018530 - SWITCH

Sustainable Water Management in the City of the Future

Integrated Project
Global Change and Ecosystems

Deliverable 5.2.5 (Annex 4)

Various materials on Beijing

Due date of deliverable:
Actual submission date:

Start date of project: 1 February 2006 Duration: 63 months

Organisation name and lead contractor for this deliverable: ETC (coordinator)

Revision [final]

Project co-funded by the European Commission within the Sixth Framework Programme (2006-2011)		
Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

5.2.5 Dissemination material on the Use of Water for Urban Agriculture
Work package 5.2

The aim of work package 5.2 is to contribute to a paradigm shift in wastewater management and sanitation towards a recycling-oriented closed loop approach. The work package is being implemented in three cities; Accra, Beijing and Lima, and includes the identification and integration of appropriate productive re-use of urban freshwater, storm and waste-water for agriculture into the policy and planning frameworks of these cities.

The deliverables of the work package follow a sequence of implementation. Based on a situation and stakeholder review (del. 5.2.1), working groups are formed, meet and are linked to the Learning alliances (del. 5.2.2), they receive training in multi-stakeholder action planning (del. 5.2.3 A), and are involved in, and informed on, specific research by consultants, MSc and PhD or action research linked to the demonstrations, (all under del. 5.2.4). Information has been disseminated in publications, magazines and newsletters (del. 5.2.5), and guidelines and related training material has been developed (del 5.2.3 B and C). The leading institutes here are ETC (WP coordinator), IWMI (Accra), IGSNRR (Beijing) and IPES (Lima), other institutions involved were WUR, IRC and NRI- GUEL.

As part of deliverable 5.2.4, this contains various materials on Beijing

Contributing products included in this document are:

5.2.5 Bf IGSNRR poster Beijing 23July09 for Scientific Committee Meeting Lodz
5.2.5 Bg SWITCH presentation Shanghai Exhibition June 2010

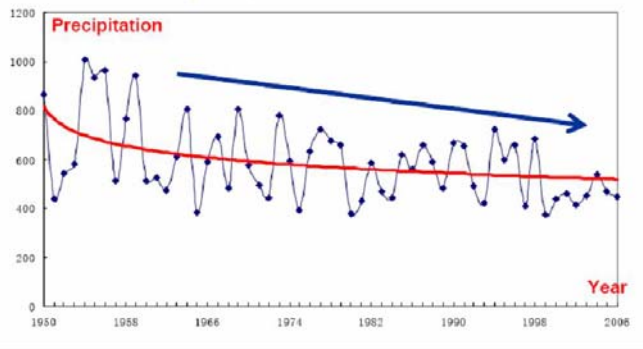
SWITCH Project: Beijing

Beijing Learning Alliance

Beijing has hosted several LA meetings including the 1st Learning Alliance meeting held in May 2007. Besides that, several informal meetings and telephone calls were made to the key stakeholders. The LA has undertaken following activities:

- Formal initiating of Beijing LA
- LA team organizing
- Multi-stakeholder Analysis
- PhD students' research opening discussion and report
- Demonstration project financing
- Information Management (workshop reports, city website, paper published on Urban Agriculture Magazine, LA Poster, reporting on academy's website)
- Training workshop
- Study visit to best practices related to smart water use
- Visioning and strategy planning workshop

Mushroom production



Rainfall in Beijing 1950-2006

Sewage disposal system in Xiedao

Distribution of Graywater use for industry

SWITCH-Beijing vision and strategy planning workshop

Rainwater harvesting system in Miyun

Beijing 1st LA meeting

Treated water for recreation use

LA Members

- IGSNRR
- China Ministry of Water Resources
- China Ministry of Construction
- Water Conservation office of Beijing Water Authority
- Beijing Academy of Environmental Protection Sciences
- Beijing Hydraulic Research Institute
- Chongqing University
- Qinghua University
- Huairou Fruit & Vegetable Cooperative
- Xiedao Resort
- Beijing municipal research institute of water planning
- Chinese research institute of urban planning and design
- Beijing normal university
- Beijing Agro-technical extension center
- Beijing municipal water-svaing center
- …

Vision & Goals for Urban Water Management

- Integrate water supply analysis into city planning
- Adopt participatory methodology in water policy formulation
- Improve water use efficiency (rainwater harvesting, recycling, etc.) particularly in urban agriculture
- Water price system reformation

Measuring Sustainability

- Multiple function of water use (ally with multi-functional urban agriculture)
- Source control of pollution
- Daily life water saving
- Graywater and rainwater utilization
- Improvement of water saving technology
- Integration with urban design and planning

Beijing's Water System & Pressure

Beijing is one of the driest cities in the world. Decreasing water availability is hampering its economic development. The fresh water resource per capita in Beijing is about 300 cubic meters per year, or one-eighth of the national average and one-30th of the world's average. Agriculture is the biggest consumer of water in the city. The challenges Beijing water faced include:

- Water Scarcity (Demand>Supply), Groundwater depletion
- Both time and spatial distribution unbalanced of rainfall
- Insufficient in water recycling use
- Low utilization efficiency of water, especially in agriculture sector

Beijing Water System

Facts and Figures

The municipality of Beijing (2006):
Land area: 16410 km^2, in which 11038 farmland
Population: 15.81 million
GDP: 787 billion yuan (equals 78.7 billion Euro)
GDP per capita: 50467 yuan (equals 5046.7 Euro)
Total Volume of Water Resource in the Year: 2.45 billion
Total Volume of Water Used in the Year: 3.43 billion
Per-capita Water Resource: 157.1 m^3

Demonstration

Huairou Fruit & Vegetable Cooperative is implementing efficient capture and use of rainwater, which is an integrated technology combined greenhouse surface rainwater collection with dripping irrigation. The cost-benefit of the rain harvest and multi-functional water use will also be studied through this demonstration project. Besides, more RWH demonstration sites have been chosen which are located in several suburb districts. These sites were built by local government together with farmers. And research on these RWHs can help us to better understand the suitable and best models, which can be upscaling in the future.

Rainwater stored in underground pool in Huairou Fruit & Vegetable Cooperative, May 2009, photo taken by Ji wenhua

Research Findings

a) RWH demonstration. Research on RWH for Beijing's agriculture focuses on several issues: finding the best RWH technologies, measuring and counting the collection rate of rainfall from RWH system in Beijing, mapping the potential sites where must be water scarce (not enough water from different water sources), the cost-benefit analysis and upscaling methodology. Research results from the demonstration show that the rainwater collection efficiency could be high to 66% in 2008 and the efficiency could be higher with improved conditions. The truths that heavy rain often means high collection efficiency and rainfall in Beijing mainly distribute in summer season

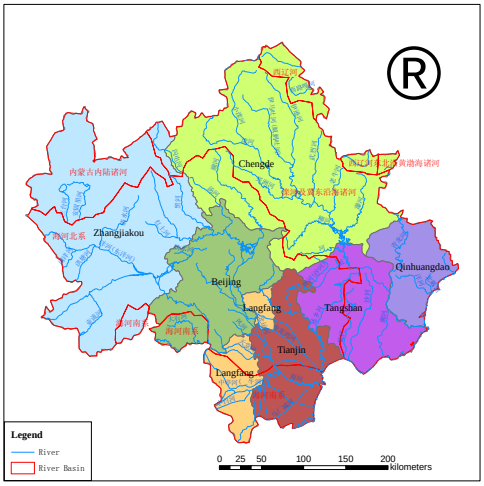
(June-August) mean the RWH system could be a effective way. But this also means that the RWH system will be unused in most time of a year if we don't perfectly combine RWH system with multiple-agriculture development. Further research on cost-benefit of the project shows that the ratio of benefit to cost can be 1.54 in case of governmental investment and 5.85 in case of individual farmer, who may use the facilities in a multifunctional way. This means the return of economy of the project can be enlarged if a new way of using the rainwater harvest facilities can be applied widely. However, the price of water for agriculture will directly influence the application and up-scaling of the project. If the project could not bring additional income to farmer, they will not use the RWH system at the current water price until it rises to 2.2 RMB per m^3.

b) RWH in residential area. In recent years, Beijing municipality also launched a series of programs to promote the rainwater harvesting in city center. RWH in Beijing could be very important due to its multi-functions. It can be a supplement source to the scarcity of water. And above of all, it can reduce the amount of polluted water crowded into the treatment plants which is becoming more and more expensive and insustainable. Our research estimate the potentiality of rainwater harvesting from residential roofs in Beijing and water saving efficiency of household water consumption in a simulated situation during year 2002-2007. we also estimated the potential of rainwater harvesting from residential roofs in Beijing in 2020 by three different scenarios. The outputs indicate that there is a big potential for rainwater harvesting from its residential roofs in the city and this is an issue deserving to get further attention. However, there are still facing a lot of difficulties for a large scale practice in Beijing due to a number of reasons, particularly lack of the substantial incentives for applying the new technologies.

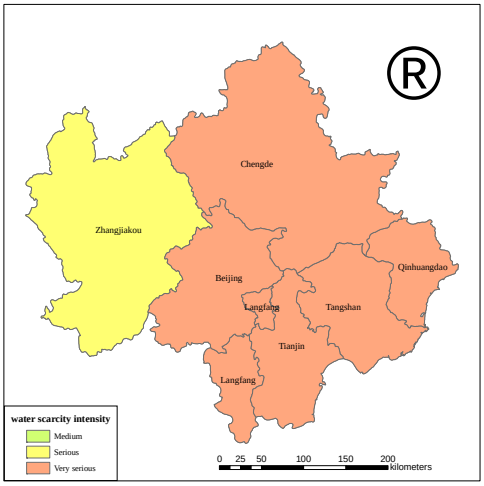
c) Water resources access in Beijing-Tianjin-Tangshan Region. Beijing-Tianjin-Tangshan Region has long suffered water scarcity. The water resources per capita is only 320 cubic meters in this region, 3% of the world average. Due to drought, the probability of inadequate water supply is relatively high. Two factors may exacerbate water scarcity in the future. One is new water demand (especially domestic water demand) caused by population growth, and the other is more water required in environmental rehabilitation. To relieve the pressure, there are two corresponding solutions provided. The first is South-North Water Transfer Project (SNWT) which transfer more than 2.5 billion cubic meters to this region annually from Yangtze River Basin. And the second is more non-conventional water resources will be used in this region. What will be the situation of water resources in this region under the comprehensive influence of these factors?

Four indices have been developed to evaluate water scarcity: the demand satisfaction index, the demand reliability index, the utilization rate of water resources and water-use efficiency. The first two indices are used to evaluate if the probability of water shortage is at acceptable level. And the latter two indices are used to evaluate the potential of improving water supply capacity and saving water. The framework for water scarcity assessment and solution in regional scale was developed based on the four indices, and analysis of Beijing-Tianjin-Tangshan Region was carried out as a case study.

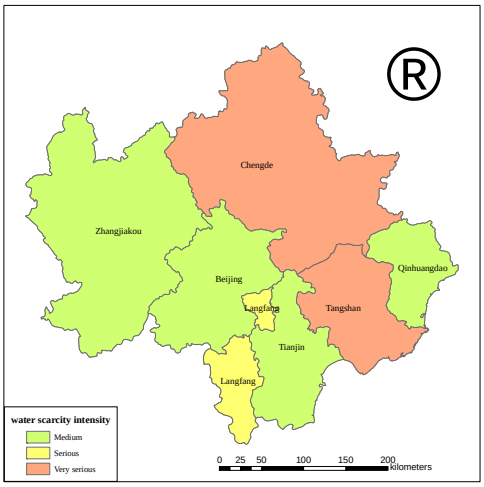
Based on the research, the situation of water resources in this region will be better in 2020 than 2005 in most parts of the region. The problem is that the current water allocation mechanisms will be inappropriate in future situation. To adapt to water scarcity of the whole region, water resources transferred from Hebei Province to Beijing and Tianjin should be reduced. For example, water supply from Yuqiao Reservoir to Tianjin is advised to reduce from 1 billion cubic meters to 600 millon cubic meters after SNWT completed.



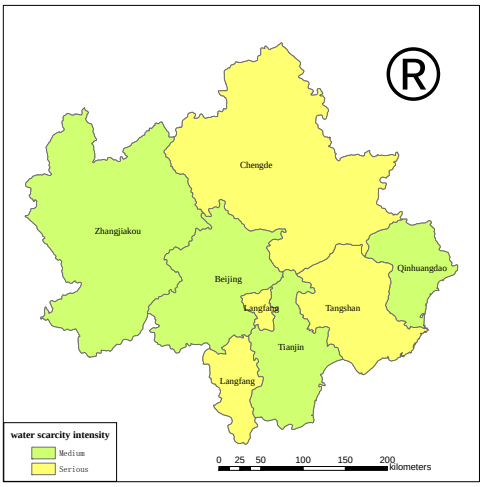
Beijing- Tianjin-Tangshan Region



Water scarcity intensity (2005)



Water scarcity intensity (WSI-2020)



WSI-2020 under new water allocation mechanisms

Potential Future Scenarios

A more efficient and multifunctional use of water will be achieved in the future.
The population of Beijing is increasing and makes high pressure to water. According to estimation, the carrying capacity of water resource in Beijing is about 18 million people, which is nearly reached. The demonstration of rainwater harvesting will contribute to water saving, which will enhance the competitive advantage of urban agriculture, thus supply job opportunities to urban producers and recreation site for citizens.

Research Focus Areas

Beijing integrated water management
Risk assessment and suggestion on greater Beijing integrated water resources
Optimizing RWH systems, mapping potential areas and upscaling the new technology

EUROPEAN UNION
SHANGHAI 2010 欧盟上海
EU-CHINA 14 - 19 JUNE 2010
SCIENCE AND TECHNOLOGY WEEK

RWH for a Sustainable City-SWITCH in China

Prof. CAI Jianming (蔡建明）
& Dr. JI Wenhua （季文华）
IGSNRR，CAS
（中国科学院地理科学与资源研究所）

SWITCH in China

- Started from 2006 as consortium member, will be ended in early 2011

- Focused in Beijing & Chengdu with different themes:
  - –Beijing-- Urban Agriculture development & Rainwater Harvest Demonstration
  - –Chengdu– Eco-sanitation demonstration

- Process:
  - –Identifying issues by Academic Research
  - –Promoting new vision and strategies by Learning Alliance (up to 10 institutions involved as network partners)
  - –Conducting cost-benefit analysis and proof by Demonstration
  - –Up-scaling by trainings and dissemination

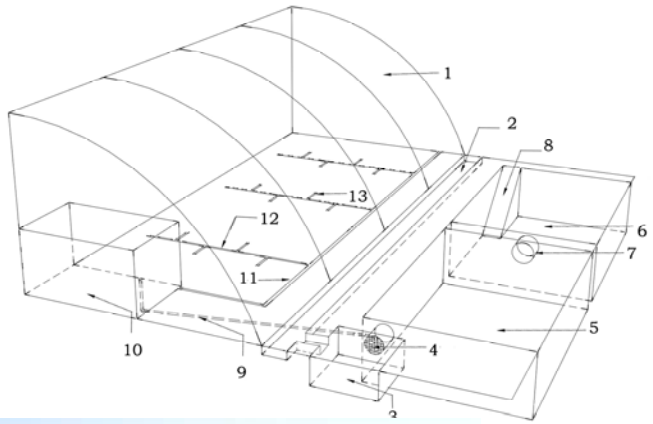
Rationale

- Fresh water per capita in China is only ¼ of the world average; Water scarcity in cities even worse.
- Beijing: 1/8 of China average and 1/30 of world average
- Rainfall become less since 1999, decreased from 600mm to over 300mm
- Underground water lever dropped 1 m each year & 8+ billion Cubic M accumulated underground water were over-extracted
- For a long time, over 50% of water in Beijing was used by agriculture. Agriculture still be the largest user, although in 2008, the percentage dropped to 34%
- 80% of rainfall in Beijing take place in June to September, which favors the rainwater harvest practice
- More greenhouses & dripping irrigation technology in peri-urban Beijing are being built & applied, which support the water self-contained for Urban Agriculture development
- Rainwater harvest practiced by farmers for thousands years & less difficult to be adopted in Northern part of China
- As relatively vulnerable sector, UA needs to find its way out for growing

Demonstration

- Cooperated with a Huairou Cooperative
- Designed an innovative RWH project: collecting rainwater from 5 greenhouses into a big ceiled pond for a multiple uses
- Pond used for mushroom growing in winter

Designed model & implementation



Result & Dissemination

- Cost-benefit analysis shows:
  - Up to 70% of rainwater can be collected;
  - Up to 80% of irrigation water can be replaced by rainwater
  - Social-environment benefit is high
- Potential RWH from greenhouses in Beijing can be high to 200 mil cubic m per year if all planned greenhouses could apply the RWH practice
- Promoted by SWITCH Beijing demo project, up to 700 RWH ponds have been built with 133 ha farmland in high value-added greenhouses being irrigated
- A patent for the innovative RWH tech is applying & a training program for farmers is under designed. Much more participants & RWH practices can be expected.
- SWITCH program in Beijing & Chengdu demonstrates:
  - A resilient city with sustainable development aspiration can be realized if appropriate technologies & integrated management with joint efforts can be put in place
  - A new assessment & evaluation system needs to be developed to capture the value of social and environmental improvement in cost-benefit analysis
  - Raising awareness to stakeholders is never late
  - Tomorrow's healthy water comes from today's harvest action