&M cost recovery basis, which is achieved through an innovative pre-paid water coupon system and the associated command area development scheme. Coupons are sold through local retailers and corner shops (commission is paid on sales); on the other hand, extension officers earn bonus based on pre-set command area target and an incentive scheme. Its governance structure is democratic and participatory where farmers are involved through water user groups at the lowest level and local members of the parliament (MPs) govern the project at the highest level of decision making. The project has several environmental enhancement programs such as water conservation, homestead and social forestry, promotion of integrated pest control, and farmers' training. In addition, it has adopted an integrated planning approach that incorporates extending rural electrification, building rural infrastructure, and an array of other support programs. As a result, the BMDP has been able to emerge as a model of sustainable groundwater-based rural development initiative in Bangladesh.

This paper will review and analyze the activities and achievements of BMDP with special emphasis on technical, socio-economic, institutional and environmental sustainability, and share the findings with the global community interested in sustainable groundwater management and integrated rural development.

Keywords：Groundwater, command area development, water use efficiency, water pricing, cost recovery, environmental enhancements, stakeholder participation, sustainable development.

How many depressions in Changjiang River Basin and how important in attenuating floods and maintaining water resources

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Abstract: A spatial depression is hydrologically defined as any lower land that is circled or surrounded by higher topographical areas. Depressions deplete or store water generated in the depressions or coming from higher draining areas, and begin to release the stored water when reaching their storage thresholds. Therefore depressions include lakes, ponds, seasonal swamps or wetlands etc. This study is to develop a method of identifying depressions from digital elevation data for the Changjiang River Basin of China, and analyze how large a role they play in attenuating floods and maintaining surface water, two key issues of hazard reduction and water resources management.

Dynamic depressions are extracted from DEM and their dynamic flow paths are determined. Pit pixels and flat areas (neighboring pixels having same elevation) are first found from the original DEM as they are possibly the bottoms of depressions. Some pits or flat areas which cannot form a bowl or bottom of depression are identified and filled out in the DEM. Secondly, for each depression bottom, pixels draining hydrologically to the bottom are searched out and they formulate a draining catchment to the depression. Find the lowest point along the boundary line of the catchment, and those pixels lower than that point form a basic depression. A basic depression might be a separate and independent one, or might be a child depression that will be nested by a larger or mother depression. Thirdly, fill out the basic depressions and search for the larger depressions called order-two depressions. A higher order depression may nest some lower order depressions. The outlet of each depression where depressed water may flow out is determined, and connectivity of depressions is given. Then repeat above process until no higher order depression can be found out. This algorithm is a dynamic process giving information of dynamic depressions. It tells how many basic depressions will formulate in the region, at what critical water level a depression will drain water to another depression or to the streams, where the flow outlet locates, and how the depressions are nested together. The method's resolution is a single pixel.

After obtaining depression information of Changjiang basin, a supposed rainfall event and resulted runoff is applied to the basin to illustrate the performance of depressions in affecting hydrological process. Each depression would accept the runoff drained in and direct it out when the depression is full of water. The runoff volume held in depressions is calculated, reduction of flood volume caused by depressions is revealed, and storage features of major depressions such as big lakes are demonstrated.

Actual attenuation and storage of event flood and year-round runoffs can be simulated by incorporating the depression information into a distributed hydrology model, which will be studied further.

Risk management for the improved operation of the Three Gorges Dam using seasonal streamflow prediction

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Abstract: The Three Gorges Dam on the Yangtze (Changjiang) River is one of the world's largest reservoirs with a critical role in energy provision, flood control, irrigation, navigation and water quality management in China. The proposed South-North Water Transfer Systems further enhance the national role played by this dam and by other upper Yangtze dams in China's economy. Given the dramatic inter-annual variability in the monsoonal climate of the region, a multi-scale strategy for the reliable multi-objective operation of the system is needed. Current operating rules for the system are based on a traditional seasonal storage allocation strategy with monthly, seasonal and end of year storage targets, i.e., rule curve operation. Given the complexity of the system and the need to manage and respond to flood events as well as schedule storage for droughts, this is a reasonable and practical strategy.

As data collection and modeling efforts have enabled real time flood forecasts and seasonal inflow forecasts, a natural question that arises is whether a more proactive reservoir management strategy is feasible. The key issues involved with this transition, including potential physical and social/policy constraints, objectives and opportunities and the adequacy of available tools is first reviewed. Based on this review, we explore whether reliable seasonal inflow forecasts can be developed and used for the Three Gorges system.

First we demonstrate that climate informed, probabilistic streamflow forecasts, at the Yichang hydrological station are feasible for the summer monsoon through modeling and analysis of the historical record. Cross-validated statistical forecast models using a suite of Sea Surface Temperature and Atmospheric data demonstrate significant forecast skill (forecast to observed correlation >0.7) at 3 month lead times. Prospects for extending and improving this method to year round forecasts of inflow disaggregated to monthly time steps and including time series information from the streamflow series are discussed. The resulting forecasts could be presented as either conditional probability distributions or as ensembles over a one year time span.

Next, we use reservoir systems simulation to develop a sensitivity analysis of how the multiple objectives of reservoir operation respond to incremental changes in the storage allocation rules, over average, dry and wet years, and with respect to the storage in the reservoir at the beginning of the period. This sensitivity analysis is then used together with the forecast skill information to assess the periods /conditions during which it is most desirable to modify reservoir operating rules given a probabilistic forecast of the remaining period. Simulations that implement the new/proposed operating rules using the forecasts we developed are then implemented and the potential gains for different aspects of reservoir use are demonstrated. The potential for a formal optimization strategy is also discussed.

Keywords: Climate indices, streamflow prediction, risk management, Three Gorges Dam, Yangtze (Changjiang) River

IMPACT OF TSUNAMI ON COASTAL PLANNING AND MANAGEMENT

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Introduction

According to the United Nations more than one third of the world's urbanised areas are on or near the coastal area. Some large cities are also located. There is unsustainable pattern of development making the coastal area more vulnerable to natural disaster – Townplanning and building regulations are often violated. There is also absence of preventive measures including early warning system and disaster mitigation programme. As a result the impact of killer Tsunami of December 26, 2004 on the Indian Ocean due to submarine earthquake was severe with great loss of life and property on the coastal area.

Asian Coast

Asia has a long coastline with conflicting landuses. A part of the coast is at sea level or just above it, has mangrove forests and fragile ecosystem, ports and harbours, tourist towns and non-urbanised areas. The land cover is contantly changing due to encroachment, soil erosion, shifting of deltic river etc. Many of the coastal areas are vulnerable to natural disaster. Many areas have unique marine life. Deforestation, pollution, loss of biodiversity and ecological degradation are problems in the coast.

Impact of Tsunami

The disaster due to Tsunami on the people, property Government and organisations was great and an awareness for new scientific coastal planning and management, disaster mitigation measures education and training etc. has been focused. There are adhoc measures which are an early warning system, developing safe zone, with regulated building and townplaning, building walls, hills and safety structures, developing drainage system, Education and training including the culture of prevention infrastructure development and strengthening of local government.

Rehabilitation

Rehabilitation of people in new shelters is still on the progress. But affected people have objected to alternative land and this has created problem in enforcing control on land use especially in sensitive area between high and lowtide lines, and special areas and islands. Besides capacity building education, training public participation in rehabilitation is essential. There is loss of biodiversity with damage to marine life and vegetation. The rehabilitation of these and restoration in the continental shelf is difficult though development control has been enforced in many areas.

Integrated Coastal Planning

An integrated and holistic coastal planning and management is emphasized. Conservation, environment and development are key objectives with balances between people and nature, between positive and negative actions, between economic development and cultural values and between conservation of natural values and between conservation of natural resources and development of human activities.

REGIONAL WATER RESOURCE PLAN
The Environment Option

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Introduction

The 21st Century will be an urban century and Asia will be a continent of megacities. According to the United Nations, by 2015 AD. there will be 70 cities each with 5 million or more population of which 90 will be in Asia. Rapid urbanisation has destabilised water balance and caused scarcity resulting poor access to water and sanitation. Both quality and quantity of water are diminishing with increasing pollution, depleting ground water resource, filling up of water bodies for unsustainable urban development, mismanagement in the use and distribution of water etc. are some reasons affecting water resources. Water is still a sectoral issue in many cities and there is no regional perspective. The UN Agenda 21 called for integrated approach to development, management and use of water resources. An integrated water resource management is being advocated with environment opion.

Broader issue of water management

Water management is a broader issue with integration of hydrological and ecological cycles. It concerns with resources, supply, demand, distribution and disposal issues. Watershed or catchment area covers large area, often with multiple local government units, both urban and rural. Coordination in plan and projects is complex due to administrative reasons and also due to absence of mechanism about interaction against different sectors of development. In many megacities these is wide gap between planned development and unplanned urban sprwal.

A concept of regional deelopment based on dam and reservoir was initiated many years ago. On the model of Tennese valley Authority (TVA), USA, Damoder Valley Corporation (DVC) was set up in eastern India. Regional planning was introduced but not properly implemented. A river basin is united by water in rivers, canals, marshes, and wetlands, flood planis aquifer and recharge areas, which are the coordinated with agriculture, forestry, human settlements, biodivesity, infrastructure etc. A regional area is affected by a number of economic, environmental and socio economic factors, Education, training and capacity building and participatory development are now part of such regional planning process.

Regional Environment Plan

Conventional landuse planning with socio economic analysis for regional planning has limitation due to wideranging environmental and ecological issues. An environmental audit can be carried out for a region. Modern techniques of geographical information system (GIS), new scientific concept of ecohydrology for restoration of degradated environment etc. can be tool. The over-all objective may be based on conservation, environment and development. Environmental parameters can be defined for such regional planning.

Perpetual water table drop and rapidly expanding urbanization in Dhaka city, Bangladesh: potential threats for future groundwater management

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Abstract: Being one of the largest mega cities of the world, Dhaka is facing continuing potable water-related problems for varies reasons. About 12.5 million people representing about 35% of the total urban population of the country live the capital city. The disproportionate rise in the urban population created tremendous pressure on existing infrastructure and urban services including water supply, sanitation, sewerage and drainage systems. For drinking, industrial and commercial purposes the city depends on the groundwater supply since the surface water sources are greatly polluted. Presently, Dhaka water supply authority (WASA) is producing about 1160.21 Ml/day water supply from about 389 deep tube wells (DTW). About 85% of the municipal water supply for the domestic use comes from groundwaters of the city. The surface water treatment plants provide only 3-5% water supply to the city. The metropolises are occupied by the Pleistocene terraces, mostly composed of the Madhupur clay deposits overlain by the Dupi Tila sand formation, which hosts the major groundwater aquifers. Study shows that the city's groundwater level has dropped about 20 meters over the last six years. It is recoded that the drop in water level drastically increased in the late 80's. Data also suggest that in 1990 the depth to the water table in the peri-urban areas was about 4 meters and in the central region it was about 15 meters. However, in 2002, the water level in the city center was about 50 meters below mean sea level. High groundwater abstractions from aquifers and decrease in substantial recharge due to rapid urbanization including construction of roads, buildings, and other engineering structures, flood protection embankments are the main causes for groundwater level drop. Disappearances of many lakes, canals, and small rivers in and around the city also depreciated groundwater recharge. Subsidence may take place in central parts of city because of water table dropping coupled with earthquake since Dhaka city is located within a very high risk zone for earthquake. This is critical to take decision on sustainable development and management of Dhaka city groundwater now. Both hydrogeological and engineering solutions should be requiring with proper understanding of regional groundwater and surface water conditions. The urban groundwater use should be reduced and abstraction of groundwater from the central part of the city should be limited to a tolerable amount that sustains safe groundwater withdrawal. Groundwater can also be abstracted from peripheral regions of the city for a time being and for the long-term solution groundwater development in the peri-urban areas by establishing groundwater well-fields are suggested. Surface water can be used the rainy period when river water is fairly low in pollutants, and groundwater can be used during the dry period since it is expected that groundwater would be replenished by monsoon rainwater and seepages from neighboring river channels during the previous rainy seasons. However, it is fortunate that groundwater of Dhaka is largely free of arsenic poisoning. So groundwater development and management in Dhaka city should involve proper planning specially emphasizing on detailed hydrogeological investigations.

Water Right for Pollution Abatement in Developing Countries :lessons; challenges; Opportunities and Options

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When we talk about water right we mean right to: 1- Pollution abatement.
2- Maintenance and enhancement of fish and aquatic plants in the water body.
Also, when we talk about developing countries we take in mind the problems of these countries. This will take us to know knowledge of the main problem water pollution. Water pollution is responsible for the death of some 25 million peoples each year and cause destroy of aquatic environment. The world Bank estimated that 65% of the rural population in developing countries was without access to safe water and over 4 million peoples die each year for water related diseases caused by water pollution.

Main sources of water pollution in developing countries?
1-Industrial effluents to watercourse. 2- Agricultural run-offs including fertilizer and pesticides. 3- Domestic wastewater from houses that represent the main source of pollution in these countries. 4- Mining activities near the watercourse 5- Atmospheric input to the water body.

Challenges for water pollution abatement in developing countries:
1-Deterioration of quality of existing water resources from pollution caused by domestic and industrial wastes. 2-The high cost of wastewater treatment technologies. 3-Quantifing acute and chronic effect. 4- Pollution monitoring. 5- Method to avoid damage to the aquatic system.
6- Water piped into our homes, town and cities must be purified before it is fit our use.

Factors influencing human exposure to water pollution:
1-Some chemical destroy aquatic life. 2-Influence human food chain, fish and plants.
3-Drinking and recreational water guideline. 4-Pollution control methods.

Impact on health:- Polluted water causes several diseases in developing countries. Arsenic poison from groundwater in Bangladesh, Chronic cadmium poisoning, Itai Itai and others.

What is the simplest method for detection of water pollution?
Biomarkers is the most common method for detection of both organic and heavy metals in aquatic environment and this including fish and aquatic plants.

Lessons of Experience:
1-Arsenic in Bangladesh where tube wells were introduced as a safe water source.
2-Water pollution abatements in rivers from South Africa.

Lesson from Egypt.
Nile River represents the main source of water in Egypt in which represents 97% of the country's fresh water. Since several years and this river suffered from pollution which affected water, fish, aquatic plants and cultivated crops at the Nile shores. The main sources of this pollution come from domestic and industrial effluents which are untreated and discharged to the river. These effluents contain heavy metals, hormone-like substances, endocrine and organic pollutants. Several laws has been issued for protection of Nile water, but the last law 4/1994 , for the protection of environment in Egypt, was the most effective one. After issued this law and till now the pollution was minimized in the Nile. I will focus in some researches concerning water pollution in river Nile before and after issued the law 4/1994 including water, sediment, aquatic plants, fish and plants cultivated with Nile water. Also, the Egyptian experience to remain the High Dam Lake far from pollution will be discussed.

Removal of toxic and noxious compounds from water and wastewater by catalysed photodegradation and electrochemical degradation

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Abstract: With increasing pressures on water resources, the concept of beneficial use of treated wastewater has rapidly become an imperative for water agencies around the world. Water and wastewater recycling and reuse has increasingly been integrated in the planning and development in Mediterranean region, particularly for agriculture and land scope irrigation, help protect public health, increase water availability, prevent coastal pollution and enhance water resources and nature conservation policies. Advanced oxidation processes (AOPs) are considered to be promising in the abatement of the growing environmental problems resulted toxic compounds. One of these processes applied successfully in this research was catalyzed TiO2 photochemical degradation techniques. The techniques include three methods:- 1-Catalysed TiO2 photodegradation assisted by using light source UV just on sample. 2-Catalysed TiO2 photodegradation by using immerged light source UV and eventually assisted by microwaves. 3-Catalysed TiO2 photodegradation using weathering tester of sun light. The other technique used successfully for the removal of toxic organic compounds was electrochemical degradation technique. Toxic organic compounds degraded in this research work include pesticides (*Terbutaylazin and Dimethoate*), dyes (Alizarin Red S Acid blue 29 and Reactive blue 2) and pharmaceutical (Betadine and Clofibric acid). The results reveal good degradation of the studied organic compounds depending in time (best results 90-100% degradation was given for dyes and pharmaceuticals) . Also, the previous discussed techniques were applied for degradation of Nile river water from Egypt and Tevere and Aneine Rivers water from Italy. Degradation of the rivers water appears to be in low rate as the result of the complex structure of the toxic organic compound presented in water. Toxicity test for the resulted degradation of pesticides, dyes and pharmaceutical gave pest results than UV spectra measurement. The laboratory results ends in a good comparison between these techniques for degradation of toxic organic pollutants in wastewater and polluted water and suitability of the resulted water for agricultural uses. The studied wastewater treatment technologies provide low cost technologies and environmental protection while providing additional benefits from the reuse of water.

Keywords: Wastewater, toxic compounds, photodegradation, catalysis, treatment, reuse, electrodegradation

Biomarkers As Indicator For Water Pollution With Metals In Rivers, Seas And Oceans

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Abstract: Water is one of our most important natural resources, and there are many conflicting demands upon it. Skilful management of our water bodies is required if they are to be used for such diverse purpose as domestic and industrial supply, crop irrigation, transport, recreation , sport and commercial fisheries, power generation and waste disposal. So, it needs no probability to state that water constitutes one of the most essentials for life existence , and enough has been said about the role of water in the various biological processes sustaining life.
The aquatic environment with its water quality is considered the main factor controlling the state of health and disease in both man and animal. Nowadays, the increasing use of the waste chemical and agricultural drainage systems represents the most dangerous chemical pollution . Water pollution is most commonly associated with the discharge of effluents from sewers or sewage treatment plants, drains and factories to the water body of rivers , seas and marines. In the attempt to define and measure the presence and effects of pollutants epically the metals in rivers and oceans, the biological markers have attracted a great deal of interest . The principle behind the biomarker approach is the analysis of an organism metal content and compared the metal concentration with the background metal levels. In this review ,the data were collected from different literatures around the world in using the aquatic organisms as biological indicator for metal pollution in aquatic system .

Keywords: water pollution; biomarkers; heavy metals; hydrology; oceans; environment; fish.

Water Resources and Sustainable Development: Factors and Constraints for Improving Human Well-being in Water-stressed Regions[1]

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Keywords: Integrated water resource management, Sustainable development, Water governance, Ecosystem approach, Water quantity and quality

Abstract

Water is a crucial natural resource for the sustainable development of world societies. The growing demand of water resources (caused by population and economic growth) and climatic conditions are driving to an increasing water scarcity as well as to the degradation of their quality, which has an acute relevance especially in water stressed regions. In arid and semi-arid regions, the management of surface and groundwater resources creates significant challenges for the development of local populations.

[1] This paper presents some results achieved in the frame of three research projects funded by the European commission: Management policies for priority water pollutants and their effects on foods and human health: general methodology and application to Chinese river basins –MANPORIVER (ICA4-CT-2001-10039); Sustainable management of scarce resources in the coastal Zone – SMART (ICA3-CT-2002-10096); Network on governance, science and technology for sustainable water resource management in the Mediterranean. The role of DSS tools – NOSTRUM (INCO-CT-2004-509158).

Impacts on both global warming and human activities in the Yellow River basin

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Abstract: The Yellow River basin is located in the eastern part of Eurasian Continent and flows down almost semi-arid climate region. Concerning long-term climate change from 1960 to 2000, air temperature seems to have increased from 1990s and precipitation amount seems to have decreased from 1980s. More great changes in the river discharge, however, seem to have occurred from 1970s by mainly irrigation intake in large irrigation districts. The effects have come out to the environment of Bo-Hai Sea and river bed rise in the lower reaches of the Yellow River. How could succeed both effective water use and the decrease of sediment yield in Loess Plateau are concluded as key issues on its conservation.

Price Elasticity of Agricultural Water Demand in China

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Abstract: To strengthen water demand management and control water demand is the important measure to realize the sustainable development and utilization of water resources and its high efficiency allocation. Based on the price lever of market economy, the increase of water price can reduce the water demand and enhance the efficiency of water use. However, in China, there is no quantitative analysis between water demand and water price, especially in the agriculture water demand.

On the basis of the theory of economics, starting with the study on price elasticity of agricultural water demand, the effects of water price on the agricultural water demand were analyzed and quantitative interrelations between the two were determined. By applying the methodology of econometrics, price elasticity of the water demand was derived through construction of agricultural water demand function for various irrigation schemes in Yellow river basin, and furthermore, price elasticity function of agricultural water demand was derived. In the process of model calculation and parameter estimation, the analysis software pack of econometrics (Eviews) was used because the core of methodology of econometrics are model design, information collection, model estimation, model test, model operation etc. With the function and model, the quantitative relations between the agricultural water demand and water price are predicted for each province in the Yellow river basin.

Discussion of Results/ Findings: The study indicates that distinct correlation can be found between water price and water demand, and water price and price elasticity as well. The price elasticity is -0.131, -0.372, -0.565 and -0.716 in Yinhuang irrigation scheme in Ningxia, Renminshengliqu irrigation scheme in Henan, Baojixia irrigation scheme in Shanxi and Donglei irrigation scheme in Shanxi, under the condition of water prices of 0.57 fen, 1.40 fen, 13.17 fen and 34.45 fen respectively, and the price elasticity function of water demand is expressed ad $E=-0.85-0.13\ln P$. A quantitative analysis was made for agricultural water demand in Yellow river basin by applying the achievements in the study. In the late 1990s, the costs of water supplies were usually recovered by the charges fro the agricultural water uses up to 30~65%, 58% on the average, and the agricultural water demand was 36.363 km^3 in Yellow river basin. In case that water price rises to recover the cost of water supply up to 70%, 80% or 100%, the agricultural water demand may decrease to 32.698 km^3, 30.738 km^3 or 27.591km^3, by 10%, 15% or 24% respectively. Therefore, rising of water price may reduce the agriculture water demand in the river basin obviously.

The results of model shows that there exits obvious interrelations between water price and water demand. Various statistical test methods and studies in foreign counties also testify the truth of agricultural water demand function and price elasticity of the water demand. So it can be applied in water demand management, rational water resources allocation, unite regulation and development and utilization of water resources.

The applied results of agricultural water demand function model presents that the adjustment

of water price can effective restrain the water demand. According to the different conditions of water resources development and utilization and water price, rising of water use efficiency can be achieved by adjust the water price properly to alleviate the contradiction of water demand and supply. Therefore, under the condition of the short water resources and low water price of China, every region should make full use of the level role of water price to promote high efficiency use and sustainable development and utilization of water resources.

Keywords: Yellow river basin; Agricultural water demand; Demand function; Water Price; Price elasticity

Biography:

Yuansheng Pei is a professor working in the China Institute of Water Resources & Hydropower Research (IWHR). He had ever been as a visiting scholar the University of Texas at Austin, U.S.A. in early 1990s, and now he is working as a member of united management of water and soil resources of International Commission on Irrigation and Drainage, and also as a member of Engineer and Technology Community of National Water-saving Research Center. He specializes in water recycle model, water resources rational allocation and efficiency water use in basins and regions, and other related studied fields such as economic assessment, ecology and water environment protection.

Evaluating and Application of Fuzzy pattern Recognition for water Resource Sustainable Using System

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Abstract: The theories and approaches about quantitative assessment of sustainable development system are rare at present. Sustainable development system is a fuzzy concept. Fuzzy pattern recognition model can be applied to evaluate many sustainable development systems, such as social economics, ecological environment, resource and energy etc. This paper elaborate fuzzy pattern Recognition model, applies it to evaluate the degree of water resource sustainable development in Ping Ba Area , Han Zhong Basin. The theory is strict. The model is feasible and resonable. The solution is simple.
Keywords: fuzzy pattern recognition sustainable development system

Rainwater Utilization in Urban Area

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Abstract: In the 21st century, water resources has become the main problem of the world, especially in the growing cities of developing countries, water for drinking and irrigation is becoming more and more scarce. While at the same time, cities are more liable to suffering from urban flooding for development and people's cluster. In order to promote sustainable development of water resources and mitigate both urban flooding and water shortage in the cities, it is essential to promote the use of rainwater. Through the use of natural landforms or artificial means to capture and store rainwater derived from the hydrological cycle, the collected rainwater may be used for adding underground water resources, as an alternative supplementary water source for industry and households, or for fire fighting purposes, or to reduce the urban flood peak. The utilization of rainwater has become an important part of urban water resources management.

In order to make the most of rainwater and mitigate water crisis, the ways that rainwater can be utilized should be studied. Basing on the analysis of feasibility and necessary, the structure and non-structure measures and management experience of home and overseas on urban rainwater utilization have been presented in this article. The problems and trend in future urban rainwater utilization development are also been presented. At the same time, it can be concluded from the social and environmental benefit that the utilization of urban rainwater is the embodiment of Ecological Hydraulic Engineering and realizing the harmonious relationship between people with nature.

Keywords: water resources; cities; rainwater utilization; ecological hydraulic engineering

Study on Water Resources Management of the Yellow River Watershed Based on Compensative Regulation Theory

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Abstract: Water resources management must be involved in water resources system itself, and that water resources system is a complex large system about economy sub-system, social sub-system and environment sub-system. Due to water shortage, there is being competition during the three sub-systems. In this paper the largest river basin in northwest of P. R. China-the Yellow River watershed is made as study case. Based on the thought of whole watershed cascades compensative regulation calculation, compensative regulation simulation model of water resources management of the Yellow River basin was established. From the viewpoint of sustainable development, water conflict among three sub-systems was resolved furthest. Aiming at three sub-systems, the objective functions included three too: water resources using, flood control and eco-object, the nodes were plotted and simulation principle was confirmed. Considered multi-year storage reservoir-Long Yang-xia reservoir losing its benefits in order to achieve the whole watershed integrated benefits maximum, that is considered watershed integrated management, three arrangements were made to solve the simulation model: the first is "Long Yang-xia and Liu Jia-xia reservoirs both participating in regulation", the second is "Only Liu Jia-xia reservoir participating in regulation" and the third is "Neither of Long Yang-xia and Liu Jia-xia reservoirs participating in regulation". It makes three sub-systems harmony order development, and makes water resources system of the Yellow River basin sustainable development at last.
Keywords: water resources management, the Yellow River Basin, compensative regulation

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Application of Irrigation Theory in Water Quantity allotment in Yellow River Lower Reach

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Abstract: The Yellow River water resources allotting adopts the method of ten-day order form in month plan on the base of the annual allotment of suppliable water of the Yellow River and the preplan of water quantity allotting in the mainstream of non-flood season promulgated by Water Resources Ministry. In order to realize the correct allotting of the Yellow River water quantity, ten-day order form in month should be forecasted. The revised Penman formula is taken to calculate the requiring water of typical crops. The real-time forecasting theory is taken and the requiring water quantity of crops under the real weather of real time is calculated through computer. Irrigation system of main crops is established in irrigation area based on the sufficient-irrigating theory and non-sufficient-irrigating theory under the existing planting structure of the irrigation area. The water-requiring forecasting model will be set up and water quantity will be ascertained at the sluice of the irrigation area to give technique support to water quantity allotment.

Study on Reasonable Allocation of Multi-water resources for Multi-user in Dalian city

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Abstract: The shortage of water resources has badly influenced the development of city and the basic life of residents, and it will become the important factor to obstruct the economy and the sustainable development of society. Dalian is a city, which very short of water resources. The fresh water is innate scarce, and the distribution of water resources is uneven. In this paper, the characteristics of Multi-water resources in Dalian are analyzed. Meanwhile, from the point of view of systems analysis, the theory of water resources reasonable allocation has been discussed and researched, and a system allocation structure and a model about urban Multi-water resources for Multi-user have been built. This model has been applied to the allocation of supply-demand of water predicted in the south of Jinzhou in 2010, so the Multi-water resources (ground water, surface water, rain water, diverting water from external region, reuse water, seawater and so on) in the district were reasonably allocated among Multi-user (domestic, industry, agriculture and ecology environment). In this way, the demand for fresh water will be less in city; at the same time, the sewage from city will be reduced. So it is important that the Multi-water resources are reasonably allocated among Multi-user to enhance utilization efficiency of water, improve the urban water environment and promote the harmony development of economy, society and environment in city.

Keywords: reasonable allocation; Multi-water resources; sustainability; Dalian

Study of the hierarchical strategies and management for ecological water demand in arid inland river basins in northwest China

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Abstract: Given the increasing threat of water shortages in the arid inland river basins in northwest China, Water resources are not only valuable natural resource, but also an important environmental factor due to the low precipitation and the dry climate. Ecosystem is strongly depends on water resources. Human impact on the water supply will certainly cause a chain reaction within the ecosystem. Especially in recent decades, with the increased intensity of human activities and overuse or misuse of water resources caused a series of environmental problems. The wetland area has varnished in great quantity, the natural vegetations have fully degenerated, the land salinization has become intensified, coverage percentage of land has reduced, desertification has aggravated. These problems were important factors to affected ecosystem safety and sustained development in the arid inland river basins in northwest China. Environmental degradation has become the research focus of many scholars in recent decades. Therefore, it is very necessary to understanding deeply the ecosystem system for the social economic system, reasonable make sure that the dry inland river area ecosystem uses the water, the quantity slices the solid guarantee also, is important link that resolves the northwest and dry inland river area ecosystem environment to worsen the problem. Take an example for Shi Yang River, this paper analyzed ecosystem hierarchical structure which was drove by water moisture conditions in the lower reach of the dry inland river region, and bring forward the hierarchical strategies and the management way, Based on this, the paper studied the hierarchical strategies and management problem of water demand by the eco-environment of Minqin oasis in the lower reach of Shi Yang River.

Keywords: Arid inland river basins; Hierarchical structure of ecosystem; Ecological water usage; Hierarchical strategies and management.

A macroscopically management strategy: a study on industrial structure of water-saving society

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Abstract: At present, the water resource has already become the key factor of restricting social sustainable development seriously. It has been a basic task to seek science effective way and method alleviating water crisis, and it is an urgent situation must be faced in the new historical current time. Based on research of the current situation of present development and utilization of water resources in our country, the thesis has analyzed the feasibility and possibility of two major ways --increasing income and reducing expenditure to solve water crisis, and put forward that it is the long result mechanism of ensuring sustainable development of social economy to set up the water-saving society. Considering the regional distribution characteristic of the water resource, the paper puts forward that to set up the layout and framework of water-saving industry in our country has been becoming one of the most important basic ways to solve water resource crisis at present and in future. From two respects of quality and quantity in attribute inside of the water resource, the paper has analyzed and explained the intension of water saving deeply, and proposed the criterion of a water-saving industry. For the object of water resources management to control the gross and quota of water use, this text analyses the effects of water use and sewage discharge of national economic sectors using the national economic statistical data in 2000, to give scientific advices for making decision. The paper makes integrated environmental and economic accounting on the national economic sectors' water use, analyzes the whole cost of water use of national economic sectors in an all-round way, and sets up an input-occupancy-output table reflecting the effect of water use of national economic sectors entirely. (1)In quantity, it is analyzed that the contribution to the water resource reduction owing to national economic sectors' water use. The paper has calculated the subtractive cost of water resource reduction created by an unit value-added production; (2) From water quality, the paper analyzes the effects of water resources demote or water environment degradation because of sewage discharge of national economic industry departments, and calculates the cost of water resources degradation resulted in an unit value-added production; (3) The paper makes a comprehensive evaluation of the impacts and contribution on water resource per unit value-added production of each national economic industry department, and identifies the nature of industry's department water use; (4) Considering the regional characteristic of water resource, the paper proposes some adjustment measurements of industrial structure arrangement of the water-saving society building and the strategy of rational allocation of water resources through virtual water transfer.

Keywords: sector, water saving, water resources reduction, water resources degradation, accounting

Joint Optimal Operation of Municipal Water Supply

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Abstract: Based on principle and method of systems science, the multi-objective joint optimal operation model for municipal water supply is established. The structure of multi-objective model is investigated and the method for solving multi-objective model is proposed. The optimal operation of water supply for Xi'an city is analyzed and computed as a cased study. This paper evaluates water supply level for Xian city by water-supply guaranteed rate and shortage index , by means of joint operations among reservoirs and operation without reservoir. The results show that present water consumption can not be met without reservoir operation in Xi'an city, and mean annual surplus water is 200 million m^3 when joint operating among three reservoirs in 2030, which prove that water resource developing is still of potential.

A Study of Inter-plant Economical Operation of a cascade Hydropower System in electricity Market

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Abstract: With the development of China's market economy, hydropower will enter the arena of bidding for connection to the grid in the light of "fair, impartial and open" principles. The paper sets up mathematical models of total minimum stored energy consumption and total minimum water consumption for the cascade hydropower system to provide a solution to the problem of rational distribution of next-day generating schedule in a cascade hydropower system awarded a contract in the bidding for connection to the grid. A case study is conducted to verify the rationality of the model, and its application scope is analyzed briefly.

Keywords: short-term economical operation, cascade hydropower plant, inter-plant economical operation

Primary analysis on Integrated Yellow River Water Regulation in Recent Years

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Abstract: Since the 1970s, with society and economy development in areas along the Yellow River, the contradict between water supply and demand in the Yellow River basin is outstanding day after day; drying up frequently occurs in the lower Yellow River; the ecological system and sustainable development of the Yellow River basin is seriously threatened. In order to alleviate the contradict between Yellow River water supply and demand and the drying up in the lower Yellow River, The central government authorizes Yellow River Conservancy Commission(YRCC) to implement integrated Yellow River water resources management and regulation. Since then, under the condition of Yellow River basin is dry and poor in precipitation in continuous years and coming water keeps relatively poor, YRCC explore and innovate to have realized no drying up in the Yellow River in continuous 5 years, maximally brought comprehensive benefits of Yellow River water resources into play, achieved outstanding economic, society and ecological benefits, and prompted a harmonious relation between human being and rivers, with the support and cooperation of provinces and hydraulic multi-purpose organizations along the Yellow River, relying on administrative, engineering, scientific and technological, legal and economic measures, and through effective instruments, careful organization and scientific regulation.

Healthy life of river network system and integrated management of water resource in the Pearl River delta

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Abstract: In the Pearl River delta, the land area accounts for 0.43 percent of china, and 3 percent population of china live in the region and they produce about 9.3 percent GDP of china. With population growing, economic activity increasing and standards of living improving, the problem of increased competition for and conflicts over the limited water resource is more and more important. The paper studies the natural characteristics of river system and the main problems on water resource utilizes by analyzing investigation data , remote sensing data and mathematical model data. based on this, The paper discusses the problem of integrated management of water resource to keep healthy life of river network system.

Main conclusions are as follows:1) the system of river network is one of the important natural factors which affect the water problem of the Pearl River delta. on the other hand, utilize mode of water resource can affect healthy life of river system. The natural characteristics of river system must be taken into account while people utilize water resource. There are two kinds of river network patterns, which are tidal pattern and fluvial pattern in the Pearl River delta. they have different evolutional rules, dynamical characteristics and exploitation values.2) The special economy and society system of the Pearl River delta affects the relation of supply and demand, quantity and quality of water. water problems of the Pearl River delta include flood protection, saltine water intrusion, pollution of water, scarcity of freshwater. 3) In order to keep healthy life of river and sustainable development of economy, integrated utilize and manage of water resource are more and more important, which are based on both natural system and human system. The basic idea is that human and nature live harmoniously. 4) integrated management of water resource comes true by means of legislation, economics, administration. integrated management of water resource include: integration of water supply and drainage, integration of freshwater management and coastal zone management, integration of quality and quantity, integration of water resource policy and economic policy, and so on.

A Study on Short-term Optimization Operation of Hydroelectric Station Group of Huangbo River

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Abstract: The reservoir group of Huangbo River is a complex system including purpose of water supply, irrigation and power generation. Under the premise of meeting the need for water supply and irrigation, an optimization operation model using DDDP method is introduced to get the maximum benefit of system's power generation. According to the characters and priorities of the three objects, and considering on the load characteristics of electric power system, the available water is reallocated by period. The result shows that the model can obviously increase the power generation benefit, while the three objects are coordinated.

Keywords: hydroelectric station group, short-term scheduling, power generation operation; multipurpose utility

Integrated Ranking of Inter-basin Water Transfers from Large Karun Basin in Iran (by Fuzzy Decision Making)

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Abstract: Iran is an arid and semi-arid country. By the year, 2025 Iran will fall in the category of countries with critical water scarcity. The uneven distribution of water and growth of population have led to the present water shortages in major parts of the country. Especially central zone and southeast parts of Iran is considered as arid regions suffering from water shortages. The Large Karun (Karun and Dez) has the largest water potential among the rivers in Iran. These rivers annually spill about 20 to 25 billion cubic meters to Persian Gulf. Since the center and Southeast of the country is facing with high water shortage, one of the ways to solve the water crisis is to transfer water from the above basins. However, it is needed to consider, the technical, environmental and social implications in Inter-basin water transfers, in addition to economics to receive sustainability. In order to achieve this, a hierarchy of criteria has been constructed the after public participation in several sessions. Some of the criteria are vague and uncertain. By merging fuzzy theory and multi-attribute decision-making (TOPSIS) in FDM software (Fuzzy Decision Making) a useful DSS has been made. Now this DSS supports the decisions of Water Management Company in ranking inter-basin water transfers.

Need of ecological balance for Sustainable water resources development in south Asia

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Abstract: The aim of people, everywhere, is to create a healthy generation to maintain a high level of working productivity and, thereby, increasing their Standards of living to the highest possible line. According to the Law of nature, the realization of these aims should be the same but practically it does not seem the same in each country. The interaction between the human race and nature, in which changes are always taking place under the influence of the human being, accelerates the introduction of new technologies. With the intensive development of science and technology in the highly developed countries, the biosphere became contaminated and, consequently, the people's surrounding environment also. In exploiting available natural resources and in the creation of new commodities in the production process, people are searching more and more deeply into the sources of nature as they are bringing the new process to a commercial level for their unlimited satisfaction. Besides, the extension of communication and technological exchange rapidly taking place now between the countries is changing the balance between society and natural environment of the area in which it lives. All these as the result of disproportional ecological balance of nature have been appearing as a cause of ***ecological crisis*** by means of ***ecological war***, especially in the least developing countries including Nepal. In this way, the ecological changes, which take place rapidly year by year, are caused by the rough/wild intervention in nature due to unlimited satisfaction of some unconscious people with irrational utilization of the natural (water) resources of this region. It has been irreversibly affecting to living being of Nepal but also of the south Asian countries. The limited cultivable land cannot be estimated for further expansion. Its quantity is being decreased annually due to erosion from the banks of rivers and the infrastructure development process. At the same time, the growth of the country's population is constantly creating pressure to increase the country's agricultural productivity. The energy contained in water flowing through steep terrain of the country causes soil erosion with the result that about 380 million metric tones of surface fertile soil is lost yearly from the country's territory. An unusual phenomenon has arrived not only in Nepal but also in the south Asian countries, which have been facing with the flood disaster in one part and simultaneously drought problems in the other part. All these are happening and will continue till the balance of ecology in nature of this region is restored. Therefore, for sustainable development of water resources to provide people drinking water, safe irrigation water and cheap hydro-electricity, a paper entitled: "**Need of ecological balance for sustainable water resources development in south Asia**" has been suggested herein for an oral presentation at the **International Conference on Hydrological Sciences for Managing Water Resources in the Asian Developing World**, 8-10 June 2006, Baiyun Hotel, Guanzhou, China.

System Observation-Control Analysis on Water Resources Planning and Management

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Abstract: To research water resources system with system theory is extraordinary important. However, there are few literatures related to how highly degree the water resources system can be observed and controlled. Aiming at this question, this study built a model of pansystems observation-control of Jieke based on Jieke theory and pansystems observation-control methodology and presented that the water resources system can be observed and controlled only under certain condition. A case study on water resources planning and management was performed in Yellow River Basin, P.R.China, in 2010. Results showed that observation-control demand of water resources system can be achieved based on certain evaluation level of input set of system with the pansystems observation-control model of Jieke, which provides to some extent theory basis to water resources planning and management.
Keywords: water resources planning and management, water resources system, observation-control analysis, system methodology, Yellow River Basin

CALCULATION of urban water supply available: THE CASE OF wUHAN CITY, CHINA

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Abstract One of the main challenges for the 21st century is how to manage the competing and increasing demands on freshwater resources given the inconsistency in time and space between water availability, human and environmental demands. The general objective of regional water supply authority is to match supply and demand at a level of service acceptable to consumers. It requires very frequent adjustments of water supply in response to demand variations in order to minimize costs.
This paper consists of three sections: (1) Investigation of the layout , water supply capacity and operation of water supply system in the Wuhan city, China. (2) Balance analysis of the industrial, urban domestic and agricultural water supply and demand according to runoff, water quality, flood control requirement and forecast of domestic and industrial and agricultural and environmental water demand in short-term year 2010, medium-term year 2020 and long-term year 2030. (3) Assuming operational scheduling of diverse water supply system which comprises reservoirs, pipes, pumps and control valves. calculation of water supply available based on above balance analysis results in short-term year 2010, medium-term year 2020 and long-term year 2030 to manage effectively the water supply system. The aim of this paper is to provide the basis for the potential analysis of the feasible water supply planning so as to ensure water supply availability, suitability, and sustainability.
Keywords: Water demand forecasting, operational scheduling, water balance equation, water supply available, water supply planning

WATERSHED MANAGEMENT AS HYDROLOGICAL PARADIGM, FOOD SECURITY AND POVERTY REDUCTION IN SOUTH ASIA

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Abstract: The watershed management has emerged as important hydrological paradigms in South Asia in general and India in particular. The monitoring and prediction of watersheds open up vast possibilities in order to achieve food security and poverty reduction in South Asia. Geographers can, and should make a variety of contributions form both natural science and socio-economic perspectives. The study of ungauged basin is also very appropriate for watershed development in India due to severe paucity of hydrological data e.g., quality, quantity, stream-flow, sediments, snow-melt, pollution, etc, through space and time. A good number of medium and minor river basins are still ungauged. Whereas, the major ones are poorly gauged with respect to one or the other hydrological variables. Considering above issues, the following two types of river basins are important: 1. Poorly Gauged Basins: Many of the major river basins and a few medium river basins which have flood-data but lacks adequate data about other hydrological variables. These include mostly peninsular river of India. 2. Ungauged Basins: Most of the Himalayan rivers and rivers of North-East comes under this category. Besides minor river basins, a good number of medium river basins are also ungauged basins. Detailed case studies at different settings provide the bases of understanding environmental changes in the ungauged basins of the Himalayan India. Emphasis has been done not only on recent data, but also on historical materials. Technical issues related to remote sensing data, such as classification and scale are also considered to be important. The basins of India, specially ungauged ones are facing a multitude of hydrological challenges including: 1) reliability of water supply (quantity) i.e., seasonality of river basins, 2) water quality i.e., concentrations of contaminants; nutrients, heavy metals, etc.; 3) space-time variability of the hydrological variables 4) problems of extreme events such flood and drought, etc., 5) differences in the attributes e.g., soil, vegetation, topography, climate, demography, etc., 6) lack of information infrastructure both in quality and quantity e.g., remote sensing, GIS, ground observation and gauging network, etc. The hydrologic response to be predicted depends on the nature of the problems including prediction of floods of a given return period, extent and frequency of floods, mean annual water yield reliability of water supply, crop fields, irrigation scheduling and water quality (concentrations of contaminants; nutrients, heavy metals). In general, the predicted hydrologic response can be a continuous time series of the quantity and quality of interest (e.g., storm hydrograph) or statistical measures of its variability in space or time (e.g., mean, variance, annual total), including extremes (e.g., annual maximum floods, droughts etc.). Thus watershed development should take into consideration the identification and measurements of hydrological data/information in spatiotemporal variability of a Indo-Ganga Brahmputra basins which are densely populated agricultural regions of India. Finally, the paper highlights watershed management as driving force for food security and poverty alleviation in the South Asia.

The Demand-side Management of Water following the operating of the South-North Transfer Project in China

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Abstract: The South-to-North Water Transfer Project(SNWTP) is an important strategic measure that will significantly alleviate acute water shortages in the country's northern areas and promote the optimization distribution of water resources. It will involve a structure of multi-water-sources supplying of the target areas, (that is surface water, ground water, water from Yellow River and water from Yangtze River.) How to guarantee the social sustainable development, realize the optimum distribution and efficient utilization of water resources and achieve a kind of harmony between the human beings and the nature under the situation? We should adopt a new approach --the management of water demand to achieved increases in the efficiency of use of water over the medium to long term.

The management of water demand is a new and important issue in China and a number of policies and mechanisms are going to be used or formulated to ensure sustainable use of water in the long term.

In the past, efforts to satisfy increasing demand have often been expended principally on increasing the supply of resources, which were available abundantly and at relatively low cost. However, the relationship between water abstraction and water availability has turned into a major stress factor in the exploitation of water resources in China. Therefore, it is logical that the investigation of sustainable water use is concentrating increasingly on the possibilities of influencing water demand in a way which is favourable for the water environment. This report seeks to identify the key aspects and factors of water demand management as they relate to the different water users or sectors .

Price structures within the urban sector are generally fixed at municipal level and can vary widely within a country. The differences, in general, take into account different types of users (domestic, industry and so on) and tend to reflect differences in cost structures. Experience has, however, shown that an increase in water prices reduces water use.

Besides, the task for China is not simply to consider which pricing structures would most reduce demand for water. It must consider the other impacts of alternative price structures including the potential impacts on lower income large households. However, the weighing and balancing of competing priorities and interests is common to much of the work of China . It will be greatly assisted in this task by well argued submissions and feedback from a broad range of stakeholders.

The industrial sector faces two different ranges of prices depending on the water source: direct abstraction or from public water supply. Abstraction charges can take the form of a nominal licence fee linked to an abstraction permit regime or they can vary depending on the quantity used.

The main water use within the agricultural sector is for irrigation, with minor use by livestock-farming and fish-farming. Irrigation tariffs can be extremely low and even free.

The general education of and provision of information for water users are important parts of initiatives encouraging more rational water use and changing habits. It is, however, difficult to quantify the effect of a public educational campaign because it is always part of a wider water-saving programme which includes other measures.

The main motive to implement water conservation programmes in companies tends to be economic incentives, normally in the form of abstraction charges and wastewater fees. Other factors can be legislative requirements for cleaner technologies, environmental image and concern for the reliability of water supply.

A modeling blueprint for assessment of satellite-based flood forecasting in international river basins

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Abstract: A problem faced by many lowermost riparian nations in flood-prone International River Basins (IRB) today is the assimilation of in-situ rainfall data in real-time across geopolitical boundaries to issue flood forecasts with lead times equivalent to basin response times. Anticipated global rainfall (at resolution: 3~6 hours, 10X10 km^2) from satellites of the *Global Precipitation Measurement (GPM) Mission* now appears as a promising alternative for achieving the basin-response lead time for flood forecasting. However, proper characterization of the satellite rainfall error and its non-linear propagation in hydrologic models for forecasting are therefore necessary to gauge the true potential of GPM in bridging the flood forecasting needs of IRBs. In this work, we propose a hydrologic modeling blue-print that is simple, robust and tailored for assessment of error propagation of satellite-based flood forecasting for lowermost nations in IRBs. The blueprint is based on first principles of conservation of mass and momentum. It utilizes an open-book watershed modeling concept considered suitable for assessing the hydro-political impact of satellite rainfall data availability over upstream nations. We present this blueprint as a parsimonious way of conducting an approximate yet reasonable assessment of the numerous IRBs in the vast ungauged regions of the world (in particular Asia) and thereby identify the flood-prone nations that would benefit most from anticipated GPM rainfall data. This approach, we believe, can subsequently motivate the identified nations to initiate a range of more detailed physically-based studies to design and test an enhanced GPM-based prototype forecasting system by 2010. We present an application of our proposed blueprint on an idealized international river basin. Our findings are then used to quantitatively project the anticipated value of satellite rainfall data from GPM in extending the current capabilities of flood forecasting of Bangladesh in the Ganges Brahmaputra basin - Bangladesh

Keywords: Flood forecasting, satellite rainfall, Global Precipitation Measurement Mission, International River Basins, Error Propagation, Hydrologic Modeling.

Sustainable Water Management for Agriculture: Examples from India and Nepal

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Abstract: IFPRI and IWMI have projected that an additional 192 cubic miles of water will be needed to meet the food demand of the world's population of about eight billion by 2025. Though water scarcity is acute in many developing countries, irrigation's share is as high as 90 per cent. Thus, increasing agricultural productivity with minimal use of water is a real challenge facing most developing countries today.

The irrigation policies of India and Nepal seek to promote social and economic development through sustainable irrigated agriculture, which means that irrigation development programs and policies should equally benefit the entire populace regardless of class, caste and gender. Opening access to affordable irrigation technology can be one of the best strategies to help rural poor people in ensuring their socio-economic development. Low- cost irrigation technology is crucial for rural poor as farming is only primary source of their livelihoods and fills an important technology gap by offering them an affordable entry into irrigated agriculture. Besides, it has been proven as efficient water use technology in irrigated agriculture.

Based on empirical study undertaken in 2003 and 2004 in rural areas of Nepal and India, the paper tires to look at how smallholders are managing irrigation water by analyzing the socio-economic aspects of the micro-irrigation technology. In this regard, the paper accords special reference to women's issues in micro-irrigation. The paper also analyzes the roles of agricultural policies and local institutions in adoption and diffusion of the technology. Besides, costs and benefits associated with the technology are examined.

Survey of 100 households in Nepal and 100 in India was done. Separate focus group discussions were held with non-users of micro-irrigation technology. Participant observation was done to capture the behavior of the adopters. Random-spot observation was done to find out who uses the technology mostly in households. Findings depict that the technology offered to the rural poor is financially viable. As it is a cost-effective irrigation technology, it not only helps improve the rural livelihoods by providing additional family income and ensuring food security but also confirm to sustainable use of natural resource.

Analysis of Water Resource Carrying Capacity in the Bohai Rim Region Using Fuzzy Synthetic Evaluation Model

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Abstract: Water resource is of critical importance to regional environmental security and sustainable development. Scientific analysis of its carrying capacity is fundamental to the harmonious and healthy development of environment and economy in a region. Using fuzzy synthetic evaluation model, this paper analyzed the carrying capacity of water resource in the Bohai Rim Region, where the water resource is extremely scarce now but the sea ice resource is potentially rich. Eight factors were used for the assessment. They are: available water resource per capital, actual water supply per capital, efficiency of water use, irrigation ratio, water supply modulus, water demand modulus, quota of living water use and ratio of ecology water use. The result shows that the exploitation of water resource in the Bohai Rim Region has reached a very large scale; the carrying capacity of water resource in this region has already come close to zero under current economic level and technology condition. It can be anticipated that population growth, urbanization and water pollution etc. will further exacerbate the contradiction between water supply and water demand in this region. Without enough fresh water resource, the formation and development of economic ring in the Bohai Rim Region cannot be guaranteed. Integrative management and multiple measures should be taken to improve the carrying capacity of water resource in this region, such as proper exploitation of sea ice and slightly salty water in shallow aquifer, implementation of water saving strategy and reasonable pricing of water resources etc.
Keywords: the Bohai Rim Region; fuzzy synthetic evaluation model; carrying capacity of water resource

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Himalayan water use and a thought for future course of action

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Abstract: The bountiful of water resources available in Nepal could not be turned into the wealth due to several constraints. Prevailing challenges in this sector call for a new approach to development. The agricultural use for the co-riparian countries/regions has been a fundamental issue. In this paper the water related issues in five northern sub-basins (Ghagra-Karnali, Gandak. Burhi-Gandak, Sapta-Kosi and Mahananda) which transport all the transit flows from Nepal have been analyzed. Main focus is given on water availability, existing use status and future requirements of sub-basin areas. Prime consideration is given to irrigation use.

Water augmentation issues including all the identified storage schemes and their multiple uses are briefly highlighted. Preliminary benefit sharing mechanism among the co-riparian inhabitants has been floated. Acceptable water pricing and benefit calculation ideas are formulated for general discussion. Similarly, futuristic strategies and plans are presented in brief for public scrutiny. Paradigm shift in emphasis has been stressed and recommended to tackle all the challenges through the comprehensive and interlinked approaches. At the end futuristic recommendations have been provided. Comments, suggestions and criticisms are invited to improve and get consensus views from the co-basins' public and experts.

Comprehensive Assessment System of Irrigation Infrastructure Asset

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Abstract: In recent years, Asset Management Approach has been developed to improve the financial and service performance of facilities, which originated in the commercial and financial field. In this paper, it is introduced to irrigation scheme management in China. In accordance with the general principle of Asset Management Approach, a comprehensive assessment system of irrigation infrastructure asset is advocated, to assess three major factors of infrastructure assets: hydraulic performance, condition and importance. The analytic hierarchy process (AHP) and entropy method (EM) are applied in this model to balance the influence of subjective judgment and objective observed data. The assessment results would be usefully supportive for irrigation district administrator to identity priority for asset renewals and middle-long-term investment planning. This paper also describes a case study of the Fourth Main Canal of Zhanghe Irrigation District, China. Assessment results of the canal show that six groups of infrastructure assets, namely regulator, culvert, tunnel, elevated aqueducts, bridge and pumping station, are ranked “Fair”, “Good”, “Fair”, “Fair”, “Fair” and “Fair” grade respectively. The comprehensive analysis results reflect the actual performance and service level of water resource delivering in Zhanghe Irrigation District.

Keywords: Asset Management Approach, Irrigation Infrastructure Asset, assessment system, priority

Using Bargaining Model to Optimize Water Resources Allocation

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Abstract: Game theory deems players as rational participants and admits the conflict existing between individual rationality and collective rationality. In this paper, a bargaining model is constructed and applied for the allocation of water resources. The model is aiming at optimizing overall benefit of water resources system, with mutual-competitive users, namely irrigation, hydropower, industrial and domestic municipal utilizing. On the basis of bargaining theory, the maximization process, strictly constrained by both water quantity and quality, is depicted to an offer-counteroffer approach and users' patience degree (or threat that they will suffer economical loss due to postponing allotment decision) is described as discounting factor. Then, the Nash equilibrium solution to the cooperative game model is given to instruct optimization result. An example of Dongfengqu Irrigation District of China is presented to illustrate the idea of constructing and solving the model.

Water price Forecasting Method based on marginal-cost Theory

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Abstract: Water price have an important position and role in the reproduction of economy, society and environment. During last 10 years, policy decision-makers have become more and more concerned with regulation of water utilities. In this context, one of the most important tasks of regulatory authorities is to determine the appropriate pricing scheme for the services provided by utilities. First to reduce water waste,and second to promote equity between users. Since then, water price has significantly increased and the water bill has begun to gain in importance for consumers.

Marginal cost is the additional cost of producing or selling a single incremental unit, thus marginal cost of water service is the cost or saving incurred in providing more or less water service. Marginal cost has two components—short-run marginal cost, defined as the change in operating costs by changing the rate of utilization of existing capacity, and long-run marginal cost , defined as the cost of expanding capacity as well as the operating costs associated with increased capacity. In contrast to average cost, which uses embedded or historic accounting costs, marginal cost calculation involves projecting future operating and capacity costs for a specified time span by using cost changes that occur because of long-run incremental cost are concepts similar to marginal cost. Marginal cost refers to multi-unit changes. For practical purposes, incremental and marginal cost concepts are interchangeable.

The purpose of this paper is to evaluate the pricing of China water utilities according to past twenty years data. An econometric model describing both water supply and demand is specified and estimated on utilities located in the east area of China. Based on the estimated technology and demand parameters, a new method of forecasting water price is presented. It used the marginal-cost theory whose is close to the historical data to establish the water price forecasting function, and according to the process of marginal-cost function to set the forecasting model. We derive the estimated parameters and discuss estimates of returns to scale and elasticities of water demand, analyze the current pricing of water utilities by comparing marginal costs and marginal prices. These estimates are then used to simulate first-best optimal pricing by solving a supply-demand system in prices and quantities. Finally, we find that the marginal cost price is the optimal pricing scheme, and it is much better than fixed charge price and average cost price. The example showed the methods is rational and reliable.

Keywords: water pricing; forecast; marginal-cost theory; water utility; Simulation

Study on Conjunctive Surface Water and Groundwater Management in Tanghe Irrigation Area

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Abstract: Reasonable configuration surface water and groundwater is the emergent problem in the region with water shortage. As a result, a linear programming model has been developed to optimize irrigation water with the goal of harvesting the maximum year net effect. The system is subjected to the quantity of different water resources, crop water requirements, transport water ability of canals, capable irrigation area, pumping water ability of wells and so on. The aim is to optimize surface water and groundwater through rational exploiting water resources in Tanghe Irrigation Area. To rational allocation limited water resources of the same crop in the whole growth period, a dynamic programming model has been developed with crop water production function as the basis. The goal of the model is to harvest the maximum ratio of crop unit area real production compared highest production, the influence factors of soil water variation, precipitation supply and groundwater supply have been thought. The models were demonstrated by real examples, which show the strong practicability for Tanghe Irrigation Area to realize sustainable development.
Keywords: conjunctive management, linear programming, limited irrigation, dynamic programming

Laboratory Study on Characteristics of Point Source Fertilizer Solution Infiltration under Sufficient Film Hole Irrigation

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Abstract: Film hole irrigation is a new water-saving surface irrigation technique of sufficient water supply. Based on lab 3-demensional fertilizer solution infiltration experiment under single point source of film hole irrigation, the transport law of wetting front were researched, the results showed that the change of wetting front with time followed the exponential function equation and the vertical profile of wetting body followed elliptical equation. Mathematical models for the dynamic movement of wetting body vertical profile and experiential model for cumulative infiltration under film hole irrigation of fertilizer solution were developed. The mechanism of cumulative infiltration under film hole irrigation of fertilizer solution more than that of demineralized water was illustrated, theoretical model for the change of average volume soil water of wetting body with time was established, the model was verified by the measured datum. Moreover, the redistribution law of soil water were studied through the contour map of the soil water content. The results lay scientific foundation for further study of film hole irrigation.
Keywords: film hole irrigation; fertilizer solution infiltration; characteristics of infiltration

Discussion of sustainable utilization of water resources on middle part of Jilin province

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Abstract： The middle part of Jilin province is an important base of commodity grain and important economic area in northeast of China. The shortage and unreasonable utilization of water resources has brought on many entironment issues, such as salinization, desertification, water pollution and so on, while also seriously restricted on the sustainable development of social- economy. In studying area, perennial average precipitation is about 593mm, decreasing from east to west. Precipitation mainly concentrates on June to September, which accounts for 70% to 80% of all-year precipitation. The total amount of water resources is about 7.046 billion cubic meters, while passing water resources is about 10 billion cubic meters. Based on the spatiotemporal variability and utilization state of water resources, the area is a fragile district of water resources generally. The advance of industrialization and urbanization will form enormous pressures to supply of water resources for a long time, but the limited water resources determines that the amount of water resources utilization will tend towards stability. The industrialization and urbanization will change from driving water resources utilization expansion to reducing agricultural utilization of water resources. Combining with social-economy trends and promoting space of water supply, water resources utilization peak will appear within 2015-2020 years, while water consumption reaches to 6-6.5 billion cubic meters. The structure of water resources utilization also will be changed. The ratio of residential water use, industrial water use and agricultural water use will be about 1:2:2 by 2030. Building water-saving agriculture is a strategic measure to sustainable utilization of water resources. Rational utilization of rain resources is a key means to enhance stability of water supply systems. Establishing reasonable water price system is a basic project to realize rational distribution of water resources. It is the system guarantee of realizing sustainable utilization of water resources to strengthen the comprehensive management of the water resources.

Keywords: middle part of Jilin province, water resources, sustainable utilization，countermeasure

Water Resource Management and Storm Runoff Simulation for a Coastal Forest Catchment in Japan

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Abstract: Forest and water resources are inextricably linked and sustainable forest management is considered a key to water resources management in particular and to upland resources development in general. Forest catchments supply water for domestic, agricultural, industrial and other needs in downstream areas. Forests and forested watersheds play essential roles in sustainng and protecting water supplies. Especially in coastal regions thunderstorms or typhoon often trigger a series of floods and landslides in mountain areas. Thus it is important to construct the catchment storm runoff analysis model to make a careful assessment of flood disaster risk in mountain areas. During a storm, the total discharge includes all or some of hydrological components, so for the purpose of predicting the peak discharge and flood by storms in forest catchments, understanding of hydrological components which include surface and subsurface runoff process is most of necessary. Hence, a kinematic wave method was used to establish a physical storm runoff model in this research using the data of a coastal forest catchment in Japan. In the model, Manning and Darcy's equation were combined in order to analyze both of surface and subsurface flow in the storm event. Through the model, the phenomena of storm runoff were investigated. Therefore, the important information of storm properties and processes can be obtained as critical index to forest water resource management and flood disaster prevention.

From Flood Control to Sustainable Development: Fifty Years of Water Resources Planning in Bangladesh

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Abstract: In Bangladesh, past strategies in water resource planning overwhelmingly focused on flood control with a view to increasing food production. This brought the country close to food self-sufficiency in the 1990s, but at the same time other water using sectors were neglected. As a result, holistic and integrated water management vision and strategies could not evolve. Stakeholders' participation was minimal contributing to the lack of sustainable development of the sector. Many projects failed to provide desired and sustained output due to poor operation and maintenance mechanism and capability. In recent times a number of National Policies for different sectors, including National Water Policy, have been formulated in Bangladesh. Though there are no major contradictions between National Policies for different sectors with respect to water resources development, there are no clear guidelines as to how the actions required by different policies should be coordinated. Contradiction also arises due to differences in interpreting policy issues. This article enumerates current, and indeed future, issues in the water sector and identifies gaps in water resource planning in Bangladesh. It argues that for sustainable development of the water resource, an integrated land and water management policy should be formulated for Bangladesh and emphasis should be given to institutional restructuring, organization of investment portfolio involving both private and public sector and stimulating regional cooperation.

Keywords: Bangladesh, Sustainable water resources management, National Policy, Stakeholder participation, Institutional development

Small Island's Water Supply in The East Nusa Tenggara Province, Indonesia

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Abstract: Small islands in East Indonesia among others in the East Nusa Tenggara Province, has a semi arid climate where shortage of raw water, either for drinking, as well as household needs and agriculture, always arise especially during the dry season.
In the framework of anticipating the scarcity of raw water, this paper introduce the small island's water supply taking into account the water source potency and the appropriate applied technology to be developed.
The locations of the subject study are small islands in the East Nusa Tenggara Provinces, Sikka district, Maumere subdistrict, in the Besar, Parumaan, Pangabatang and Damhilah islands.
Raw water sources in Besar island, consist of ground and springs water which are potential enough to supply water for the inhabitant needs either in Besar or surrounding islands. The discharges at Wairterang and Lada Unen springs that has been measured during the study are about 1,8 l/s to 2 l/s. Raw water sources in Parumaan, Pangabatang and Damhilah islands are ground water and rainfall, but the ground water quality is brackish to salty and only used for household needs whereas drinking water is carried from Besar island by boat. These small islands has no river, only intermitten rivers in Besar island that exists during wet season only.
The possible applied technology to develop in these small islands are the spring water in Besar island, especially in Lada Unen spring while Wairterang spring has been developed by constructing a storage and distribute the waterby using pipe network. Another possibility, due to the geologycal and soil condition, are to construct ground water dams in Besar and Parumaan islands, small field reservoir in Besar island and very small field reservoir in Parumaan island. The promising technology to applied in these islands is rainfall harvesting. In Parumaan, Pangabatang and Damhilah islands rainfall harvesting is done by storing rainfall from the roof to the water tank or, for a better water quality, to an artificial aquiffer and in Besar island by constructing small field reservoirs.
By taking into account the cost of the constructions, the water capacities that can be obtained, the socio-economy and environment condition, it is concluded that the most appropriate applied technology to develop the water resources in the study area are rainfall harvesting by storing rainfall from the roof to water tanks for Parumaan, Pangabatang and Damhilah islands. In Besar island, it is suggested to develop springs water by constructing a water storage or weir and distribute it to the villages inhabitant by using pipe network.

Keywords: small island, water sources, applied technology

Irrigation and Flood Control Strategies in southern Indian state

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Abstract: Optimal utilization of the water resources through appropriate conservation and management measures assumes critical importance in sustaining the life support systems. The southern Indian state (Kerala) has 44 rivers and has ample rainfall for about 72,000 million m^3 of water every year, only 5.5 % gets stored in medium irrigation and hydro-electric dams. Nearly 40 per cent of the resources are lost as run off causing heavy floods. The ground water resource is estimated at 7048 MCM. Its ground water levels are falling, its rivers, canals, lakes and backwaters are shrinking, and its people are reeling under a severe shortage of potable water. Priority in resource allocation (69% of total) in Kerala was given for major and medium irrigation projects for rice crops, but not succeeded in increasing the area irrigated or productivity or in returns. Minor irrigation schemes are best suited for irrigation in Kerala, but adequate priority was not given in the allocation of resources. Ground water development also comes under minor irrigation. Around 25 per cent of the ground water resource potential has been tapped and the coastal and low-lying regions of the midland offer good scope for ground water development. Out of the 152 blocks in Kerala, eight have been identified as critical, six as semi critical, two as over exploited and 136 as safe. Traditionally irrigation management has been considered as a departmental exercise without any provision for participatory approach either in the selection of the works or in their execution and management. Local level Water Resources Development and Management through participatory approach to be given a thrust to attain sustainable local self-sufficiency regarding water requirements. Recent communities Irrigation Project with the active participation of the beneficiary communities have drilled 131 bore wells. Several minor irrigation schemes have been taken up recently as local governments have to spend about 40 per cent of their allocation in productive sector. A good number of schemes have not resulted in increasing water availability as undue emphasis was given to protective structures. In flood control, most of the schemes are related to relief work for the affected areas. Flood control works continue to be on conventional lines. The identification and execution of works are on adhoc basis and largely based on public pressure and there is no system for the assessment of needs and priorities. Basin wise studies are required for the identification of flood prone areas. A strategy for water resources development and utilization for irrigation and other purposes envisaged for the coming years includes the revamping of 1st and 2nd generation irrigation projects to improve the current level of utilization by taking into account the changes that have taken place over time and bringing about necessary modifications with the partnership with local governments and user groups. Water resources planning and management to be taken up by the river basin level by aggregate watershed based plans prepared locally. Special focus would be given to revival, conservation and up gradation of local water resources and traditional systems of water management. Ground water exploitation would be based only after proper zonation and with the involvement of farmers at the local level. Technical

support for development of groundwater sources and helping farmers for acquiring sources of irrigation on individual as well as self help basis are features included under future programme.

CV Summary

Doctor of Science (D.Sc.) in **Oceanography** (Geophysics) from **Tohoku University, Sendai, Japan (1981) and Master of Science** (M.Sc.) in Oceanography from Kerala University (1971). **More than 28 years of Research & Administrative experience** with more than **75 scientific publications** dealing with different aspects of Marine Sciences (Marine Fisheries, Coastal Zone management, Marine Pollution, Coastal processes, Coastal circulation, Ocean wave generation & prediction, Numerical modeling, Biological diversity, Fisheries oceanography, Estuarine modeling, Environmental pollution, marine archeology). Participated and presented papers in international scientific gatherings **such as UNESCO, SCOR, FAO, IUGG, IAPSO, APN, LOICZ, EMECS, COPEDEC, MOI etc**. Research experiences were at supervisory levels with the services at **National Institute of Oceanography**, Goa (India), **Kuwait Institute for Scientific Research (Kuwait)**, Center for Earth Science Studies, Kerala state (India), **Cochin University** of Science and Technology (India), **Royal Commission for Yanbu & Jubail (Saudi Arabia), Tohoku University, (Japan).** Organized International training course in Marine Sciences, Fisheries and acted as Organizing / Technical Committee member for many Regional/International Scientific Conferences in Marine Sciences & Fisheries. Research interests include Marine Environmental Monitoring, Fisheries stock Assessment, Wetland ecology, Marine pollution, Modeling of Coastal Processes, Coastal Oceanography and Coastal Zone Management studies, Bio diversity studies, Ocean Waves & prediction etc

Impact of urbanization on local groundwater quality and water supply in the Pearl River Delta

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Abstract: Located at south part of China, the Pearl River Delta (PRD) is facing serious water problems in both quantity and quality with its rapid urbanization in last decade. It is the most remarkable that the local groundwater, the source of drinking before the urbanization, was polluted due to using plenty of the septic tanks without proper management.

In order to know how the septic tank affects the local water environment, Fencun, Guangzhou has been chosen. It was the village with a drinking well for each family twenty years ago and become the residential area with more than 500 residents now. One third of them have their own septic tanks in the house. Under the septic tank, they use calcareousness to prevent infiltration of wastewater that is finally drained into pond through ditch.

To measure major ions and stable isotopes (^{18}O, D and ^{15}N) in the groundwater, water samples were taken from the wells in Fencun twice in March and July, 2005. It was found that the $\delta^{18}O$ values of groundwater ranged from -3.3 ‰ to-5.6‰, which were heavier than the $\delta^{18}O$ value in precipitation. The average electrical conductivity (EC) of the groundwater fluctuated between 560 and 1188 us/cm. Nitrate concentration of groundwater in the study area were higher than 10 mg/l, with the highest around 51 mg/l. The poor management of the septic tanks can be considered as the main reason for local groundwater pollution. Shallow water table and high permeable soils also increased the vulnerability of the study area to nitrate contamination by septic systems.

Because the groundwater of wells has been polluted, the residents have to use taps water which is transferred by pipe line from the reservoir far away. In the same way, population increase will further accelerate the pollution of groundwater and reduce the supply of potable water, which makes more pressures on the water supply in the Pearl River Delta.

Finally, some scenarios are discussed to consider the effects of septic tank system on the local and regional water problem in the Pearl River Delta near future.

Keywords: Groundwater, septic tank, nitrate, urbanization

How to Realize Food-Water Security in China?

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Abstract: The increasing gap between the water needs and the water supply has become the constraint factor to developing country, especially to China. At same time, with the change of sector structure, we intend to invest more and more in high value producing sectors comparing to low value producing sectors, such as agricultural sector. So it is believable to expect that we would depend on international food market increasingly. How to realize water security and food security has been a big challenge facing China in future.

In essence, food security and water security are not absolutely isolated, but they are connected with each other. Irrigation water consumption has accounted for seventy percentage of total water consumption which includes municipal water consumption, livestock water consumption and irrigation water consumption. In recognition of aforementioned relationship, we should consider food security and water security integratedly rather than consider them separately.

Recent years, many models have been developed to analyze the food security and water security in views of global and national scope. The PODIUM which developed by IWMI investigates food and water requirement as a whole. The CAPSIM(China's agricultural policy simulation and projection model)which developed by Agri-policy research center ,China Academy of Science, has analyzed the impacts of policy changes and other external shocks on China's agricultural production ,consumption, price, and trade. The IMPACT model which developed by IFPR offers a methodology for analyzing baseline and alternative scenarios for global food demand, supply, trade, income and population.

Based on these models, other models have been built up to consider food security and water security associatedly. The IMPACT-WSM which is the outcome of Global Water Demand and Supply Projections presents an approach for projection of water demand and supply for domestic, industrial, livestock and irrigation at the basin or country level in a global scope. The CAPSIM-PODIUM which developed by Yongsong Liao (2003) has analyzed food security and water balance scenarios of China in 2020 based upon the database about food and water situation at national level ,provincial level, basin level and county level.

But abovementioned models do not fully reveal the relationship between food security and water security .This paper has built up a Food –Water Security Model (FWSM) which highlights the function of "virtual water" trade. On the one hand, food security can be achieved by food importing which means importing virtual water, not by region or country itself only. De facto, the virtual water trade has affected the region's or country's water balancing which is the important index of water security. On the other hand, water security in arid or semi-arid region can be achieved by decreasing agricultural production which is high water consumption. With the liberty of food market, such regions can get food they needs easily and cheaply.

Utilization of the FWSM, we can analyze and forecast the trends of the supply and demand of food and water in China in future, and can put forward advices for food and water policy.

Water Integration: Bangladesh Perspective

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Abstract: Bangladesh is deltaic land blessed with the Ganges-Brahmaputra-Meghna rivers systems. The problem is that Bangladesh has too much water in the monsoons and too little in the dry season. Unless the water is conserved when it is in excess for use when scarcity follows, the problems for flooding and drought will continue to plague the country. Besides, demands for freshwater are growing rapidly in the urban and industrial sectors, in agriculture, in fisheries, in inland navigation and for controlling salinity.

Simultaneously, agricultural water logging is degrading water resources and salinity are no longer problems of the coastal area alone but occur in and around embankments and dams. Construction of flood-control embankments and roads are impeding water flows and both the wetlands and their fishery resources are under threat.

Other pressure on the wetland are form desiccation and encroachment for Boro rice in the winter season, especially in the Haor regions in Sylhet and Mymensingh and from reduced dry seasons flows particularly in the South West in the Ganges system.

Callous interventions along the course of common rivers, at the cost of Bangladesh, are nothing new. The severe environmental disruptions in both West Bengal in India and Bangladesh set in motion by the infamous Farakka barrage on the Ganges are a bitter testimony to how devastating the consequences can be for those whose livelihoods depend on the land and waters of the affected areas.

The much-hyped Ganges water-sharing treaty can scarcely undo the ecological damage triggered by excessive withdrawal of the waters during the dry season and veritable deluge during monsoon as the floodgates are opened to ease pressure. Unfortunately, being a lower riparian country, with some 93% of the catchments areas of the common rivers outside Bangladesh, this uncomfortable situation often finds itself at a great disadvantage with respect to both sharing common waters and riparian regions. This, despite the fact that there are international river-sharing norms and rules, which by their very definition, ought to exclude any injustice to the disadvantaged party.

Bangladesh has not been receiving the stipulated amount of waters under the terms of the so-called treaty. Agriculture, forestry, fisheries and the environment have suffered serious setbacks in large areas of Bangladesh as a result. Insufficiency of river waters have forced the farmers to go for lifting of underground water and this is posing a threat of land subsidence and creating the worse health threat to arsenic contamination.

The other countries of the world that have suffered from arsenic poisoning found remedy in stopping the use of ground water. Instead, they developed an efficient management of their surface water resources. Bangladesh also needs a proper watershed management plan immediately to combat the problems. Some multi-dimensional research should be addressed for further definition of environmental risk factors for major health problems and development of appropriate techniques, technology and methods of communication.

Besides, to address the overall problems of water management, water pollution and unilateral withdrawal of water in upper riparian zones an integrated national and regional water approaches and policies are needed to be worked out.

Managing water resources in developing countries in South and South-East Asia

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Abstract: The amount of water present on earth is estimated at about 1.41 bn km3 of which only about 2.5% is fresh water. The average amount of water running off the land mass each year as a renewabloe resource is 39000 km3 . Of this, the share of Asia is 13190 km3 . Water exploitation has risen particularly sharply in the second half of the 20th century and the increase was disproportionate in Asia and Europe : from 865 km3/annum to 3187 km3/annum in Asia and from 94 km3/annum to 673km3/annum in Europe between 1950 and 2000. The World Resource Institute forecast a global increase of 17% in demand in agriculture . The likely increase in population by 3.06 billion in the developing countries, mostly in Asia , the increasing urbanisation, world wide increase in industrial water use, all these add up to 171-438% increase in the use of water in developing countries. Thus there could be water shortage.This could be met only by supply management and demand management . Maqjor riversm of South and South-east Asia are international in character ; they originate in one country, and pass through other countries before flowing into the sea ultimately. Examples are the Ganga, the Brahmaputra, the Indus and the Mekong'. Systematic development and management of these water resources is vital for the economic growth of the countries concerned. The Mekong-Ganga Cooperation was launched in Laos by six nations , India, Myanmar, thailand , Laos, Cambodia and Vfietnam, on November 10, 2000 , but the focus was was on tourism, educdation and communication between India and the five Mekong river basin countries. Strangely, development and management of water resources was missing in the areas of this Cooperation. Water pacts were already made between India, Nepal and Bangladesh in 1995. The Mekong-Ganga Cooperation is named after these two major rivers. It would be appropriate if these countries in South and South-east Asia extend this concept and include water development and management in the over-all picture of managing water resources in the developing countries of Asia. With the National Water Policy of 2004 being implemented by India and China taking up major water projects , a comprehensive policy of cooperation and coordination in water management should be possible .

CHALLENGES ASSOCIATED WITH WATER RESOURCES MANAGEMENT OF PENINSULAR INDIA IN CHANGING ENVIRONMENTS

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Abstract: Globally, gap between demands and availability of water is widening, necessitating immediate measures for its sustainable utilisation and efficient management, especially in the developing world where economic crisis and population explosion are hazards in further development of water resources. This is especially true in regions like peninsular part of India with wide disparity in the distribution of rainfall and water resources. The paper analyses the challenges in integrated and sustainable water resources Management of Peninsular India in a changing environment. Water need in the entire region is increasing with rapid rise in population whereas availability of reliable water is fast decreasing due to pollution, overuse and inadequate conservation and management practices. Topography of the Western Ghats Mountain that runs parallel to the Arabian Sea coast brings very heavy rainfall in the west coast, producing a number of rivers, most of them flowing fast westwards through the steep slopes to join the Sea. Some of major rivers flow east through the water starving Interior Peninsula, which is a rich agricultural land. Here, increasing demands associated with rising population exacerbate the existing conflicts over water. Management of these rivers and settling disputes over the water is a key factor determining the social and economic development of the region, as life of the majority is related to agriculture. Estimation of the water availability after two decades in a changing environment, using the water balance model shows considerable decrease in coming years. When the factors affecting water quality and quantity are considered, actual availability of safe water will be even less. Existing disputes over water will definitely worsen and new disputes are likely to originate in near future. The new scheme of river linking may create unpredictable environmental issues in coming years. Though the pressure from the rising population outpaces all water development projects, there is still exploitable water in the Mountain region that can solve water crisis to a good extend. But, present methods of conservation and management of water resources are inadequate as a result of poor finance, corruption, slow government machinery, non-cooperation among different departments involved and vested political interests. The region needs an appropriate water policy and a strong political will to implement rules and regulations to protect resources from destruction.

Water Resources and Sustainable Development: Factors and Constraints for Improving Human Well-being in Water-stressed Regions[2]

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Abstract
Water is a crucial natural resource for the sustainable development of world societies. The growing demand of water resources (caused by population and economic growth) and climatic conditions are driving to an increasing water scarcity as well as to the degradation of their quality, which has an acute relevance especially in water stressed regions. In arid and semi-arid regions, the management of surface and groundwater resources creates significant challenges for the development of local populations.
Keywords: Integrated water resource management, Sustainable development, Water governance, Ecosystem approach, Water quantity and quality

[2] This paper presents some results achieved in the frame of three research projects funded by the European commission: Management policies for priority water pollutants and their effects on foods and human health: general methodology and application to Chinese river basins –MANPORIVER (ICA4-CT-2001-10039); Sustainable management of scarce resources in the coastal Zone – SMART (ICA3-CT-2002-10096); Network on governance, science and technology for sustainable water resource management in the Mediterranean. The role of DSS tools – NOSTRUM (INCO-CT-2004-509158).

Planning and Research of Haihe Drainage Basin of Jinan City Shandong Province

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Abstract: Based on the general situation and development goals of Haihe drainage basin of Jinan city Shandong province, author gave the planning goals and the planning scheme of the four parts with a near future and a specified future separately. For the part of preventing flood planning, in the near future, the goal is that the preventing flood project will be renovated completely and could defend the flood that happened in 1961, and in a specified future ,The goal is that the preventing flood project could prevent the flood happens per 50 years. For the part of irrigation planning, the near future goal is to spread the save-water technique and improve the utilizing rate of water resource， and a specified future goal is that systemize the irrigation project and achieve modern irrigation and finally realize the nicer function and the continuable development of irrigation area. For the part of national environment preserves planning, soil and water loss with 382.07km^2 area of Haihe drainage basin will have been treated up to 2010, and the entire erosion area will have been treated up to 2030. For the part of management planning, the major works is the municipal water supply project, sewage treatment project, plain reservoir regulating and the reconstruction of irrigation area. So in order to achieve the organic unity from the water using to management, a new management mode—the chief department of water administration are in charge of united management will be put in practice, and the old mode—several departments in charge of water management will be abandoned. The result of this planning and research may give benefit to the farther treatment and exploitation of Haihe drainage basin, and accelerate the continuable development of this drainage basin.

Keywords: drainage district planning Haihe continuable development

Trans-boundary environmental issues of Asia international rivers: an example of the Mekong River

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Abstract

Abstract: Asia international rivers are large both in size and water discharge such as the Mekong, the Ganges-Brahmaputra, and the Salween etc. The rapid disturbance of ground surface, for example, as a result of land use/land cover change and dam constructions, cause significant changes in water and sediment, and subsequent river bank and fresh water ecology among others. The significant changes in the trans-boundary rivers arising from these human disturbances have become a main concern for communities located downstream of the international rivers. Often, reports about these issues are not consistent. In fact, most of them are contradictory in the case of the Mekong River. Hence, a holistic review on these environmental issues is necessary. This paper aims to examine the current developments in some of the main environmental issues arising from the hydro-power development the upper Mekong River in China, and potential conflicts and areas for cooperation between China and the riparian ASEAN countries.

Historical Perspective on Salween Dams: Hydrological Science, Sustainable Development and Water Governance in China, Myanmar and Thailand

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Abstract: Under the macro international cooperation in hydropower projects between China, Myanmar and Thailand on the Mighty Salween River is one of the longest rivers in the region with an approximate length of 2400km., an international river, originating from Tangula Mountain of the Himalayas in the Tibetan plateau as Mae Kong River. The Salween then flows southward through Yunnan Province of China, down through Shan and Kayah States in the East of Burma (Myanmar), and along the Thai-Burma border, passing through Kayan and Mon States (Burma), and emptying into the Gulf of Martaban in the Andaman Sea.

There are 5 potential dam sites on the Salween that have been mentioned within the past 10 years, from closest to the Chinese border to where the river meets the sea, namely **Tasang**, **Wei Gyi**, **Dagwin**, **Mong Hta-Homong** and **Hat Gyi**.

Numerous impacts to Natural Resources and Environment will go on; Forest**,** Flooding**,** Drought**,** Physical Changes**,** Lost of Species**,** Climate**,** Disease**,** Construction**,** Water Diversion**,** Alternative and so on.

As USER, a small academic unit for researches, publics, conducts and helps coordinate interdisciplinary work on the relationships between human society and environmental change in the Southeast Asia region, the great challenge in Salween Hydropower projects, also is one of the most interesting topics in water governance and Hydrological Sciences for Managing Water Resources in Asian Developing Countries; China, Myanmar and Thailand.

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Climate trend and agricultural water deficit in North China Plain

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Abstract: North China Plain (NCP), the largest agricultural production area in China, provides more than 50% of the nation's wheat and 33% of its maize production with a dominant wheat-maize double cropping system. Water deficit, the gap between crop water demand and rainfall water supply, has been one of the major constraints limiting crop production, because annual potential evapotrranspiraton exceeds annual rainfall in most part of the plain. This water deficit is particularly severe in the dry and windy spring time before the summer monsoon rainfall period, when winter wheat is actively growing. Intensive irrigation water use has led to over-consumption of groundwater, resulting in rapidly falling groundwater tables (at a rate of >1m/year) and cessation of water flows in the rivers. In spite of some studies showing that there seems to be decreasing trend in water deficit due to the decrease of potential evapotranspiration over much of China (Thomas, 2000), big uncertainty remains in North China Plain due to the rapid declining trend in rainfall in the last 40 years and the large temporal and spatial climate variability.

In this paper we use 40 years (1961-2000) of historical climate data from 40 climate stations uniformly distributed in the North China Plain to study agricultural water deficit as influenced by climate change and trend. The changes in the gap between potential evapotranspiration and rainfall, crop water demand and actual soil water supply will be analyzed both temporally and spatially. A cropping systems model will be used to simulate inter-annual and intra-annual variations in water deficit and its impact on winter wheat and summer maize production will also be assessed. The cropping systems model captures the dynamic interaction between soil, crop and climate, and thus provides insights into the interaction between climate trend on water deficit as it impacting on crop growth and grain production.

Based on the simulation results from the cropping systems model, the levels of sustainable crop production that can be sustained by different levels of water supply will be investigated. This will provides a basis for assessment of sustainable agricultural water use in the future.

Interactions between deep drainage and cropping systems in North China Plain as influenced by climate variations

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Abstract: The North China Plain (NCP) is the largest agricultural production area in China, providing more than 50% of the nation's wheat and 33% of its maize production with a dominant double cropping system. Although its monsoon climate with concentrated summer rainfall favors summer crops like maize, annual rainfall is not enough to support the intensive wheat-maize/wheat-cotton double cropping systems currently in use. Intensive irrigation water use, especially in the dry spring for winter wheat crops, has led to over-consumption of groundwater, resulting in rapidly falling groundwater tables and cessation of water flows in the rivers. Currently, various options are being explored to stabilize the water levels and to achieve sustainable groundwater withdrawal rates, which include proposed changes in cropping systems, water pricing, water-saving technology, and urbanization. Crop changes have been considered an effective option to reduce evapotranspiration and increase drainage and groundwater recharge. This requires quantification of the interactions between deep drainage rate, cropping practices and variable climate both temporally and spatially.

We explore a systems approach using an agricultural systems model (APSIM) to quantify these interactions. APSIM integrates the crop growth and water use, soil water balance and impact of climate and specific management practices together, and can simulate the field water balance (infiltration, runoff, transpiration, evaporation, drainage) continuously over time. It allows flexible specification of crop types, cropping systems (eg wheat-maize rotation), and timing and amount of irrigation and fertilization applications, thus is well suited to quantify the drainage rate for a given climate-soil-cropping systems combination. APSIM model will be validated using experimental data from Yu Cheng and Luan Cheng stations (in another project) for its ability to simulate evapotranspiration, crop growth and water uptake from different soil layers and drainage passing the crop root zone.

Historical climate records from 1961-2000 from 40 sites uniformly distributed in NCP will be used to run the validated model to generate annual drainage values. Typical soil profile representative for each site will be characterized for the simulation study to capture the impact of soil water storage capacity. Simulation scenarios will include single, double and opportunity cropping as possible options, and at zero and different levels (both timing and amount) of irrigation and fertilization. Regional drainage maps will be produced showing the average and variations of drainage as influenced by climate and management practices. The generated drainage rate represents the potential fraction of recharge to the aquifer as a result of soil-climate-cropping systems interaction. The effectiveness of changes in crop types, rotation types, water-saving technology and other possible management practices will be discussed.

Discussion on China's water resources management and its law and regulation system base on water right theory

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Abstract: As the largest developing country in the world, China is facing with the challenges of flood disaster, water shortage, water pollution, soil and water loss in aspect of water resources, among which the water shortage crises is especially remarkable. The per capita water resources amount in China accounts for 31 percent of the world's average level. Together with the temporal and spatial uneven distribution, the water supply ability doesn't match the local economic and social development, and water shortage has become the bottleneck of sustainable development in some arid region. Based on the above problems and their origin, a new conceptual thinking in water resources management named the State Water Right System Framework (SWRSF) is advanced in this paper, which aims at improving the rational development, efficient utilization and effective conservation of water resources through the construction of the SWRSF. Some key problems in SWRSF are discussed, such as initial water right allocation and water right circulation. The SWRSF relates to most areas of resources, economy and society, so a whole system of laws and regulations in water resources management should be established, so that the application of national water strategy and the construction of the SWRSF can be ensured. China is launching some experimental work in initial water right allocation and its circulation, which primarily reveals that the construction of the SWRSF and its law and regulation system can help achieve the sustainable water resources utilization and the economic and social sustainable development in China.

Keywords: Water shortage, Water resources management, State Water Right System Framework, Law and regulation system

THE ANALYSIS AND RESEARCH ON THE WATER PRICE MODE OF WATER TRANSFER PROJECT

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Abstract: Water transfer is one of the most important measures to mitigate uneven distribution of water resources and to balance water demand and supply among regions. It also plays a significant role in helping the harmony development of society, economy and environment in water scarce regions. On the other hand, despite these advantages, many problems still exit, among which, the reasonable water resources allocation in importing regions and the efficient and sustainable operation of the projects are widely concerned. Many researches and practices in China and abroad have shown that reasonable water pricing can effectively reduce water demands, facilitate reasonable water distribution and water use, and guarantee a highly effective and sustainable operation of water transfer projects. In this paper, a new water price mode, TPSWPM, was designed for sustainable operation，water saving and maximum benefits. The mode was also improved to make its use more practicable. The promoted TPSWPM model was applied in Yin Da Ji Huang (transferring water from Datong River to Huangshui River) water transfer project, the No1 project of Qinghai province.

Using “blue-green water” concept to optimize water resources management in China

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Abstract: Water, like energy, is essential to the nation's economic productivity, and the maintenance of biodiversity values and ecosystem services. However，China, especially its northern region is facing severe and increasing water scarcity. The largest remaining water challenge is whether there is enough fresh water to sustain food production and service natural ecosystems. Of the solutions to solve the water crises, using “blue-green water” concept to optimize water management is one useful way. The concept of green water was first introduced by Falkenmark(1995), to distinguish it from blue water, which is the water that occurs in rivers, lakes and aquifers. In fact, of all water resources, green water is probably the most under-valued resource. Yet it is responsible for by far the largest part of the world's food and biomass production. Through compute, the paper finds the average ratio in many years of green water to the total water resources is 60 percents in the whole nation, and above 80 percents in the northern arid region. The paper argues that the crucial resource is "green" water, not "blue" water, and there are grounds for optimism if resource management can be improved. For food production, engineers have concentrated on irrigation，and neglected rainfed agriculture, which does not require impressive engineering works. The most probable way forward is not the building of gravity irrigation schemes (involving a number of farmers), but the prudent use of groundwater or rainwater harvesting in combination with soil and water conservation.

Water Woes in South East Asian Riparian Countries; A Conservationist's Appraisal

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Abstract: Himalayan Rivers flowing through the Indo Nepal borders of Ganga Basin has made the floodplains of Bihar vulnerable to devastating flood rendering thousands of hectares of land as waterlogged fallows. Drained mainly by the eastern Himalayan Rivers, the Ganges basin provides geo-ecologically diverse features, which are reflected in its resources. Being one of the most populous places on earth, there is, consequently, a substantial demand and competition for resources, particularly the water itself. Irrigation barrages control most of the tributaries modifying the flow of the river and considerably influence aquatic biodiversity. Impacts on the fertile floodplains where empolderment for rice farming is practiced have already modified to an extent of more than 50% of the floodplains of Bihar state along the Indo Nepal borders. The diverse and productive aqueous agro-environment of the basin is already under anthropogenic pressure and this is likely to increase in future. The present population of the Basin is around 500 million, which by 2030 would cross over to a billion, with almost half below the poverty line. This plain remains submerged under flood waters for around 100-120 days a year between July and October. Major rivers of Nepal that contribute over 40 % of the total flow of the Ganges and over 70 % of its dry-season flow are Mahakali, Karnali, Gandak and Kosi of which the last two are looked up as the "sorrow of Bihar". The total amount of water though enough to meet the social, economical and environmental requirements of this part of the basin, land man ratio and per capita food grain availability is steadily declining. The integrated development and utilisation approach of the basin's huge natural resources have never been sought by the regional countries due to past differences in perception, legacy of mistrust, lack of political vision, and lack of goodwill. The international water regulation issues on high dams between India and Nepal is still in a stalemate whereas politicized Flood Games have become annual rituals of assuring flood hit people. The present paper reviews the problem from a conservationist angle in an attempt to suggest alternative policies and adaptive technological practices to save the ecology of these wetlands and manage the water resources.

The Problems and Countermeasures on the Demand and Supply of Water in Fujian Province

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Abstract: The paper analyzes the natural characteristics of water resources in Fujian province. The main problems in the development of water resources in the province are discussed. According to the prediction of social and economic development, the water requirement, the structure of water consumption and the water pollution of 2010 in the province and its coastal area have been predicted. It have been put forward that there are five problems faced in the equilibrium of supply and demand of water in Fujian Province. They are the contradiction of the rapidly increased demand on water supply with the higher rate of development and utilization of water resources, the shortage of water supply in low-flow season, the contradiction of geographical distribution of water resources with that of un-matched social-economic development, the contradiction of relatively abundant water resources with worse conditions for its development, and the water shortage characterized by serious pollution. The countermeasures of sustainable utilization for the water resource in the province are discussed.
Keywords: Fujian Province, water resources, water demand and supply, countermeasure

Population growth, consumption patterns and water quality management : A case study of Nigeria

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Abstract: The UN (1992) projects that world population will, under the most likely scenario have increased from the 5.3 billion of 1990 to 6.3 billion by 2000, growing there after to 8.5 billion in 2025, 10.0 million in 2025, and 11.2 billion in 2100. The world bank 担 project are very similar.

Nearly all of this growth is anticipated to occur in today 担 developing countries increase in world population would mean increase global demand of energy, which with current energy technologies, would result in increase in green house gases (GHG). Nigeria 扮 natural environmental resources and the quality of it water is severely threatened, according to a 2002 U.S Agency for International Development (USAID) study of the challenges and possibilities facing the Nigerian environment. The report found that increasing poverty, high population growth and migration, especially into urban area and political/institutional constraints are the underlying causes for environmental degradation in the country.

The paper therefore aims to emphases that when making plans for long term water quality management in Nigeria, dispersion modelling is important top project trends in water quality, which include what to monitor, how to monitor, where to monitor and the data collected from water quality monitoring systems may be used for a variety of purposes.

The paper concluded that in Nigeria, water quality management aims to maintain the quality of the water that protects human health and welfare but also provides protection of animals, plants (crops, forest, natural vegetation), ecosystems, materials and aesthetics, such as natural levels of visibility was also discussed.

RESARCH AND CAPACITY BUILDING IN Management of water environment IN NIGERIA

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Abstract: This paper gives a general overview of research and capacity building as they relate to Management of water environment in Nigeria. Defintions of some common terms were presented . Social or Management of water environment models were examined while action plans for different levels were recommended .At the individual and national levels, tranning and information sharing are considered crucial to ensure sustainability and equity. At Government level, allocation and timely release of funds and other resources to Management of water environment projects Should be pursued vigorously. The paper further recommends that a multidisciplinary and multi-locational research and development strategy should be adopted for Management of water environment projects.

GROUNDWATER VULNERABILITY ASSESMENT AND SUSTAINABLE MANAGEMANT OPTION FOR ARUSHA MUNICIPALITY AQUIFER, TANZANIA

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Abstract: Groundwater is a strategic resource due to it's usually high water quality and perennial availability; however groundwater management all over the world lacks sustainability and has often been left as an open access resource. Indeed aquifer management is a complex problem with conflicting objectives, in which all aspects should be taken into account in order to achieve sustainability. The recent upsurge in urbanization, industrial, economic and agricultural development within Arusha Municipality and its surrounding has put more stress in its major water resources supplier: the groundwater. The water demand and abstraction has been continually increasing since 1999, with an annual increment rate of about 5.3%, and the projection is such that the Arusha Municipality groundwater resources will not meet its industrial, domestic, institutional and agricultural water demand by the year 2015. The biggest challenge faced by the water planning and supply Authority in the municipality is to identify the optimal management option for sustained and meaningful aquifer abstraction, and to delineate areas which are more vulnerable to overdraft: this formed the objective of this study. The 3D- numerical model, Visual MODFLOW was used to simulate transient flow in the unconfined Arusha aquifer. Different management scenarios were formulated and evaluated based on some constraints. The GIS package Arc View was used in identifying and delineating areas more vulnerable to overdraft of groundwater. The study found that the use of groundwater resource only will not meet the water demand by the year 2015, and that the sustained option is to introduce ten new pumping wells with varying discharges in a span of fifteen years within specified locality. The study also found out that the most vulnerable area is the western and northwestern part of the Arusha town. For sustainability purpose, no new wells to be put up from the year 2015 onwards, and the aquifer artificial recharge options to be incorporated in the Arusha Aquifer management plan.

Keywords: Urbanization, Groundwater abstraction, Groundwater Management Option, Sustainability, Groundwater Vulnerability, Groundwater overdraft.

Water Management Techniques for Mitigation of Drought in Pakistan

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Abstract: According to an estimate about 2.3 billion people in about 50 nations will be saddled with severe water shortage by 2020 because of global warming . According to another estimate the Himalayan glaciers , which are life blood of fresh water for many South Asian rivers have already receded considerably in the past decade . In Pakistan its importance is more than ordinary due to the fact that pakistan is a developing country with an agro-based economy. Out of 79 million–hectare areas about 22 million-hectare area of Pakistan's in cultivation and is watered by one of the largest irrigation systems in the world. The Indus Basin Irrigation System in Pakistan comprises of three major reserviors Tarbela, Mangla and Chasma, 16 barrages, 2 head-works, 2 siphons across major rivers, 12 inter river link canals, 44 canal systems. Thus the total water available for irrigation purpose is 144 MAF of which 97% is used for agriculture and the remaining 3% for domestic and industrial use. Yet the country's rural economy still facing a problem of inadequate water resources, and increasing water scarcity. Inspite of having intensive natural resources of water the country has endured its 9th successive years of drought, with national rainfall levels at 41% below normal. The 50% of average annual rainfall is lost as run-off. Even if the run-off is taken at 20%, the average annual run-off loss of water comes to 36 MAF which is a huge loss which the nation can ill afford . The existing conventional water harvesting practices in the arid and semi-arid regions hardly collect 20 to 30% of the precipitation while more elaborate technology may permit to collect up to 90% of it. Present paper highlighted the various water harvesting techniques if implements have a good potential of conservation of water and its subsequent uses.

Integrated planning to improve the ecological status of surface waters under consideration of socio-economic frame conditions

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Abstract: The European Water Framework Direction demands new planning approaches for river basin management. The general aim of planning, specified by the EU with “a good ecological state” of surface waters demands a detailed analyses of anthropogenic pressures on the aquatic ecology. As river basins are distributed systems spatial differentiated characterisations of human impacts are needed. Also the resulting effects on the aquatic ecology have to be localized and related to the human impacts specified before. Here the WFD prescribes a differentiation of river networks into spatial elements (river reaches, the so-called water bodies). For these sub-units the state (physico-chemical and biological characteristics) but also the pressures and even the driving forces for these pressures within the watershed have to specified. The fluxes of water and chemical loads within the river basin have to be related to the human activities.

The subjects of planning are ecological systems. These systems depend on complex interactions of many factors which can not be described in a quantitative way in total. Often additional expert knowledge is needed to specify the limiting factors. Here the methods of soft-computing seems to be helpful. In some cases monitoring programmes have to be initiated to provide better data and information about the quality elements and the status of aquatic ecology.

A large variety of data and information is needed which has to be combined in an effective way. Client-server solutions using the Internet are useful to set up a complex data base combined with GIS. Strategies to improve the ecological status demand causal relationships between the aquatic ecology, described by different indicators, and the human impacts. These relationships can be provided by models interlinked with the spatial database mentioned before.

Planning without a consideration of socio-economic restrictions and boundary conditions can not result in sustainable solution. To ensure an integrated planning approach the socio-economic objectives, constraints and consequences of any measures have to be considered. Potential measures should be judged not only by their ecological efficiency but also with regard to the long-term costs, the social consequences and the public acceptance. Here costs, benefits and possible conflicts have to be estimated with methods of socio-economy under assumptions of different management strategies and different baseline scenarios. Multi-criteria optimization methods are needed to balance social and economic costs with ecological benefits and to find the most cost-efficient and ecological effective strategies which are feasible with regard to their social impacts.

The planning approach described above was realized for a river basin in Germany to demonstrate the feasibility of complex and interacting planning tools, based on a close cooperation of ecologists, hydrologists, water managers and economists. Informatics provided the framework of this planning approach. It will be shown how spatial distributed data bases, mathematical models from different disciplines and a decision support systems were combined into an interactive useable system for river basin planning.

On Virtual Water Trade Exported from Guangdong Province to Hong Kong

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Abstract: The concept of 'virtual water' was first given by Tony Allan of London University in 1993(Allan, 1993, 1994), and it was defined as the water used in the production process of commodities and service, e.g., 1-2 tons of water for producing 1kg rice, and 32kg of water for a 32-megabyte computer chip of 2 grams (A.Y. Hoekstra, 2003). It is the water embodied in the product or service, not in real sense, so it could also be called 'embedded water' or 'exogenous water' (A.Y. Hoekstra, 2003). The concept of 'Virtual Water Trade' was used to explain how water deficit was balanced in a region and country by importing water-consumed commodities, especially agricultural products.

The first international conference about virtual water was held in Delft, the Netherlands in Dec. 2002, and virtual water was a topic in the 3rd World Water Forum, held in Kyoto, Japan. In China, research on virtual water became a focus since 2004. Virtual water trade provides a new way to deal with water resource management, allocation, and the impacts of water resource on social and economical aspects on the regional and global scale.

Hong Kong is located in the southern part of China, with an area of 1,098 km^2, and a population of 6.803 million. Annual precipitation is 2,200 mm , and one-third of its area, about 300km^2, is used for water catchment, which provides 2.95×10^8 m^3 fresh water per year, less than 30% of total water demand. Currently, Hong Kong imports 8×10^8 m^3 of fresh water (real water) per year from Guangdong province through water transfer project from the east tributary of Pearl River. Guangdong province is adjacent to Hong Kong, and both of them are closely connected economically. Export of agricultural products from Guangdong to Hong Kong is equivalent to water export, i.e., virtual water trade between them.

The main objective of the study is to calculate virtual water in the agriculture products exported from Guangdong to Hong Kong during the period of 1981 to 2000. The calculation of virtual water in the study included the unit requirement of water resource for grains, vegetables, fruits & tea, oil, aquatic product, associated with poultries and livestock, and then the total virtual water embodied in them. If virtual water vaporized from seawater aquatic product feed area 9.34 $\times10^8$ m^3 was exclude, annual average virtual water exported from Guangdong Province to Hong Kong is thus calculated to be 1.15 $\times10^9$ m^3, it is a little higher than the total water resource used by Hong Kong every year.

Estimation of virtual water trade volume by input-output analysis - a case study of Zhangye in Heihe Basin

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Abstract:Virtual water trade is a new concept of transfer of water resources associated with transfers of commodities. It may be utilized as a strategy to alleviate water scarcity and to achieve water and food security in water-short areas. Virtual water trade has emerged as a new field of water management, for which difficulties arise in the calculation or estimation of virtual water content, particularly for industrial products. By taking Zhangye in Heihe Basin as a case, this paper explores a new way to assess virtual water consumption based on input-output analysis. The analysis results show that the deficit of virtual water trade of Zhangye in 2000 reached 5.68×108 m^3, which is obviously not healthy for its water endowments. It is therefore imperative for Zhangye to adjust its virtual water strategy in order to relieve the pressure on its domestic water resources and to achieve longer-term water security. Our study has also shown that the input-output model is an operational tool for virtual water assessment.

THE WILLINGNESS TO PAY FOR INCREASED WATER SUPPLY RELIABILITY IN JAPAN

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Abstract: Motivated by the observed downward trend in precipitation in Japan over the past century and subsequent drought events, this paper uses the contingent valuation method to estimate the willingness to pay of residential water users to avoid water supply disruptions. Using the double-bounded dichotomous choice elicitation format, we find that households are willing to pay an average of 2338 Japanese Yen to avoid a 20% reduction in water pressure for one month, 2758 Yen to avoid a supply disruption of 10 hours per day over the period of one month, and 4748 Yen to avoid a water supply disruption of 19 hours, per day over the period of one month.
Keyword: drought, water supply reduction, contingent valuation method, economics, statistical analysis

Theories and Practice of Ecotype Slope Protection Works in Fudu River

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Abstract: Ecotype slope protection works is a safety measure that makes use of natural and artificial materials to resist erode and scour of current, at the same time to create suitable habitats for riverbank creature. From 1970's, people begin to meditate negative action brought by hard slope protection works. Up to now, correlative scientific researches and practice works have been done in some countries, such as Japan, America, Germany and China. As seen by present applications and developments, the researches on ecotype slope protection works are about materials and structural forms. There are many successful cases that have different emphases correspond with different rivers. But as so far, the theories researches of ecotype slope protection works are very scarce. Systemic procedure has not been presented and formed, which result in this technique does not form a universal criterion. Thus the generalization and application of this technique will be limited. At present, hard slope protection technique is still adopted in some rivers engineering. Based on above-mentioned reasons, this paper intends to present a construction theory for ecotype slope protection technique from six aspects that including principle of design, procedure of design, choice of material and structure, calculation of hydrology and hydraulics, stability analyses of riverbank and effect evaluation. At last, the paper introduces ecotype slope protection technique of Fudu River in Dalian city. This engineering adopts 2m × 2m granite meshed net, with lime muck in it; builds granite slope protection belt every other 20m, with the depth 30cm, the length 8m; plants local grass in the meshed net; plant willow in the platform at the embankment root; to prevent the scouring, put wire and stone basket in the platform at the embankment root; the width of the embankment top is 4m; plant forsythia 0.5m to the embankment shoulder; erect a tall bulletin board, with the height 18m; the name of the river is carved on a huge cobble; the engineering instruction is made on the granite sheet. All of the constructive materials come from the local place. Thus the completed project is harmony with the surrounding environment. It is a particular token in this area. Adapting to local conditions, the embankment construction of Fudu River is a project that embodies the thought of ecological recovery and relaxation. It plays an important rule in the flood control, ecological recovery and landscape architecture. Meanwhile, it implements the plan of ecotype riverbank restoration.

Keywords: Ecotype Slope Protection Works; Construction Theories; Engineering practice; Fudu River; Dalian City

Research of Ecological Harness Mode for Urban Seasonal River

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Abstract: The urban river has many functions such as flood discharge, supplying water, storage water, landscaping, ecosystems and environment and so on. With the development of economy and improvement of standard of living, the landscaping, ecosystems and environment functions have gradually been attached importance to. The urban seasonal river has a huge runoff in the times of flood, while a very small runoff in the times of low water. So the research of ecological harness mode for urban seasonal river with economy, ecosystem and environment is very significant in urban programming. This paper analyses the features on hydrology and ecosystems of seasonal river firstly and in succession presents an ecological harness mode of flood land greening on compound cross section. Under normal water level natural stones are been adopted and over normal water level vegetations are been adopted to protect bank slope. The paper researches flow capacity of this ecological harness mode with generalization model. The depth-integrated equations of fluid mass and momentum conservation in two horizontal directions are adopted to make a numerical simulation on a hypothetical generalization model. The equations are solved by the finite element method using the Galerkin Method of weighted residuals. The elements are two-dimensional quadrilaterals. Integration in space is performed by Gaussian integration. Derivatives in time are replaced by a nonlinear finite difference approximation.
Keywords: Urban Seasonal River; Ecological Harness Mode; Compound Cross Section; Flood Land Greening; Numerical Simulation; Two-dimensional Shallow Water Equations.

Joint German-Chinese project towards the development of a water allocation decision support system for Beijing

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Keywords: water resources management, water scarcity, decision support system, optimized water allocation, simulation system

Introduction

Sufficient amount and quality of water resources are preconditions for the development of big cities. Water scarcity is especially a main restricting factor for cities in semi-arid or arid climate zones. An example for such a city is Beijing. The capital of P.R. China takes up the challenge of water shortage, the outstanding conflict between water supply and demand.

Sustainable utilization of water resources through modern technologies has become an important research subject. In this paper the approach of an decision support system (DSS) for the joint optimal operation of different water sources such as surface water, ground water, recycled water and transferred water is presented. It will be developed in the frame of the joint Chinese - German project "Toward Water-Scarcity Megalopolis's Sustainable Water Management System". The project is of significance for the sustainable development of economics and society in Beijing and the success of the Olympic Games in 2008. An indispensable requirement for such a DSS is a simulation model of the water resources and the water supply system.

Water allocation DSS and simulation model

BWA, the Beijing Water Authority, is developing a "Capital Water Resources Allocation Decision Supporting System" to assist in the management of all the water resources of the capital city of the People's Republic of China. Because water being scarce in Beijing, central management of all usable water resources for the city is urgently needed (the former Beijing Water Resources Bureau 2003).

Principal purpose of the DSS is optimal allocation of existing water resources such as surface water, ground water, recycled water and transferred water. For the optimization the goal function and a simulation model of the water resources as well as of the water supply system are necessary (Pfuetzenreuter and Rauschenbach 2005). This model meets the demands for a decision support system with respect to accuracy and simulation speed (Rauschenbach 2001). The simulation system and first results (figure 1) as well as the implementation of the simulation model into the decision support system will be presented.

Strategy of integrate management of Water Resources for transboundary river basin of Central Asia

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Abstract: The goal of Integrate management of Water Resources (ICWR) is to unite on basin level all aspects of water resources control for realizing it under the united leadership. For demonstrating of changeability of ICWR principles there were offered to use approaches "experimental objects" under-basins of the Aral Sea by organize Centers of Planning, which experience may be spread later to another basins include all basin of the Aral Sea. There were chosen four under-basins to demonstrate the operation in different situations. The main characteristic of each under-basin is situation relatively to all basins and situation belongs to state borders. Moreover other characteristics are the natural condition and development level.
Nowadays situation of Vakhsh River's basin is learnt enough in order for showing some results.
Existent water-economic organizations on in considerable degrees inherit their structures and function from Soviet Union. They are structured vertically reflect soviet command economy. These vertical structures work against ICWR and real integration is possible only on common national level. At the some time Ministries and departments are not given necessary attention to problems of integrated control of resources. On interstates context integration is more restricted. The opportunities of integration are discussed only at restrict numbers of chance meeting between ministries of one sector. Nonetheless it needs to be mentioned that in region during the independent years there were conducted a few interstates organizations and also in some states were accepted legislative acts on support of integration in water sector. However effeteness of these integration reforms is too restricted, as in former no two sectors on regular base discuss together having problems (may be with the exception of hydro-energy and water problem).
The trial of advancement to full integrated control with drawing hardly will be successful because of well-organized vertical structure of existent institutions. If there will be attempt to establish all embracing intersector integration in one's stride it is a danger that fail of this attempt may detain achievement of ICWR goals for certain time.
That's why it proposes to work on direct of ICWR inculcation little by little with the result of complete integration achievement during a few years.
The first aim could be in establishing formal mechanism for integration on minimum accessible level according to two to two main models: a) to organize the Working Group (WG) and b) to found Basin Commissions/Committees inculcate basin method of water resources control.
So far as the given informational basin is extraordinary weak, offered institutional changes must be accompanied by the action refer to improvement of informational statistics basin. Otherwise the Working Group could not offer clear and rational decision.
The role of WG and Basin Commission will be gradually increased with the growth of their ability to control water resources. In time gutter forecast, communical-existence o water supply problems and environment will become the main tasks of WG under condition that decision of these problems will be existed by rational and effective way.

Research and evaluation on arithmetic of water saving of irrigation measures in Hebei Province

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Abstract: Water-saving irrigation is a long-term strategy and a focus of water resource management in areas with shortage of water. Great potential exists in Water-saving irrigation because rural water takes more than 70% of available water resources. However, exiting indicatives of water-saving efficiency only comprises water-saving amount or water-saving efficiency in irrigation without considering water amount in repetitives; this incurs error in calculating water-saving amount.

In this paper, firstly, the concept of water-saving irrigation was identified in the perspective of water resources, then new indicative system was established to evaluate water-saving irrigation, i.e. Coefficient of irrigation water resources was used including once water use percentage and repetitive percentage, multiple water use coefficient in channel and multiple water use coefficient in the field, on which was based to deduce water resources coefficient transporting in channel, coefficient of irrigation water resources in wells and channels, coefficient of irrigation water resources in base land. These help calculation of actual water-saving amount and better understanding the actual potentialities of water-saving in local area.

Keywords: water-saving , computing method，coefficient of repetitive use， coefficient of irrigation water resources use, appraisal in water-saving irrigation potentiality

Protect and utilize water resources to guarantee water supply security in Dongguan City

作好水资源的保护和开发利用
保障东莞市供水安全

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Abstract：近年来，随着经济社会的高速发展，东莞市用水形势越来越紧张。2004 年冬末春初出现大规模的咸潮上溯，直接威胁到沿江各取水口，导致东莞市多间水厂出现超盐度取水、甚至停水等恶劣事件，严重影响了当地人民群众生活和第二、三产业生产。文章首先分析东江流域水资源状况和变化趋势，通过进一步分析东莞市水资源开发利用现状及水污染形势，找出水资源开发、利用、节约、保护等方面存在的主要问题，认为东莞市处于东江流域的末端，90％以上的供水水源直接取自过境的东江水，由于东江流域经常出现连丰连枯的现象，加之径流年内分布不均，80％以上的径流量集中在汛期，致使东莞市的枯季供水安全常常受到威胁。文章结合新时期治水思路，提出建立水资源优化配置体系、建设资源节约和生态良好的节水防污型社会等水资源管理系统工程，为解决当地水供需矛盾献计献策。

Indigenous Knowledge and Technology, Integrated Water Resource Management and Sustainable Development

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Abstract: The Apa Tanis of Arunachal Pradesh in India constitute a separate endogamous community with its own territory, language, customs and traditions. The valley used for cultivation of rice is most efficiently irrigated by the Apatanis. Water source is diverted to rice fields through a network of channels regulated by wooden sluice gates. By opening and closing these gates, the flow of water is regulated, so that the desired field can be irrigated. Pissiculture is done along with late variety of rice because of assured water supply and this provides additional income of the farmers with a production of about 50 kg of fish equivalent of about 400-500 kg.

Green Revolution was introduced in India to increase per acre agricultural productivity by western technology with chemical fertilizers, pesticides, mechanization and excessive use of water. But it was neither green nor revolution. Per acre productivity started declining after few years; water level went down dangerously; water became polluted and the farmers started committing suicide en masse. On the other hand we would analyse an indigenous knowledge based technology and water management which produces highest per acre productivity in a sustainable manner using organic cultivation and integrated natural resource management. We also propose to show a 25mts film on the paper.

Every drop of water is carefully utilized. Water is not allowed to flow unchecked as that might sweep away the finest layer of clay from the top. Along the boundary of the field, inside a shallow drain had been dug which would carry the water without disturbing the top layer of surface clay. The slow spill-over from these drains actually waters the fields. Moreover, when water has to be drained from one field into another, which may belong to one's neighbour, a peculiar device is adopted. A hole is made in the balk and a bamboo pipe of short length carries the water to the next lower field.

Using diverse species and often ingenious combinations of water management practices, all these systems contribute tremendously to food security, agricultural biodiversity and the world's natural and cultural heritage. The integration of fish in rice farming provides invaluable protein, especially for subsistence farmers managing rainfed systems. The wet rice cultivation of the Apatanis, is one of the most energy efficient agricultural systems, with integrated water management system and with an energy out/input ratio of upto 60 compared to about 7 for traditional Indian agriculture.

Indicators system and method for rainwater resources sustainable utilization in small catchment on the Loess Plateau of China

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Abstract: Water scarcity is one of the most prominent issues of discussion worldwide concerned with sustainable development, especially in the arid and semi-arid areas. On the Loess Plateau of China, population growth and fast-growing cities and industries have caused ever-increeasing competition for water resources. In recent years, rainwater harvesting, as the age old traditional practice which is being practiced from the birth of human civilization, had becoming very effective in providing water supply and alternative water source. Research of rainwater resources sustainable utilization is a core problem concerning development of dryland agriculture, soil and water environment protection as well as coordinated economic and eco-environmental development. Nowadays the evaluation models and indicators system of rainwater resources mostly use economic indices maximum as optimized objection function, regardless of social indices and eco-environmental indices. Based on the current situation of rainwater resources utilization and the theory of sustainable development, applying analytic hierarchy process theory (AHP), the present paper establishes indicators system and mathematical model for rainwater resources sustainable utilization by taking small catchment as research unit and rainwater resources as research object. The evaluation indicators system is proposed based on characteristics and principles of scientific, practical and concise. These indicators system includes three aspects such as a goal layer – the comprehensive index of rainwater resources sustainable utilization, five standard layers and a serious of element indices. These indicators system systematically reflect rainwater resources utilization features in small catchment. Because of the complex relation of indicators factors, synthetically sustainable utilization evaluation includes quantitative and qualitative aspects. The evaluating model and indicators system are applied to evaluate synthetically the status of rainwater resources utilization in Nihegou catchment in Shanxi Province of China. The evaluation model played an important role in the evaluation and management of rainwater resources sustainable utilization and eco-environment construction in Loess Plateau of China.

Keywords: small catchment; rainwater resources; sustainable utilization; indicators system; evaluating method

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THE PESPECTIVE OF WATER DEMAND IN CHINA

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Abstracts:The paper reviewed the water use trend of China over the past half century (1949-2005) and concluded that the total water use ranged from about 100 billion m^3 to 550 billion m^3 and the rate of increase was declining. It was high (5.2%) in 1949-1980,about two times of the increase in population (2.7) for the same time period. Since 1980, China has maintained rapid economic development and has taken various measures in water resources management, the trend of a high increase rate of water use has restrained. From 1980 to 2005 the low increase (< 1.0%) of the water use rate supported the rapid economic growth at the average rate of over 9 %; the zero growth of irrigation water lasted for 25 years while the grain output increased 44.3% under the expansion of 6.7 million ha of irrigated land.

The steady decline of per capita water use and the zero growth of water use for 15 provinces/autonomous regions in recent years indicate that the gap between water supply and demand is expected to be bridged, if the national water saving policy can be fully implemented.

The author pointed out that overestimates of water demand in the past exaggerated the estimated gap between water supply and demand. In the early 1980s, the estimated water demand for China in 2000 was projected to be 700 billion m^3 based on a nation wide water use project. Similar projections were made in 1990s for the entire country (650 billion m^3 for 2010, for author's view this would not be possible to achieve). Overestimation of water demand has led to mistakes in strategy and policy formulation. As a result the government may prefer to rely on taking structural measures rather than concentrating its efforts in improving water use efficiency. The author emphasizes the importance for speeding up the process of building a demand oriented strategy in water resources management.

Giulan Water Source (potential, Limitations and its Problems)

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Abstract: One of the must important elements in the comprehensive development in any region is undoubtedly the accessibility of the sweet water. Guilan located in southern coasts of the Caspian Sea and in north of Alborz receiving various moist sources, is one of the densely rained areas in Iran. The presence of different rivers along with the height of the water table has caused the growth of economic activities dependent on water. So the abundant of water sources has stopped the officials to think of accessing new sources or adapting necessary measures and policies to rationalize the use of water sources. Increasing growth of population, lack of adequate instruments for job creation, traditional methods of using water sources along with unplanned development of agricultured area have caused different problems especially in recent years that precipitation were insufficient. This paper has tried to consider the role and place of the waters sources in the future planning of the State. The research methods is based on the descriptive statistical methods and analyze of the water sources.

Keywords: Southern Coasts of Caspian Sea. Guilan, Water Source

Water Resources Management in Karkheh Basin-Iran

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Abstract: Karkheh basin is located in the semiarid and arid regions of Western Iran, an area with severe water scarcity. 70% of rainfall is directly evaporated. The potential annual evaporation of the southern and northern regions is 3,600 mm 1,800 mm, respectively. Agriculture plays an important role in the economy of the basin. In the present situation, 3.9 bm3 of water are used for irrigating 378,164 ha of irrigated agriculture (horticulture and field crops), and surface water and groundwater resources provide 63 percent and 37 percent, respectively, of this volume. Of the irrigated area, 76.5% is under cereals (wheat and barely), 23% under pulses, and 0.5% under cultivation of forage, orchards, melons and vegetables, and oil seeds. The area is particularly low in terms of yields, productivity and incomes. Irrigation efficiency in the basin is 28-36 percent and the overall Crop Water Productivity in the basin is about 0.55 kg/m3. In this paper, the specifications of the Karkheh Reservoir Dam & Hydroelectric Power Plant as the biggest dam in history of Iran with total volume of reservoir 7.3 Bm^3 and Karkheh irrigation and drainage network project are illustrated. Also the situation of water availability in the basin, surface and groundwater potential and some aspects of water resources management in the basin are considered.

KeyWords: Karkheh-Water Resources-Zagros - Iran-Basin- Management

Towards Sustainable River Basin Governance in the Dongjiang

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Abstract: At the moment, the overall management responsibility of water resources in the Pearl River Delta region rests with the Pearl River Basin Water Resources Commission, although there is a multitude of other local and provincial bodies responsible for various aspects of water resource management issues in this river basin. Being designated as the lead agency overseeing water resources management in the Pearl River Basin, the successes and the limitations of the work undertaken by this Commission have enormous implications for the welfare of the economies and people residing in the greater Pearl River Delta region well into the 21st century. To what extent the Commission, which was established as early as 1979, is empowered by the central and provincial governments to carry out its mandate is one of the primary questions to be explored in this paper. The primary functions and responsibilities of the Commission, as well as those of several other government bodies with assignments pertaining to some specific aspects of water resource management, would be examined to help improve our understanding of the problems and prospects of creating a sustainable river basin governance system to ensure that an adequate supply of clean water for all the communities in and around the delta region be available for generations to come. Focusing on the river basin of Dongjiang, the paper is designed (i) to help improve our understanding of the primary functions of and institutional constraints faced by the river basin commissions in China; (ii) to explore the feasibility of introducing an innovative institutional mechanism for the purposes of strengthening river basin governance as the country shifts toward a market-oriented economy; and (iii) to examine the extent to which concerned stakeholders such as different water-user groups from up-stream, mid-stream and down-stream communities could be involved in the river basin decision-making processes.

Preliminary Study on Water Demand and Economic Development in China in the Past 20 Years

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Abstract: A model for relationship between water demand and economic development has been established firstly in this paper. Then, according to the statistical data of water use and economic development from 1980 to 2000 of the National Integrated Water Resources Planning, the contribution rates of water supply increment, water use efficiency improvement, and industrial restructure to the development of GDP (Gross Domestic Product) are computed using this model., Finally, some analysis are primarily made based on the computed results, including the role of water supply increment, water use efficiency improvement, and industrial restructure to economic development, and their differences in different provinces. The main conclusions include: 1) in China, from 1980 to 2000, the contribution rate of both water use efficiency improvement and industrial restructure is much higher that of water supply increment; 2) the rates of the three measures are quite different in different provinces; and 3)at present, China is still in the process of rapid development, the strategic countermeasures for water demand control, therefore, should be water use efficiency improvement and industrial restructure.
Keywords: water demand, water use efficiency, industrial structure, economic development

Study on Countermeasures of Maintaining Sustainable Water Resource Utilization in Semi-arid and Arid Areas

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Abstract: To the question of the characters of water resource system, exploitation and utilization of water resources at the present stage and series of interrelated environment deterioration in semi-arid and arid areas in North China, by the way of integrated action of technology and policy, water resource management system has been built which based on a new water-control conception of the harmonious progress between human beings and nature. Some important measures should be implemented as followings: managing water resource aimed at certain basins, optimizing surface water and ground water in conjunction, evaluating the capacity of water system exactly, protecting and perfecting the development of the oases and the headwater, keeping reasonable ecosystem water level and the related ecological water demand, enhancing recycle and reuse of water resource，and constructing water-saving economic structure by regulating water price and popularizing water-saving technics in arid area. Finally the sustainable development of water resource system can be realized in semi-arid and arid areas thus the harmonious progress among resources, environment and social economy can be achieved.

The choosing and change of water conservancy ——Exploiation, manage and distribute in yangwu river-basin since late-Qing and democracy nation period

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Abstract: Centering on the exploiation of the water resource, the local society has formed one set water conservancy order which people abide by in the basin, from head to foot it visit canals , not between village each according to dividing there aren't journey by boat definitely,in accordance with when irrigate, get along harmoniously. But, this " balanced " to say forming of " order " receive this basin climatic conditions , population , land , capital , technology and force including such factors as clan's force ,etc. to restrain from village community. Once these restrain the condition from changing, it is balanced and extremely apt to break , the order is difficult to maintain , must redistribute the water resource, otherwise water will be fought for unable to avoid.In a word,the change of resource may induce social change.

Key word:water conservancy; order; commodity water; social adapt

The Bargaining and Arbitration Model of the Allocation of the Initial Water Rights in the Drainage Area

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Abstract: At present the laws and management system of water resources in the drainage area is unperfect.， and there aren't the correlative matching management ordinance and the implementary detailed rule ,which have led to these problems as the executive dictation of water rights allocation only becomes the technological indicator ,and don't bring about any actual sanction to every water user .The executive water rights allocation isn't implementary in practice gradually ,in addition, Due to the contradictions between the increasing water requirement and the relative steady river water resources ,the water allocation of the river especially in the arid region has caught the public eyes .Actually in the process of using water resources in the drainage area, the information among the areas of the drainage area or the institution of managing drainage area and the areas is incomplete and asymmetry ,for example, the institution of managing drainage area don't know about the actual withdrawal of water quantity and the marginal benefit of using water ,in order to obtain the true data ,the institution of managing drainage area must spend a great deal of the manpower and material resources in investigating the data ,and the transaction cost is expensive ,these problems make the institution of managing drainage area have some difficulty in allocating the withdrawal of water .Presently the allocation of the initial water rights is only limited to the macro-theoretical guidance, lacking in the micro-quantitative analysis .According to these ,as viewed from the efficiency of the allocation and the equity , this paper applies the game theory to study the bargaining and arbitration model of the allocation of the initial water rights in the drainage area ,analyzes the behavior of those concerned and the result ,and discuss the economic efficiency and the fairness of the result ,which make the institution of managing drainage area reduce a mass of the affair cost brought due to the incompleteness and asymmetry of the information ,at the same time how to reasonably share the abridged transaction cost needn't to be considered ,and the content of this paper is significative in theory and reality.

Water resource sustainable utilization of Longgang, Shenzhen

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Abstract: The sustainable utilization of water resource is the important guarantee of the social economic sustainable development. The water resource capacity in Longgang District of Shenzhen is poor; the water amount there is less; the population is large; the economic output is high, and the structure and overall arrangement are unreasonable. These questions have already become the main restriction factors of social economic development. During 11^{th} Five Years Plan, in the premise of reducing expenditure and dealing with pollution in Longgang District, fully utilizing the local surface flow, building and adjusting the storage reservoir, and enlarging the capacity of reservoirs with good conditions will be carried out to achieve the association and optimization of reservoir. And collecting and utilizing the flood of rain, more time utilizations of water and so on, are used to increase water resource, and, at the same time, transferring water from other districts will be continued to alleviate the imbalance between supply and demand of water resource in local district, and then promote the sustainable development of social economic.

Research on flood utilization in Guangdong Province

广东洪水资源化的探讨

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Abstract：近年来，由于气候的变化，我省年内降雨时空分布极不均匀，旱涝灾害交替发生，洪水资源化是减少水灾害最有效的途径。本文以“05.6”洪水为例，探讨在我省实现洪水资源化的途径、效果以及作用。

Exploitation and utilization of sea ice as freshwater resources in the Bohai Rim

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Abstract: With the massive urbanization and industrialization, the Bohai Rim has been inevitably facing many difficulties and challenges for its modernity and prosperity, in which freshwater shortage has become the bottle-neck of regional sustainable socio-economic development under the tremendous pressure of ever-increasing populations. In this area, the total quantity of fresh water is only 2% of the whole country, but nursing 18.15% of the total population of the country and providing over 24.91% of the total GNP. And the average per capita quantity of fresh water in most coastal cities is less than 500m^3, among which Tianjin, DaLian, Qingdao and Beijing are even below 180m^3. So, to seek and enlarge new fresh water resources is a vital role in solving this problem and putting the regional development on a sustainable track.

Some tentative plans have been provided for using the sea ice resource during these years, considering that the sea ice salinity is much lower than that of the seawater during the freezing course, which could be transformed into fresh water by simpler treatment with small cost. Recently, many case studies on the resourcization and utilization of sea ice have been conducted around the Bohai Sea region and a series of active progresses have been made accordingly. Some works has been down in the following areas. (1)The sea ice resource gross in Bohai Sea was up to $1.0\times10^{12}m^3$ in a heavy ice year by remote sensing estimation.（2）The micro-structural characteristics of sea ice as a hybrid of crystal and brine symbiotically formed the basis of desalination technology. (3)Four kind of methods and technologies on the desalination of sea ice were proved useful in a field trial, whose product water quality could accord with the drinking and surface water environment quality standard and trial cost was about from 3.9 to 6.5 yuan per stere. (4)The melt sea ice and product water desalting from sea ice was used in agriculture irrigation and aquiculture in a project supported by the Ministry of Science and Technology, China. The trying for the exploitation and utilization of sea ice may help to find a new type of unconventional freshwater reserve resources in the Bohai Rim.

***Keywords*:** freshwater resources; the Bohai Rim; estimation by remote sensing; desalination of sea ice; sea ice water agriculture

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Emergy assessment of water resources value of China's main rivers

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Abstract: Water is one of the most precious resources. The value of water resources occupies an important place in water resources management and sustainable utilization. In this paper, the emergy analysis is introduced into the assessment of water resources value. Emergy analysis is a methodology of quantitative analysis based on thermodynamics which determines the values of natural resources, services and commodities in common units of the solar emergy. Based on ecological economics theory, the emergy value concept of natural resources was discussed. According to the rules of water cycle and emergy concept, the connotation and extent of water resources value was analyzed. Different aspects of emergy value of water were compared and summarized. Taking China's main rivers as a case study, the value of water resources was investigated using the chemical potential energy of water. Several indices of the different rivers from the emergy assessment were figured out. Several indices of average total rivers are close to those of the average global river water. The main data of average total rivers of China are the emergy transformity (4.17×10^{4}sej/J), the emergy per volume (2.05×10^{11}sej/m^3) and the emdollar per volume (0.068\$/m^3). The value of water resources of Haihe-Luanhe River (11.39×10^{4}sej/J) is highest, followed by Yellow River (10.27×10^{4}sej/J), the lowest is the Rivers in Southwestern China (2.92×10^{4}sej/J).The results show that using the traditional methods (e.g. market price) to appraise water resources value possibly underestimates its real value and that emergy analysis is a scientific, equitable and effective method. However, the application of emergy analysis method in the research field of water resources value remained to be further studied.

Keywords: emergy; assessment; water resources; value; rivers

Potentiality Analysis of City Rainwater Utilization and its Countermeasures

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Abstract: City rainwater is a useful strategic water resources. The study of utilizing city rainwater values much in the 21th century. This paper analyzes the background of city rainwater utilization and its significance. The author puts forward two methods of potentiality estimation, including ordinary experienced formulation and model of half distributed month water balance. An example with the college region of ZhengDong New District in Zhengzhou is given to calculate the rainwater utilization potentiality and available utilization. Then, some of the common city rainwater utilization mode, such as lawn, roof and lake, square storage, infiltration equipment, are introduced according to different underground mats. The integration utilization mode that involves several utilization methods is also presented. Finally, some specific countermeasures and solutions are provided, in allusion to the problems of city rainwater utilization.
Keywords: rainwater utilization; potentiality estimation; roof rainwater collection; Countermeasures

Research and discussion in utility of rainy and flood resource in plain river net area

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Abstract: In this article, based on northern plain of Jiashan city among Tai Lake drainage area, analyzing and researching how to utilize parts of rain and flood resources have been done. And we must bear certain risk, insure the safety of flood control, attemper with scientific way, make full use of rain and flood resources, supplement the water source for preventing dry, dilute and metathesis polluted water and pour back underground water, etc.

The Study of the Water Resources Allocation Fairly in different sectors

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Abstract： The article sets up the model of allocating fairly the water resources in different sectors and the indexes system of fairly weight, puts forward the new conception of allocating fairly the water resources and efines it. The article firstly allocates fairly the water resources in different sectors in reason through the point of view about original usufruct of the common water resources. The new conception enrichs the content of the original usufruct of the water resources and makes it have the better operability. .It will promote the establishment and perfection of the market of water and has provided the new theories and method for the implementation that the allocation of water resources of the district is optimized.

Keywords： Fairly Water Resources allocation；the Initial Water Right ； Fairly Weight ； Index system

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The Impact of Sticky Gross Water Supply to The Adjustment of Industrial Structure in Ningxia

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Abstract：Studies the problem of how to adjust the industrial structure to raise the carrying capacity of water resources under the sticky gross water supply in Ningxia. The paper analyzes the utilizing status of the water resources in agricultural areas irrigated by Yellow River water and the impact of various industries to the utilizing efficiency of water resources in Ningxia using the principal component analysis，and finds that the order, from high to low, of the various industrial utilizing efficiency of water resources is servings industry、industry、agriculture, however because the amount of using water of agriculture takes a maximum rate, the key of raising the utilizing efficiency of water resources is the agricultural adjustment in Ningxia. At last the paper gives the strategy of adjusting industrial structure in various levels under the sticky gross water supply in Ningxia.

Keywords：Gross Water Supply、Stickiness、Industrial Structure、Principal Component Analysis

The Proportion of Water Usable Distribution for Sustainable Development in Haihe River Basins, China

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Abstract: Sustainable development means that society development and ecological environments is reciprocally harmonious. The proportion of water usable distributed rationally in industry, agriculture, life and ecology is the key to the sustainable development of a river basin. Since 1970s, large amount of water usable of ecology is occupied by industry, agriculture and life because of over-fast society and economy development, and thus many serious eco-environmental problems are produced, such as water and soil loss, channel flow-breaking, wet-lands shrinking, water contamination and the annual water volume reaching to sea outfall decreasing, etc in Haihe river basins. At the same time, serious water pollution is caused by a large amount of contamination discharged from society and economy activities in the river basins. These serious eco-environmental problems and water resources shortage has blocked the sustainable development of Haihe river basins. In order to resolve the water resources shortage and serious eco-environmental problems, some water will be diverted into Haihe river basins by the South-to-North Transfer Project that from 2010 on, 79.9×10^8 m^3/year of water in Yangtze River will be diverted into Haihe river basins by Easter Route, and from 2030 on, 108.4×10^8 m^3/year of water in Yangtze River will be diverted into Haihe river basins by Eastern Route and Middle Route, and at the same time eco-environmental restoration program will be done and the eco-environments is predicted to be ameliorated to a good state about 2040 or so. The rational distribution of water resources usable is the key to resolve the contradiction between water use of ecology and that of agriculture, industry and life, especially is the key to reach the aim of eco-environments restoration is being reached about 2040 or so. So, multi-objectives optimization and time series analysis is used to calculation the rational proportion of water usable distribution from 2003 to 2040 in Haihe river basins under the conditions of sustainable development, the plan of society and economy normal development, the water supply of “South-to-North Water Transfer Project” and eco-environments gradually meliorating of the river basins. This will not only supply a scientific basis to the eco-environmental restoration of Haihe river basins but also supply a scientific method to the eco-environmental restoration of other river basins.

Keywords: Rational proportion of water usable distribution; multi-objectives optimization; time series analysis; sustainable development; Haiher river basins.

The Groundwater Resources Research in Beijing Area and the Strategy of Sustaining Development

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Abstract: The author introduce the groundwater resources of Beijing area from past to now. We discuss the disequilibrium relation in city and water resources distribution and development. Analyze the problems in using groundwater resources. Point out the environment and geology troubles by that. And analyze the strategy of the wastewater reused.
Keywords: area Beijing, groundwater resources, sustaining development, wastewater reused, water resource conservancy.

The Demonstration of Optimization for Water Resource Developing and Utilizing-----Taking Urban Agglomerations in Guanzhong as an Example

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Abstract: Water resource is a kind of important economic resource. The sustainable development of water resource utilization is not only a significant constituent for the sustainable development in a country or a region as a whole, but also the base and indemnitor for the whole national economic and society. Urban agglomerations in Guanzhong is a dense towns in northwest which is also an area lack of water badly, the per capital water resource of which is only 285.5m^3 only 12.4% of the average level of the whole country(2300m^3). The per capital water resource for one unit of plowland in this region is only 17.7% of the average level of the whole country(1581m^3).Moreover, many anabranches of Wei He river on both north and south riverside in this area have been polluted in different degrees which lead to the broadening of water resource gap in Guanzhong area, which seriously affected the implementation of region economy development strategy. This thesis analyses the actuality of water resource developing and utilizing in urban agglomerations in Guanzhong and construes the existing problem in water resource utilizing. A optimization approach for water resource utilizing also be given from many aspects such as water resource optimizing collocation, determination of reasonable water prices, changing water resource management system, establishing water abstemious society and strengthening legal system management of water resource to promoting

The Establishment and Application of Model of Water Requirement Prediction for agglomerations

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Abstract: Agglomeration as an important and unique field in the process of urbanization has been paid great attention to by more and more people while the reasonable utilization of water resource is vital to the agglomeration sustainable development. This thesis establishes a water requirement prediction model based on gray system theory by analyzing the influential factors of water requirement and predicts the water requirement of urban agglomerations in Guanzhong in 2010 and 2020 based on which the balance of supply and demand analysis can be given for urban agglomerations in Guanzhong in 2010 and 2020 through this model.
Keywords: water resource, water requirement, prediction model, urban agglomerations

The Sustainable Use Model Research of Regional Land Resources and Water Resources
—a Case study in Luancheng County of Hebei Province

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Abstract: Water resources and land resources are the material base of people's survival. As human demands increase, the extent and depth of using land and water resources are enhanced. The contradiction of water resources and land resources distributions between the different enterprises is obvious. Under the situation, the sustainability of land resources and water resources is in question. Water resources, as the key factor of the regional land use especially the agricultural land, decides the land-use patterns. Based on this background, it is necessary to study the issue with a quantitive method. The coupled function of land resources and water resources affects the change of land-use. Based on the regional characteristics of land use structure and the features of water resources, the paper shows how to build up a model of the land sustainable utilization under the limit of water resources in Luancheng County of Hebei Province . It is a typical area of the North Plain which is one of water scarcity in China. The profits of land-use pattern involve economic, social and ecological benefits. So we adopt the multi-objective decision method in this paper to assure resign projects. By means of the economic goal, social goal and environmental goal, the model proposed different plans under different water consumption. Through the comprehensive evaluation, an optimized plan is advised. In this plan, the economical and social benefits are accessed to the expected goal.

Keywords ： the sustainable use； land resources ； water resources ； coupled function

Integrated regional water resources planning and its application

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Abstract: Along with the development of the society and economy, the shortage of water resources in North China becomes more and more serious. In order to balance water resources, the integrated regional water resources planning is focused on the reasonable development of water resources, as well as its optimal allocation and protection. It will also promote sustainable development of population, resources, environment and economy. In this paper, an approach of regional water resources planning was put forward based on the prediction of water supply and demand, as well as the protection and economization of water resources. By using a series of technical and management countermeasures, such as increasing use efficiency of water resources, adjusting the industrial and agricultural structures to reduce the water demand, considering both of the productive water demand and eco-environmental water demand, and applying of reclaimed water to enlarge the water supply ability, this approach improved technically and rationally the traditional way of water resources planning which simply enlarged the water supply capability to meet the needs of water quantity. It is advised that we should undertake comprehensive protection of both surface water and ground water, and consider synthetically the protection of drinking water head and ordinary water body, water supply and drainage system, and wastewater treatment and reclaimed water. As a case study, this approach was applied in regional water resources planning in the Shunyi District, a new planned satellite city of Beijing. Considering the water demand and water supply project of south-to-north water diversion, it marked out the developing scale of industrial, city and agricultural in the Shunyi District from 2010 to 2030. At the same time, it gave the planning of water resources for industry, agriculture, life and eco-environment, and the utilization pattern of surface water, groundwater, wastewater treatment and reclaimed water. According to this planning, water supply and water demand can be basically balanced after the planning year 2020 in the Shunyi District, and it will be helpful in solving the contradiction between supply and demand under the constraint of water resources. And the technique and rationale involved in this approach also can be applied to regional water resource planning in other area of North China.

Keywords integrated water resources planning; reclaimed water; water supply; water demand; optimal allocation; water resources protection

Sustainable development and management of water resources in Songnen Plain, Northeast China

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Abstract: Songnen Plain, located in the central part of Northeast China, lies between latitudes 121°27´N and 128°12´N, and Longitudes 43°36´W and 49°45´W. Its climate is semi-humid and semiarid continental monsoon type, with mean annual precipitation ranges from 350-450mm in west and southwest low plain to 450-600mm in east and northeast high plain, in which 70-80% of precipitation mainly occurs during the period from June to September, and mean annual evaporation is about 1800mm. It covers a total area of 18.7×10^4 km^2, in which 342×10^4 hm^2 is saline-sodic soil, having been considered as one of three centralized distribution areas of the saline-sodic soil all over the world. Additionally, wetlands are widely distributed within Songnen Plain, there are three wetlands preserved as national natural reserves, two of which Zalong and Xianghai wetlands were included in the List of Wetlands of International Importance in 1992 (Ramsar Convention).

Water resources play a vital role in municipal and rural supplies, eco-environment maintenance, and socio-economic development in Songnen Plain, Northeast China. But in the last two decades, water and its related eco-environmental problems have come out due to natural change and irrational development and utilization of water resources, which are mainly presented in drought, flooding and waterlogging, river dry-up, continuous drawdown of regional groundwater level, salinization of soil and water, and shrinking and eutrophication of wetlands, they have become key factors constraining sustainable eco-environmental and socio-economic development in this region. Therefore, how to develop and manage water resources has been of important concern by the local and national governments, as an urgent and important task.

In this paper, to counter the critical problems mentioned above, strategies and countermeasures of sustainable development and management of water resources have been proposed in terms of the standpoint of scientific development, namely: (1) integrated river basin management must be strengthened, and some countermeasures should be adopted by different government levels to harmonize the beneficial relationships among upper-, middle- and down-stream, including economical, technological, administrative and legal; (2) optimally collocating water resources into effect in space and time, and controlling water conservancy must be established along Neijng River to increase available water; (3) rational wetland area should be restored, protected and managed by making safe use of flood resources and transferring water from river or reservoir in the case of water shortage; (4) agricultural structure and irrigation manner will be modified, and saving-water agriculture will develop intensively and widely and non-point source pollution will be severely controlled; (5) multi-water resources comprehensive utilization should be performed, for example some salt-tolerant crops can be irrigated with mildly saline water and mixture water at a reasonable ratio of surface to groundwater, or different groundwater sources; and (6) A proper relation between irrigation, leaching, and drainage must be maintained in order to prevent irrigated lands from becoming excessively waterlogged and salt-affected, and efficient drainage system must be installed in rice paddy fields to prevent high saline surface water from recharging shallow groundwater through infiltration, at the same time, some measures must be fulfilled to reduce salt discharges to the major rivers.

The Study of Water Resource Sustainable Utilization in the Middle Route of South-to-North Water Transfer Project for China

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Abstract: Due to increasing acceleration of both economic development and population growth, water consumption and requirement have increased greatly since the 1980s, and water shortage in northern China has become a major factor constraining economic and social development. The middle route project will transfer some water from the Danjiangkou Reservoir on the Hanjiang River to Hubei, Henan, and Hebei Provinces, and ultimately to Beijing and Tianjin, as well as to the western part of the North China Plain. The south-to-north water transfer project is considered as a strategic and ambitious approach to resolve water shortage problems in the north of China, but it changes the relationship of water resource utilization in water source region at the same time. The middle route project transfers water 9.5 billion cubic metres (BCM) in 2010 and 13 BCM in 2030 every year from the Danjiangkou Reservoir, which will change the streamflow process of the Danjiangkou Reservoir and create a new hydrological cycle and constitute a new water resource system in the middle and lower basins of the Hanjiang River. Focused on water resource sustainable utilization, a water balance study conducted according to the principle of integrated water resources planning and management is shown in this paper, the result shows, w and the relationship between the basins and the middle route project is discussed in detail. Finally, some suggestions are given to ensure the sustainable utilization of water resources of the two regions.

Keywords: sustainable utilization of water resource; transferable water; the middle route of south-to-north water transfer project; the middle and lower basins of the Hanjiang River;

Studies on a model of protection and integrated water resources management of Tai Lake

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Abstract: Based on the discussing of the present situation of the water resources, water environment and eco-system of Tai Lake and the issues it face, analyses of the present management situation and the existing problems of management of Tai Lake is carried out according to the results of visiting the related management organizations of Tai Lake with interviewing and questionnaire survey, these analyses related to the management of plan, administration, law enforcement and property right of Tai Lake, and the reasons which cause these problems are analyzed. In view of the rapid development of economy and society demands sustainable use of the water resources of Tai Lake, a model of protection and integrated water resources management of Tai Lake is suggested by using of the theories of hydrology, ecology and the water resource management science etc.
Keywords: Tai Lake; protection; management; water resources

Discussion on the watershed management in Regional Planning

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Abstract: Water resource is one of the most serious constraint factors of urban development in China now. Thus, study on water resource utilization and watershed management is one of the most important issues for sustainable urbanization system. Integrated water resource management based on watershed is now very popular and worldwide. Water, as a key factor of natural resource and environment, its movement has significant geographical characteristics. Watershed is a complex hierarchical system with multi-function, and water cycling within a watershed is the resource basis of socioeconomic development and the restraint factor of environment. Thus, integrated watershed management abides by the law of nature and socioeconomic rules, could then optimize regional water resource utilization, and therefore favor sustainable development. This paper firstly talks about the experiences of watershed management from the worldwide perspective, then the watershed management of China and related administration drawbacks are analyzed. At last, the proposal to Legislate “regional planning law” to realize harmonious watershed management and regional development is put forward.
Keywords: watershed management; Regional Planning; China

Study on Coordinative Management System of Water Resources

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Abstracts: Water resources system is a kind of open large system. It has a great connected with social and economic system. Social system determines the purview relationship of water resources and affects the exploitation degree of water resources. Economic system also has influence on the exploitation and intensive use of water resources. In new period, in order to realize the best allocation and optimum utilization of water resources, coordinative management concept of water resources management should be built when unified management of water resources is emphasized. In this paper, the systematicness and harmoniousness of water resources is analyzed. Coordinative management system of water resources management is built and coordinative relationships among different water resources management departments are analyzed. Coordinative management system includes coordination between water management departments and other departments, coordination among different basin management departments, coordination between basin management departments and district management departments and coordination among different water management departments in the same district.
Keywords: water resources; harmoniousness; coordinative management system

Discussions on SC-CO_2 Dyeing Technology and Protection of Water Resource in the Taihu Basin

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Abstract: This paper points out: research and application of supercritical fluids (SCFs), especially supercritical carbon dioxide (SC-CO_2) have very important significance to protect the water resource in the Taihu basin.

Taihu Basin is one of most developed areas in China in terms of economic and social development, especially in the field of textile, dyeing and finishing. However, conflict between water supply and demand becomes more obvious because of the dense population, water deficiency, water pollution and growing demand of water in the region. Among them, textile dyeing and finishing is one of the roots of the troubles, because the textile industry uses large amounts of water in its dyeing process.

Establishing water-saving society and developing corresponding technologies in the Taihu Basin are the fundamental measure for solving water shortage and water pollution problems in this area, which should be the key tasks and main functions of water-saving research at all levels in the basin. In order to reach and finish these goals, textile dyeing and finishing should play an extremely important role.

Due to environmental problems such as the emission of organic materials in wastewater, a new dyeing process has been developed, in which supercritical carbon dioxide is used as an alternative solvent which is considered for dry dyeing processes.

The advantages of supercritical carbon dioxide are that it can be recycled; it is low in cost, nontoxic and nonflammable. Moreover, the dyes can be more usefully utilized, because all the dye dissolved in the supercritical fluid can be recovered when the fluid is expanded.

In this paper, the worldwide development of the CO_2 dyeing technology and the advantages over water dyeing is presented. Furthermore, the influence of CO_2 on the fibre behaviors is described, such as the lubricating effect, CO_2 sorption, crystallization, shrinkage, and thermo-mechanical behaviors, the influence of CO_2, on the glass transition and effective temperature of fibres and the fibre damage. Another important topic is the distribution equilibrium between the fibre and the dyes in CO_2 and the parameter, which influence the solubility of dyes, the dyeing steps, the plant and the optimum process parameter for the most frequently used fibers, such as the polyester are also described.

Keyword: water-saving , supercritical fluids, dyeing technology, Taihu Basin.

Sustainable Relationship of Economic Development with Water Resources in Luoding City

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Abstract: The condition of water resources and flood and drought disasters were analyzed in Luoding city. Combined the condition of water resources and corresponding problems, the countermeasures of industrial structure regulation and economic increasing pattern change, industrial and agricultural system construction of high efficiency water resources unified planning and management, water resource reasonable position and establishment of water right institution have been suggested for water resources sustainable development.
Keywords:water resources; flood and drought disasters ; industrial and agricultural structure; planning and management;sustainable development

Policies for water supply security in Guangzhou, China

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Abstract: Though located in the subtropical zone with an annual precipitation of about 1800 mm, Guangzhou suffers water shortage seasonally and qualitatively. With the rising of the living standard, people are more concerned with drinking water quality. Now, there are basically 3 types of supplier for drinking water in Guangzhou, tape water company, purified water producer, and the separate or dual system for drinking and non-drinking water. Though 3 types of supplier in the market do meet the needs of different customers, municipal water governance needs to consider policies related to safe, affordable and sustainable water supply for all citizens.

A questionnaire was carried out in SUN YAT-SEN University, along with the survey in the purified water factory for the purpose of policy design. The questionnaire includes three groups of questions regarding price, quality and approach to improve the quality of drinking water. 1000 Questionnaires were handed out and 894 with answer were collected. Primary results were given as:13% people hold the opinion that the quality of the tape water is awful, even though the price of tape water is very low indeed, compared to its quality. Female is more concerned with quality instead of price than male.

The price of the purified water is too high to be affordable for university student. Water use efficiency, energy consumption, re-contaminated and health are the important issues to be resolved in the purified water processes and business.

Dual water supply system has the merit in both price and quality, and it is still in a test stage due mainly to technical problems for clean water transport, installation cost, etc.

Approaches to improve drinking water quality were suggested according to the questionnaire:

To protect water source areas.

To control wastewater disposal, especially restrict the disposal without any treatment.

To invest more money on upgrading of drinking water quality and wastewater treatment technique.

Technological system of rainwater utilization in lithoid mountain area in North China

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Abstract：The shortage of water resource is one of important limiting factors to the development of economy of lithoid mountain area in north China. Currently, rainwater utilization is an effective way to meet the deficit of water resources in this area. Taihang Mountain is the typical granitic gneiss area characterized by 'rock-soil dualistic' hydrogeological property— a shallow soil layer and a deep weathering rock layer. The effective methods of rainwater utilization should combine the "water collection" with "water-saving". Based on the hydrogeological features of local area, the paper analyzed the rule of infiltration of rainwater, the movement process of shallow subsurface flow, the recharge characteristic of cranny water by rainfall and the moving path of shallow undercurrent. The paper advanced the technology of seepage harvesting by pipe in mountain slope, seepage harvesting by tiny spring, infiltration-increasing by hedge and biological rainwater harvesting. The effective water-saving irrigation technology was discussed in this paper to match the rainwater harvesting technology. Integrating the above technology and the traditional rainwater utilization technology, we established a series of rainwater utilization mode in Taihang Mountain, such as "the integration of cutting-collecting-trickling water" and "ecologic-economic channel", which was summarized as "trees planted in mountain top, fruit trees circling mountainside, grain cultivated in valley". At present, the utilization rate of rainwater in Taihang Mountain has increased from 20% to 40%, which reinforced the local agricultural irrigation and the water requirement of man and livestock, meanwhile promoted the ecologic restoration in Taihang Mountain.

Keywords：the technology of rainwater utilization; technological system

Water Right Trade and Water Market in China

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Abstracts: Water is the basic resource for the existence and development of human being. China is short of water resources, with its mean water resource per capita far below the global level. Therefore, appropriate water management is essential in China. However, two mistakes exist in the development of water resources. One mistake is that people regard resources have no value and they can use them without any payment. The other is the vagueness of water rights in China. Currently, there are no proper rules for the management of water rights. The randomness, fluidity, vulnerability to pollution, duality and non-alternative of natural stream flows, can easily cause the conflicts between upstream and downstream, left and right banks, and different sections. The legibility of water rights is vital for solving such conflicts. With the diversity of water demands, there are different ways of water resource development as well. Different ways of water resource development therefore form various combinations of water rights. Without clear and detailed definitions of water rights, people tend to easily abuse resources, thus affecting national economy and people's livelihood. Based on the research on foreign water rights, this paper introduces the current water right trade and water market in China. Through analyses of demand and supply of water resources in China, this paper concludes that sophisticated water right management regime and mature water market are efficient ways that will lead to the sustainable water resource management and optimal water resource distribution.

Keywords: water rights; water market; sustainable water resources; water resource distribution; water resource development

The Current Situation of Chinese Water Resource and Security Countermeasure

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Abstract: The water resource safety strategy for China in the 21st century discussed in this paper includes：To increase water resource utilization efficiency; to set up the information network of water resource; to pay more attentive to stratagem water resource and save up technology; to develop water resource trade for abroad market.

Keywords: water resource; the current situation; management; sustainable utilization

Study on Tradable Water Right Management Model in China

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Abstract: Along with economy continuously developing in Chine， water resource is gradually becoming one kind of lacking nature resource， how to utilize the resource efficiently is an urgent question to resolve. Establishment of water market and tradable water right is efficient management means for allotting water resource. Chine should develop trade mechanism of water market under macroscopical control in aspect of the management innovation of tradable water right；Chine should accomplish original water right allotment recur to real options；Chine should constitute rule of law aim at idiographic details of tradable water right；Chine should achieve further perfect uniform management of river valley and offer necessary guarantee for tradable water right；Chine should exert price function in resources allotment with water price system gradually perfected，in this way，Chine will establish perfect tradable water right management system consequently.

Keywords: tradable water right； original water right； water price； management model

Water Availability and Saving, Desertification Control and Poverty Reduction in Minqin County, Shiyang River basin

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Abstract: Water Shortage and desertification is the serioius environmental problems in NW China. Desertification usually leads to poverty. Poverty means people have no surplus resources which then result in the mining of the environment. The Shiyang River and the Minqin Basin provide an excellent type area for investigating the stress on water resources in the arid area. The basin is composed of clastic sediments of widely differing grain size and over the past half century over 14000 boreholes have been drilled with groundwater decline of around 1m yr^{-1}. The evolution of groundwater has been investigated using a combination of isotopic, noble gas and chemical indicators. Modern recharge is around 2mm yr^{-1}, determined using unsaturated zone profiles and chloride mass balance. A small component of modern, presumably river-derived, groundwater is identified in parts of the basin from tritium ^{3}H-^{3}He. A clear distinction is found between modern waters with median $\delta^{18}O$ values of 6.5±0.5‰ and most groundwaters in the basin with much depleted isotopic values. Radiocarbon values as pmc range from 0.6 to 85% modern, with ages from 1200 to 40 000 years.

Water in the Minqin Basin is stratified with the deepest waters of late Pleistocene age and it is evident that most current abstraction approximates to mining of the resources. A new Project is conducted in oasis communities in Minqin County so as to reach following purposes:

Integrating desertification control with poverty reduction based on community development approaches; Promoting the public to participate in desertificatin control and ecological rehabilitation to break the vicious circles of environmental degradation and poverty; Exploring effective ecological poverty reduction approaches so as to set good examples for other comunities and to promote the communities in Hexi Corridor to set good circles of ecological protection and sustainable community development; Imposing potential impacts on traditional governmental development approaches that separate desertification control from poverty reduction so as to demonstrate in ecological poverty reduction for other regions in NW China.

A special breed of goat which is now very popular in all over China has been identified. A total of 530 goats were purchased and distributed to beneficiary households and now increase to more than 2500 for two years. The population is growing steadily over the two years. Fennel has been planted as forage. Trees are grown on previously cultivated land. Desertification control measures, including fixing of sand by wheat stalk and planting of trees along the marginal zone of the Tangeer Desert, have been carried out. Community groups for different purposes were formed. Villagers have participated in trainings and exchanges including, immunization skills and gender analysis etc. The impact on Water saving and desertification control is visible.

Flood resources utilization based on flood control forecast operation

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Abstract: As a key parameter of coordinating flood control and impounding, the flood limited water level of reservoir in flood period is a crucial factor of improving flood resource utilization. With the shortage of water resource, there are more and more problems emerged in reservoir operation. Not considering the information of meteorology forecast and flood forecast, the flood limited water level is at the low side and remains constant during the whole flood season. These are the main problems in impacting unfavorably on flood resource utilization. Therefore, a method of forecast operation classifying flood by accumulated net rainfall is proposed to elevating flood limited water level. Meanwhile, Flood control system is generally complex as it involves a large number of uncertain factors, including hydrological phenomenon, engineering structure and hydraulic calculation, etc. To utilize flood resource in security, a comprehensive evaluation system is presented to obtain an optimum flood limited water level, including risk rate, damaged degree, renew degree and impounding benefit. These approaches are demonstrated by applying to Yuqiao reservoir. It is concluded that different classifying-flood indexes affect variously the impounding capacity of reservoir, and forecast operation mode and comprehensive evaluation system are important for the safe utilization of flood resource in flood period.
Keywords: flood resource, flood limited water level, flood control forecast operation, comprehensive evaluation

Game model of water resources optimal allocation*

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Abstract: A two-stage dynamic game model for water resources optimal allocation is set with the objective of maximization the overall value of water resources. Water rights, public interests, water market and the water price in market which are determined by the dealers' decisions are all taken into account. The solution which satisfies both the administrator's resources allocation mandate and the consumers' private objectives is solved in the case of sub-game perfect Nash equilibrium. An example is given to illustrate the idea with the purpose to provide useful decision support for the modern management of water resources in China.
Keywords water resources; optimal allocation; dynamic game model; Nash equilibrium

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The Water Environment System Coordinating Degree Model and its Application on Xiao-Hua Region in the Yellow River

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Abstract Along with the economical development, water pollution problem has been recognized increasingly. The paper discussed the coordinated development idea of water environment economy system by describing the Kuznets curve of environment quality and economical development. A coordinating model of water environment-economy-population composite system is built base on the multi-objects optimal thoughts and synergetic algorithm, which is used on Xiao-Hua region in the Yellow River. The calculation and analysis indicates that the coordinated development degree is unsatisfied in the last several years, but the total direction tends to harmony.

Keywords water environment-economy system; coordinating degree; sequential parameter; environmental Kuznets curve

Study of double auction Bayesian model and design of mechanism in water rights market

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Abstract：As the water scarcity in creasing, introducing water markets and establishing tradable water rights mechanism are regarded as a strong alternative institutional arrangement for managing water more effectively to improve the efficient allocation and use of water recourses and to achieve optimization allocation. Accordingly water markets and water rights have been widely discussed in recent years. The transactions modes and models of water rights are the core in water markets study of theory and practice. Based on the market norm of double auction, this paper analyzes and describes the characteristics of double auction in water rights market, and establishes the Bayesian model in incomplete information of water rights double tradeoffs. A mechanism design of water rights double auction is given, including auction rule and market clearing rule, and the affectivity and incentive compatibility is proved. Lastly a model implementation is given.
Keywords water rights transaction; double auction; Bayesian model; mechanism design; incentive compatible

Research on Economical Utilization of Water in Foshan Based on the Sustainable Development

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Abstract: Aimed to tackle the water supply problems occurred in some areas of Foshan City such as water shortage and lack of water project which are caused by successive drought, unbalanced water resources distribution, water environmental pollution, lower water prices, widely spread water wastes and quickly development of economic and society in recent years, we calculate the latent capacity of water saving in agriculture, industry and the domestic water consumption, and suggest that following measurements should be taken to tackle the existing problems and to ensure the sustainable water resources utilization and to benefit the sustainable development of economy and of society in the City of Foshan. These measurements are: giving publicity with might and main to economical utilization of water, reforming water price, encouraging water saving, reducing the water using quota, exploring new water resources, unifying water management.

Keywords: water conservation, sustainable development, Foshan City

Separation of Crop Transpiration and Soil Evaporation in a Cornfield in the Yellow River Basin Using the Dual Crop Coefficient Approach

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Abstract: The dual crop coefficient approach for separate evaluation of the crop transpiration and the soil evaporation was applied to analyze water balance of a cornfield during the growing season in the upper Yellow River basin, China. In the initial stage when ground cover with corn plants was supposed to be less than 10%, the cumulative soil evaporation accounted for 84% of the cumulative evapotranspiration. In the crop development, mid-season and late season stages when most of the ground surface was covered with corn plants, the cumulative crop transpiration accounted for 80-90% of the cumulative evapotranspiration. During the whole growing season, the cumulative crop transpiration and soil evaporation were 367.6 mm and 128.1 mm, respectively, which corresponded to 74.2% and 25.8% of the cumulative evapotranspiration (495.7 mm) in the cornfield where the cumulative precipitation was 294.6 mm and more than 150 mm water was irrigated at the end of the crop development stage.
Keywords: cornfield; crop transpiration; dual crop coefficient approach; evapotranspiration; soil evaporation

Study on Risk Evasion Model for Hydropower Entering In Power Net Work

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Abstract: For hydropower suppliers, water condition and market price are the key facts affecting their grid price bidding profit. In order to consider the affection of both of them to bidding strategy, this paper introduces the concept of water value, and regards the discharged water as dummy cost calculated in hydropower suppliers' profit model. With using risk evasion exponent describing the different risk partial of each hydropower supplier, this model keeps the balance between risk and profit; In addition, throng analyzing the affection of water-level, inflow and market price on water value, it provides important evidences for hydropower suppliers to make bidding strategy. Numerical simulation shows that higher extent of risk evasion is on expense of reducing expected profit; the higher the extent of risk evasion, the lower the expected profit.

Keywords : Power market；hydropower；Risk evasion； Water value；Bidding price

Water in a Changing Climate

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Abstract: In this talk I will attempt to provide a framework for understanding how human actions impact on the future sustainability of our water resources. First, I shall describe how water transports and mixes the ingredients for life and removes the waste products. In this way water provides the medium in which life can flourish! Second, I shall examine some of the most important hydrological cycles (water, carbon, nutrients and heat) and show how evolution has ensured a beautiful harmony between water and nature; water cycles through nature sustaining nature and in return the various organisms of nature cleans the water of harmful elements. Third, having discussed how the various components of the water cycles interact, I shall very briefly examine how, over the last 200 years, humans have impacted physically on the above hydrological cycles; venting the carbon dioxide back into the atmosphere, denuding the surface of the earth of natural vegetation and overloading water bodies with pollutants. This is resulting in catastrophic effects raising the following important series of questions concerning current water resources planing:

1) Direct Effects: How will the release of Greenhouse gases effect, in the long term, the atmospheric temperature, growth and melting of the ice caps, the depth of the oceans, the local precipitation, the frequency of droughts, floods and storms, the sequestering of carbon, the abundance of oceanic and terrestrial food resources and the surface runoff and groundwater recharge fractions?

2) Indirect Effect: Will biodiversity increasingly disappear as natural disasters impact on ever more partitioned natural reserves with an increased frequency?

The importance of these questions cannot be over estimated! Currently there are about 2 billion people who have inadequate access to drinking water and about 3 billion, or half of the world's population, who have inadequate sanitation. Combine this with climate change/variability uncertainty and we will be confronted with rebuilding most of the world's infrastructure in the next 50 to 100 years. The costs will be enormous leading to a further divergence between the poorer and richer regions of the world giving added cause to the terrorist

Study on the Sustainable-development-oriented Optimal Allocation of Water Resources in Foshan City

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Abstract： For the sake of sustainable exploitation of water resources, based on a dual-dynamic mode of water cycle, considering obligations including water supply capacities for water works, flood and salinity control and water demand for the river ecology, a sustainable-development-oriented optimal allocation of water resources in Foshan City is built through the process of coordination of reservoirs, river courses and region runoffs using the theory of “decompose-coordination” for large-scale systems and the methods of hierachical analysis and step by step toleration obligation. The results of perennial average distribution for each water unit come out by optimally operating water resources in year 2030 on condition of monthly water input during year 1956 to 2000. The results show that the quantity of water resources is sufficient in Foshan City and can meet the needs in the year 2030, but some measures on increasing supplied water and decreasing need must be adopted to ensure the water supply security in the future due to the limited amounts of water can be provided by the present waterworks.

Keywords: water resources; optimal allocation; sustainable development; step by step toleration obligation; Foshan City

The Research on Transferable Water Resources of South-to-North Water Project

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Abstract: Due to increasing acceleration of both economic development and population growth, water consumption and requirement have increased greatly since the 1980s, and water shortage in northern China has become a major factor constraining economic and social development. The south-to-north water transfer project is considered as a strategic and ambitious approach to resolve water shortage problems in the north of China, but it changes the relationship of water resources utilization in water source regions at the same time. The middle route of the south-to-north project transfers some water from the Danjiangkou Reservoir on the Hanjiang River, which will obviously affect the water balance of the middle and lower basins of the Hanjiang River. Focused on the sustainable utilization of water resources, a water balance study is conducted according to the principle of integrated water resources planning and management in this paper and the analysis of transferable water resources of the project is discussed in details. Finally, some suggestions are given to ensure the sustainable utilization of water resources of the two regions.

Keywords: sustainable utilization of water resource; transferable water; the middle route of south-to-north water transfer project; the middle and lower basins of the Hanjiang River;

Dhaka Water & Waste Management: Risk & Responsibilities

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Abstract:
Dhaka is the capital city of Bangladesh. 14 million dwellers live herein Dhaka city. Dhaka is an example of severe pollution. Water, Air, Sound, Light etc all types of pollution are very intensive herein Dhaka city. We are working in the field of water related engineering. Some of our findings are presented in brief.

1. The Water supply Authority of Dhaka city supplies 1400 million liters of water everyday.(i) 1300 million liters water are withdrawn from underground aquifers everyday through Deep Tube Wells.(ii) 100 million liters of water supplied by treating the surface (river) water.

2. We are getting 350 million liters of Sewage everyday.(i). 120 million liters sewage is treated by a one so called treatment plant.(ii) 230 million liters sewage is directly flown to the peripheral rivers & canals of Dhaka city.

3. Dhaka city doesn’t have any drain water treatment plant. Water coming from rain directly goes to rivers & canals washing all the Clinical waste, Domestic & industrial waste, Heavy metals and all the poisonous municipal dusts, because there is no scientific waste management system here.

Now let us think about, 1.(i), due to continuous withdrawal of sufficient underground water, the layer of water is going down day by day. There are many Deep Tube Wells are not functioning due to shortage of water in that layer. So recently Dhaka WASA is withdrawing water from deep aquifer. It is simply a suicidal activity for a nation. We don’t know, what will happen, if a heavy earthquake takes place in Dhaka city or we are inviting a disaster like earthquake or tsunami by our unscientific and imprudent activities. Near future, we must depend on surface water treatment for urban water supply demand. But what a hell, we are polluting all the peripheral rivers & canals of Dhaka city by untreated sewage & drain water. As we are not a rich nation, so at least we must search a low cost technology for, a)Urban Waste management, b) Sewer Treatment, c) Rain water with municipal waste Treatment & d) Industrial effluent Treatment.

Due to the highly polluted environment, non-viral diseases like Diabetes, Cancer, Allergy, Short of hearing, Asthma etc are spreading exponentially.

So, to save our nation & the generations, we must adopt a total solution of water & waste management system and to convert the solid waste, waste water & sludge into resources by recovery, recycling, re-integration.

A System Frame for Water Resources Sustainable Management

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Abstract: Water resources are the material foundation of the existence and development of human society. In this paper, an analysis of the relationship among sustainable development, water resources sustainable exploitation, water resources sustainable planning and sustainable management is firstly made, then the frame of sustainable management is specified in respect of management system, controlling mode, laws, education, and technical methods.
Keywords: Water resources; Sustainable development; System; Management.

IMPACT OF TSUNAMI ON COASTAL PLANNING AND MANAGEMENT

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Introduction: According to the United Nations more than one third of the world's urbanised areas are on or near the coastal area. Some large cities are also located. There is unsustainable pattern of development making the coastal area more vulnerable to natural disaster – Town planning and building regulations are often violated. There is also absence of preventive measures including early warning system and disaster mitigation programme. As a result the impact of killer Tsunami of December 26, 2004 on the Indian Ocean due to submarine earthquake was severe with great loss of life and property on the coastal area.

REGIONAL WATER RESOURCE PLAN
The Environment Option

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Introduction: The 21st Century will be an urban century and Asia will be a continent of mega cities. According to the United Nations, by 2015 AD, there will be 70 cities each with 5 million or more population of which 90 will be in Asia. Rapid urbanization has destabilized water balance and caused scarcity resulting poor access to water and sanitation. Both quality and quantity of water are diminishing with increasing pollution, depleting ground water resource, filling up of water bodies for unsustainable urban development, mismanagement in the use and distribution of water etc. are some reasons affecting water resources. Water is still a sectoral issue in many cities and there is no regional perspective. The UN Agenda 21 called for integrated approach to development, management and use of water resources. An integrated water resource management is being advocated with environment option.

A Decomposed Approach to Optimal Planning and Operation of Water Supply Networks

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Abstract: Drinking water supply systems play a vital role in the people's daily life and for the stability ofthe society. To optimize the operations of such a system we have different goals to be achieved. First water resources should be optimally distributed concerning the water quantity and quality management and second the energy consumption for the water transportation should be minimized. At the same time the necessary supply to fulfill drinking water demands should be ensured. All these goals are not manageable in a complex water supply system with various plants and elements (tanks, reservoirs, pipes, pumps, valves etc.) as well as changing market conditions (supplies, demands, prices etc.) without an optimization solution strategy. However, due to the complexity of water supply systems the optimization problems are usually very complicated and large-scale.

A decomposed approach to solve such problems is proposed in this work. Based on its inherent characteristics, a water supply system is decomposed into three kinds of subsystems: water processing plants, pump stations and a pipeline network. Corresponding to these different subsystems, a nonlinear dynamic programming (NLDP) problem, a mixedinteger nonlinear programming (MINLP) problem and a large nonlinear programming (NLP) problem are formulated, respectively. The optimization software packet GAMS is used to solve the sub-problems, while simulated annealing (SA) is used to coordination the subsystems to ensure the minimum of total operation costs of a water supply system. Optimal operating policies for future 24 hours can be developed for water supply systems bythe proposed approach.

These optimization studies were based on a validated process model obtained by rigorous modelling and simulation. As a result, a simulation and optimization program packet, HydroDyn, was developed. The packet runs under MS Windows with a user-friendly graphical interface. HydroDyn allows static and dynamic calculations of the water network including physical and qualitative parameters and rule-based control of the network elements. Optimization of long and short term water distribution as well as consumption are possible. Furthermore, HydroDyn can be used for tracking the water network status (design of networks, calculation of hydraulic and quality in networks within pressurized pipe networks and distribution system). It can exchange on-line data with several types of SCADA and process control systems. An interface for importing data from Smallworld GIS system is also available. This packet has been installed and successfully applied for the optimal operations of drinking water supply systems in several cities such as Mainz, Marburg and Hof in Germany.

Water-supply reservoir operating rules extraction based on artificial immune algorithm

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Abstract: For reservoirs, the best release decisions over study horizon can be obtained only with hindsight and cannot be used in practice. Up to now most reservoirs are guided by predefined operating rules, which specify the desired releases based on certain important factors related to reservoir operation, such as the within-year time (WYT), the existing storage volume (SV) and the projected inflows (PI). For example, the traditional rule curves in china determine the reservoir release merely dependent upon WYT and SV; and the linear decision rules (LDR) regard the reservoir release as a linear function of the aforementioned three factors. Even though these operating rules are often acquired through simulation or optimization or their combination, or other statistical methods, they sometimes seem relatively simple when facing the multiple objectives and uncertainties. So in this paper we try to design operating rules for a multipurpose water-supply reservoir, which is able to consider more factors and make use of some experience and knowledge of decision makers. Except for the above three factors, here the water demand, fluctuating widely within year mainly due to irrigation，and hydrologic year type (wet, normal and drought) are also taken into account, in which the judgment of hydrologic year type can be seen as the reflection of manager's knowledge. In this way the proposed operating rules will becomes more reasonable. To derive such operating rules, the artificial immune algorithm is adopted, which is inspired by the human immune system of evolutionary learning mechanism. In our work an artificial immune-based machine learning model (AIBML) is built to produce the operating rules database and then identify the rules in the database or discover the new rules through reasoning in real operation. The principle of AIBML is stated as following:

Step 1: operating rules in existence viewed as antigens to provide the training samples, and the rules to be extracted regarded as antibodies.

Step 2: utilizing the AIBML model to carry out learning on line to acquire the antibodies with high affinity to the antigen, which composed of the immune memory set, namely the operating rules database.

Step 3: introducing the new antigens (test samples), the antibody with high affinity to the antigens in the database (viz corresponding rule) will be identified by the AIBML model, or if all antibodies in the database could not match the antigen a new antibody (viz a new rule) will be formed by reasoning of the model. By this means the rationality and reliability of the model can be examined off line.

The obtained rules are applied with a real case, and the operation results compared with those of rules curves and LDR demonstrate better performance of the proposed operating rules by AIBML.

Keywords: Operating rules; artificial immune algorithm; reservoir

Estimation of Water Resources Distribution in River Basin though GCM data

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Abstract:A lot of climate change studies using a coupled ocean-atmosphere general circulation model (CGCM) show that, due to the global warming the amount and distribution of precipitation will change all over the world in the 21st century. Change in precipitation is a big matter of concern for the water resource management. In the recent global warming studies using a CGCM, the spatial resolution of it is increasing because the computing power and resources are increasing. However, there is still a big gap between the resolution of a CGCM and that required by the water resource management studies especially in Japan, because the Japanese country consists of small mountainous islands which generally makes precipitation distribution more complicated. For this reason, the "Downscaling" techniques have been desired as a mean of bridging this gap. In this study, we provided a downscaling technique which temporally and spatially interpolates the precipitation dataset simulated by a CGCM, using the sea level pressure (SLP) of the ECMWF re-analysis (ERA40) dataset and the precipitation of the AMeDAS dataset. The re-analyzed SLP are classified into some clusters by the ISODATA method, a kind of pattern classification methods. For each SLP simulated by a CGCM, one cluster is selected which minimizes the difference between the simulated SLP and the cluster center, the mean value of classified re-analyzed SLP. Then, an observational precipitation data which corresponds to the selected cluster is randomly sampled and regarded as the downscaled output. The downscaled precipitation has the temporal and special resolution of 1hour and about 17km respectively. And, the future hydrological indices of the Tone River are estimated by putting the downscaled dataset into the Hydro-BEAM (Hydrological Basin Environment Assessment Model), a kind of distributed basin models.

When we applied this method to the present-day output simulated by a CGCM, the downscaled results becomes similar to the observed data. The downscaled precipitation derived from the future projection experiments by a CGCM based on the SRES (Special Report on Emissions Scenarios)A1B scenario show that comparing to the present-day results, the precipitation decreases over the areas along the Sea of Japan in winter, and it also does throughout Japan in early summer. On the other hand, the downscaled results suggested that the precipitation increases in summer, over a lot of areas in Japan. About the Tone River flow discharge, it is estimated that the discharge will decrease from spring to summer, while it will increase in winter because of the reduction of the precipitation and the early snowmelt due to global warming. In addition, it is suggested that the frequency of the high water event will increase but the averaged flow discharge will decrease. As a result, it should be noted that the water management in early spring and the disaster measures to high water event have to be more concerned in the end of the 21st century.

Ultrasonic Reactor Systems for the Low-volume Purification of Groundwater and Surface Water

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Abstract: Ultrasonic irradiation appears to be an effective method for the rapid destruction of organic chemical and biochemical contaminants present in water. The degradation of chemical compounds by acoustic cavitation is shown to involve three distinct chemical pathways: 1) oxidation by hydroxyl radical formed during the vapor phase decomposition of water, 2) pyrolytic decomposition in transient collapsing cavitation bubbles due to high localized temperatures and pressures and 3) transient supercritical water reactions. In order to harness this technology for practical applications, we have developed a highfrequency and high-power pilot-plant reactor for the purification of water. The removal rates of contaminants such as trichloroethylene, dichloromethane, and phenol were found to exceed those of similar frequency, small-scale bench reactors by factors ranging from 2.5 to 7. Furthermore there is linear dependence between the observed sonolytic rate constants and the applied power density. The rates of elimination of total organic carbon (TOC) were enhanced dramatically due to synergistic effects by combining sonolysis and ozonolysis. The enhanced reactivity of sonolysis coupled with ozonation is due to the sonolytic formation of hydrogen peroxide in water, which in turn reacts with ozone to form a highly reactive ozonide intermediate, dihydrogen trioxide, that reacts in a similar fashion to hydroxyl radical, however, its lifetime in aqueous solution is found to be substantially longer, and thus it is more likely to react with refractory organic compound fragments and microorganisms.

The effects analysis of climate change on surface humidity index in zhalong wetland

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Abstract: This study is carried out in zhalong Natural Reserve, a semiarid wetland that situated in songnen flood plain. Shuangyang River, a branch of Nenjiang River, and Wuyuer River provide with the primary water supply to this region. Using the historical meteorological data from 1961 to 2000, which comes from five weather station around Zhalong wetland, the seasonal and annual change trends of surface humidity index(HI) and its spatial characteristics are detected. The expression $HI=P/ET_{0,}$ expressed as the ratio of precipitation to reference crop evapotranspiraton(ET_0) ,is adopt to calculating HI, a local experiential model, which couples four meteorological varables, the macimum temperature , the minimum temperature ,precipitation and wind speed is used to calculating monthly $ET_{0.}$ The tendency of ET_0, which influences HI significantly, is detected by univariate Mann-Kendall test, the effects of climatic change on HI of zhalong wetland are explained consequently.

The study results show that there exist wet springtime and dry summertime trend in Zhalong wetland. By the seasonal Mann-Kendall test, the surface HI of wetland presents rising tendency in April to June and degressive tendency in July to September, which means in rainy season the decreasing trend is found of surface HI, it means the shoal wetland is apt to dry, and this phenomenon seems more evident in the east of wetland than in the west. The tendency detection of annual $ET_{0,}$ (April to September) proves significant trend in both stations in recent 40 years, which means the $ET_{0,}$ in wetland is reducing evidently. The trend analysis and sensitivity analysis of meteorological factors in experiential model illuminate the difference of change speed between the maximum and the minimum temperature result in the decrease, but the essential reason is the augment of greenhouse gas and aerosol in the atmosphere；These substances serve as a screen to prevent the heat transferring to outer space and at the same time reduce extraterrestrial radiation, consequently, decrease net radiation, the most correlative variable to $ET_{0.}$. The annual precipitation of wetland presents non-significant decreasing trend in recent 40 years, and the decrease trend is more evident in the east of the wetland. For the reason of significant decrease of $ET_{0,}$ in the whole wetland, the differences of precipitation between the west and the east result the inhomogeneity of surface HI. The sensitivity analysis shows precipitation is more sensitive to HI than $ET_{0,}$ and the decreasing values of precipitation exceeds that of $ET_{0,,}$ that os ehy the $ET_{0,}$ presents decreasing trend but the surface HI does not takes on increasing tendency.

Keywords: surface humidity index, univariate Mann-Kendall test, sensitivity analysis, reference crop evapotranspiration, Zhalong wetland region

The effects analysis of climate change on reed swamp evapotranspiration in Zhalong wetland

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Abstract: Evapotranspiration (ET) process of water plants in wetlands was controlled by several factors, besides the physiological factors of vegetables, height, density, LAI (leaf area index), etc, the meteorological parameters, such as, radiation, temperature, wind and precipitation can influence the ET process evidently, hence, remodels the distribute of ET in spatial and temporal. In order to illuminate the ET variety along time and the effects of climate change on ET process, a period of relative long (1961 to 2060) was chosen in this study.

By using monthly meteorological data from 5 weather stations around Zhalong wetland, the reed swamp evapotranspiration (ETc) of the wetland region was calculated from 1961-2000. Under the climatic scenarios of four General Circulation models (GCMs), HadCM3, CCSRNIES,CSIRO-Mk2 and CGCM1, the ETc in future 60 years (2001-2060) was predicted. An experiential model, which includes monthly maximum temperature (T_{max}), monthly minimum temperature (T_{min}), monthly precipitation and monthly mean wind speed, was used for ETc calculation and sensitivity analysis of meteorological variables, according to the results of sensitivity analysis and the change range of meteorological variables in future period, the effects of climate change on Etc were analyzed.

The results show that T_{max} and T_{min} proved to be two dominating factors which influence Etc markedly (precipitation and wind speed contribute less than 1 percent to ETc), and the difference of rising speed between T_{max} and T_{min} controls the change trend of ETc, the differential equations, $\frac{d(ETc)}{dt}=k\left[7.01\times\frac{d(T_{max})}{dt}-3.33\times\frac{d(T_{min})}{dt}\right]$,describes the changing relationship of them. In the period when the condition $7.01\times\frac{d(T_{max})}{dt}>3.33\times\frac{d(T_{min})}{dt}$ is satisfied, the climatic tendency rate of ETc is positive. However, in the three periods, 1961-1970, 1981-1990, and 2031-2040, the rising speed of T_{min} is more obvious than T_{max}, hence, the ETc shows degressive trend $(\frac{d(ETc)}{dt}<0)$ although the average temperature is rising in this period. The water consumption by ETc in Zhalong wetlandwill increase largely in future time (2001-2060, with respect to the 1961-2000 period), according to the GCMs prediction scenarios, the rise of T_{max} (about 1.1 Hg to 3.5Hg)and T_{min} (about 1.2Hg to 3.9HO will cause an additional water consumption of 15%-22% for reed swamp of Zhalong

The Research of Floodwater Utilization Scheme in Baicheng City 2005

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Abstract:The Research of Floodwater Utilization Scheme mainly includes making the systemic investigation，setting up the preparation plan, seeking the floodwater utilization opportunity, and achieving the goal of utilizing water resources and preventing flood disasters through engineering and non-engineering systems. Since some uncertainties, such as the safety of project, the error of predict and the emergency treatment and so on，have existed in floodwater utilization, the risk analysis of interrelated eventuality is the important part of the research of floodwater utilization scheme. By the cooperation of the potential benefit and losses, the paper gives the decision-makers the valuable decision references to seek the good opportunity of flood season and use Moon-lake Reservoir and other reservoirs, lakes, wetlands and grasslands reasonably to import the water from Nenjiang River, Taoer River and other rivers. The research of floodwater utilization scheme consists of some parts: floodwater utilization systems analysis, the runoff prediction, the risk and benefit evaluation, the operation control, the management measures and so on.

Key words: floodwater utilization, scheme, Baicheng city, Nenjiang River, Taoer River

Analysis of New Water Supply System for Wetlands -----Moon-Lake Wetland as an Example

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Abstract: Water resource is important for wetlands existence and development. With the development of society, water resources system changes constantly. Similarly water supply systems of wetlands change too. Wetlands degeneration appears ever and agah because of the lack of water supply. New water supply system of wetlands will help wetlands to exist and develop. Taking Moon-lake wetland as an example, this paper analyzes the change and development of water supply system of wetlands. Moon-lake wetland lies in end of Taoer River. Moon-lake reservoir is built beside it. During the last 30 years, several reservoirs have been built on upstream of Taoer River. Since water quantity of downstream decreases gradually, water supply is not enough to keep the existence of Moon-lake wetland. However, Nenjiang River has abundant water which flows beside Moon-lake wetland. It seems a good measure to import the floodwater of Nenjiang River into Moon-lake for maintaining wetlands around the reservoir. In order to investigate the measure, a detail hydrological analysis of two rivers has been carried out. It is found that Taoer River and Nenjiang River have certain hydrological differences which are useful for water management of Moon-lake wetland. Dalai hydrology station and Jiangqiao hydrology station in Nenjiang River lie near Moon-lake wetland. In Taoer River, the nearest hydrology stations are Taonan and Heidimiao. Using 45 years of hydrological data gotten from four stations, a detail analysis is done. The conclusion is that the water flow of Nenjiang River and Taoer River is different and the hydrological behaviors in same years and same months are not in the same phase. Besides, the time difference also exists in flood process. It is possible to import floodwater of Nenjiang River into Moon-lake Reservoir then supply water for wetlands.

Keywords: Water Supply System，Wetlands，Floodwater.

Risk Analysis and Discuss of Floodwater Utilization

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Abstract: The conflict between Water shortage and flood disaster exist in many places of China. Flood resource utilization is one of the most important measures to resolve the problem. Since flood has the characteristics of hazards and resources, risk and benefit will both occur in floodwater utilization. Therefore, risk analysis is a necessary work to ensure that floodwater is used under low risks and high efficiency. Different floodwater utilization kinds lead to different risks. Commonly, the risk analysis of floodwater utilization consists of four parts: the systematic cognition, risks identify, risk evaluation and optimize decision. Taking Baicheng city as an example, this paper analyzes the risks in several floodwater utilization kinds, such as wetlands utilization, grasslands utilization, ponds utilization and reservoirs utilization. Firstly, the risk factors are made clear after fully understanding the floodwater utilization system. Secondly, the potential benefits and losses brought by different factors are calculated in different ways. At last, the optimize decision is made based on the benefit and risk evaluation. The analysis results are helpful for floodwater utilization.
Keywords: Floodwater; Utilization; Risk analysis; Baicheng city.

The study of flood recycling in Guangdong

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Abstract In recent years, because of the variety of the weather, the rain is not uniformity in time and space. The dry and flood disaster takes place alternately. The flood recycling is the most valid path to reduces flood and dry disaster. This text take "05.6" Dongjiang floods as an example, research the path to carry out the flood recycling in Guangdong province.

Keyword flood recycling study

Improving regional cooperation and public participation for conflict prevention and resolution in international river courses: the Senegal River case

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Abstract: The Senegal River Basin economic development and its transition towards sustainable development are strongly linked to the availability, fair management and distribution of its resources among all users. Water management forms the most critical process in such semi-arid land, as it impacts livelihood, food security, land tenure, productivity and social stability in general. As is common in international watercourses, integrated planning for efficient watershed management is hampered by the difficulties of coordinating riparian countries policies with diverse priorities and also between local users with often conflicting needs. Though the Senegal River is noted generally for a successful and productive case of regional cooperation at the state level, the cooperative nature of the basin management is being strained by the size and potential environmental impacts of the second generations' infrastructures. Severe political instability and recurrent conflicts, the scarcity of resources, unilateral short term gains, recent transformation of social institutions, and lack of public participation had raise old and new types of disputes and violence in the Senegal River Basin in recent years.

This paper, a step in what is hoped to be continued exploration of disputes, cooperation and over the Senegal River Basin, aims to identify the main constraints in implementing institutional arrangements and effective preventive measures to mitigate the potentially driven social and environmental conflicts. The current study offers the opportunity for institutional and administrative reform to acquaint local stakeholders in the decision making process with ecologically sound management practices, integrated and cooperative management options to cope with the discontinuities, such as extreme climatic events or sudden institutional changes.

Though locally some tremendous progress have been achieved in some economic sectors, several indicators point out that, to date, the majority of the stakeholders in the valley have not benefited yet from the output, the entire management approach has been strictly sectoral without any constructive public participation in the decision making process.

Key words: Senegal River, public participation, water management, Transboundary River, institutional arrangements, regional cooperation, conflict prevention

Research on Water Resources Carrying Capacity and Sustainable Development of Small Towns

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Abstract The sustainable development is linked closely with water resources utilization in small towns. The relationship between the water resources carrying capacity and the sustainable development of small towns were discussed, and point out proper utilization of water resources based on water resources carrying capacity is a major subject for sustainable development of small towns, the paper also give a simple method for evaluating water resources carrying capacity. Yeji Town of Anhui Province as example of realizing small towns' sustainable development based on proper utilization of water resources.

Keywords: water resources carrying capacity; sustainable development; small towns

STUDY ON URBAN WATER RESOURCES CARRYING CAPACITY -A CASE IN THE SUBURB OF BEIJING

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Abstract: At present, lots of urban water problems, such as the shortage of urban water resources, deterioration of the ecological environment，and so on, are becoming prominently day by day because of urbanization process picking up and the rapid social economy development. Under the sustainable development principle and based on “natural- artificial” water circulation , an urban water resource carrying capacity computation model has been developed in order to study the multiplex system of “social economy - water resources - ecological environment” in the city. This model contains seven modules, viz. the multi-objectives generalized analysis module, the water resources circulation transformation module, the social economy forecast module, urban water resources demand module, the water resources carrying capacity appraisal module, the pollution migration and transformation module and the restraint module of ecological environment. This model has been applied in Tongzhou region, Beijing city. The research result indicated that this model has a certain instructional role on solving water resources deployment in cities and the improvement of aquatic ecosystem.

Key words: urbanization; water resource carrying capacity; social economy; ecological environment

Integrated Management for Drinking Water Security in Karnataka, South India: An Overview

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Abstract Water problems are frequently caused by inefficient water governance, that is, poor planning and management of water resources and infrastructure. As populations grow, economies develop and mega cities expand, fresh water will be in even greater demand. Unlike a resource like oil, for which there are alternatives, water has no substitute. Ground water is the principal source of drinking water in rural areas of the state. It is harnessed mainly through a network of bore wells. It is clear that water quality problems in the state are due to fluoride, total dissolved salts, total hardness, nitrate, iron and bacteria. Recent initiatives, both at community and Government levels, have made use of long neglected water quality management and water harvesting traditions. The results show that reviving water management systems stimulate urban and rural development and restores local ecological systems.

Keywords Community; Depletion; Deterioration; Master plan; Sustainability

Climatic Trends of Different Intensity Heavy Precipitation Events Concentration in China

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Abstract: Based on 740 stations daily precipitation datasets in China, the precipitation-concentration degree (PCD) and precipitation- concentration period (PCP) of different intensity durative precipitation events were calculated to analyze their statistical characteristics, mainly including spatial and temporal distribution, variations and climatic trends of the two parameters of the durative heavy precipitation events in China. It is proved that these two parameters of heavy rainfall can display the temporal inhomogeneity in the precipitation field. And it is also found that there is a good positive relationship between the precipitation-concentration degree and annual rainfall amount in the Eastern China and Middle China. This method can be applied in flood assessment and climate changing fields.
Key words: Durative heavy precipitation; Climatic trends; Precipitation-concentration degree (PCD); Precipitation-concentration period (PCP); China

The experience of regional water management in Dalian

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Abstract Nowadays, regional water management plays an important role in the integrated water management because water demand has been increasing tremendously while the supply and usage of water can't be considered sustainable in the range of a region. In order to manage the water resources of Dalian in the long term and thus to promote sustainable development, 863 program "Technology of water environment quality improvement and demonstrate project in Dalian", which was initiated with strong support of Ministry of Science and Technology of the People's Republic of China and the government of Dalian city, has being operated. According to the project above, the experience of regional water management in Dalian of China was proposed in this paper. Moreover, the linkages and inter-dependencies of socio-economic and environment in the process of management were also discussed respectively.

Keywords: Dalian; experience; integrated water management; regional water management

Water Resources and Hydropower in Bhutan

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Abstract: Bhutan is a small landlocked country of about 38,000square kilometers sandwiched between China to the north and India to the South. Around 72% of this Himalayan country is still covered with forest and the general topography of the country is mostly deep narrow valleys, high mountains and very few wide valleys with the altitudes ranging from 100m in the south to 7800m in the north. Almost 80% of the 700,000 population still lives in various rural areas in the country sides.

The country is basically comprised of three river basins viz; Wangchu, Punatsangchu and Manas. A fairly good network of hydro meteorological stations covers the country which was established during the early 1990s. At present there are about 30 hydrology stations covering all the major rivers and 80 meteorological stations which are spread across all the towns and district centers. These hydro-met stations were mostly developed from hydropower perspective.

Water resources and the natural environment are given top priority in the government's planning and during the overall development activities. A water resources master plan has been prepared in the recent years which guide the water resources planning and development in the country.

Electrification of Bhutan commenced with the installation of the first 256 KW diesel generator in 1966. At the moment, the total power output of Bhutan is 468 MW from which about 70% is exported to India. The 1020MW Tala Hydroelectric Project is almost completed, the first phase is due to be commissioned by June 2006 and the full firm will be run by end of 2006. The total domestic consumption is around 105 megawatts. Annual Per Capita Electricity consumption is around 900kWh.

The hydroelectricity is the single largest revenue earner of Bhutan. Sale of Hydropower contributes to almost 40% of the total national revenue. Bhutan's hydro-electricity power potential is estimated at over 30,000 MW. Within the next ten years around four other mega projects are planned to be built up which would take the power output of Bhutan to about 3000MW.

The Bhutan 2020 Vision Document envisages providing electricity to 50% of rural population by 2012. The Department of Energy (DOE) is currently developing a Rural Electrification Master Plan, which aims at electrification of 100% of rural households by 2020. Although Bhutan has surplus hydro energy, the costs associated with the transmission and distribution networks necessitates utilization of alternative energy supply options including mini/micro hydropower, solar, biomass and wind energy on decentralized basis.

The Department of Energy (DOE) guides the national policy and programmes in Energy Sector of Bhutan including the water resources data collection and dissemination. Starting from hydro-meteorological data collection, analysis, planning of hydro power plants to monitoring and evaluation, system analysis of the power transmission are being done by the Department of Energy.

The Salient features of the Bhutanese Hydro power sector is that we have all the major rivers flowing through deep valleys where we can easily develop run-of-river schemes which are quite economical, environmentally benign and results in no re-settlement. In addition to that, we have rich and conserved forests at the moment.

Therefore, for the economical and effective harnessing and generation of the available hydropower energy it is indispensable to conserve this rich bio-diversity and the water resources in particular.

Ecological Problems and Countermeasures in Pearl River Water System

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Abstract The Pearl River water system belongs to the warm river and has abundant biological species. But the quantity of species is decreasing in the abrupt human actions. In this paper, the relevant countermeasures was brought forward after the author discussed the effect of human actions to ecosystem and the primary questions of river ecological protection and management in the Pearl River.

Keywords Pearl River; ecosystem; ecological protection; management; countermeasures

A multi-objective optimization method for river basin water resources allocation coupling reservoir regulation model

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Abstract: This paper presents a method for river basin water resources allocation coupling reservoir regulation so as to increase the available water resources in dry season and dry year by better regulating the reservoir, thus securing the water demands of the users over the whole basin. The method is a hierarchical decision making method that decomposes the problem into a three layer decision structure. Two decision models were set up to make the system decisions. The first model is the optimal reservoir regulation model with model objective as minimizing the squared water shortage, that is sets up for determining the water allocation in every stages at the distribution node and the Dynamic Programming is employed to solve the model. The second model is a multi-objective optimization model that is set up to allocate the water resources among every user, including domestic user, industrious user, agriculture user and ecologic user. The model objectives include maximizing the economic profit of water supply for economic users and maximizing the water supply guaranteed ratio of ecologic user, and is solved by employing an interactive decision-making process. The model was used to study the water resources allocation schemes of Xizhijiang River Basin in Southern China, and the results show that with the regulation of Baipanzhou Reservoir in the upper stream, the water supply satisfaction can be largely improved.

Key words: water resources allocation, multi-objective optimization, Dynamic Programming, reservoir regulation, water shortage