Integrated Urban Water Management in city of Darkhan, Mongolia

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Kharaa River Basin

- Kharaa Catchment area ~15.015 km²
- Kharaa flow at Darkhan: MQ ca. 10.5 m³/s
- Catchment Orkhon (~132.835 km²), Catchment Selenge (~280.000 km²), → Baikalsee, Russland
- Population of Darkhan ca. 90.000
The IWRM-MoMoMo Project: Past, Present & Future

Integrated Urban Water Management / TM3

Kharaa River basin, Urban and rural water management analysis, city of Darkhan and Orkhon Sum

Identification of
• existing problems
• impacts on population & environment
• effective programs of measure.

Testing of measures
• Evaluation of proposed measures from MoMo 1 ➔ pilot measures
• Methods for multi-disciplinary planning of effective and efficient measures ➔ toolbox model

Implementation of measures
• application and optimisation of measures,
• evaluation of the IWRM approach.

Past
2006
2009
2010
2014
Future
2017

2006
2009
2010
2014
2017
Drinking water extraction for city of Darkhan: Ground water monitoring

18 wells of USAG (depth: 60-70m)
8 km south of Darkhan bank filtrate
~ 9,700 m³/day

8 wells of Thermal Power Plant
(depth: 70-80m)
~ 8,300 m³/day

13 wells of other industries
(brick manufacture, tannery)
Drinking water extraction for city of Darkhan: Monitoring Ground water situation

10 levelloggor measure

ground water level continuously
Drinking water extraction for city of Darkhan: Ground water modelling by MODFLOW

model area: ~ 500 km² (mathematical and numerical formulation)
Drinking water extraction: Ground water simulation results

Result 1: simulated steady-state water table (hydraulic head) (April-October 2013)

- represents average flow conditions
- Warm season =>
  - river and soil water not frozen
  - groundwater recharge (10mm/year)
- GW-flow in alluvial aquifer from South to North parallel to Kharaa River

Draw down in 8 TPP wells gallery is larger than in 18 USAG wells gallery

TPP wells are further away from the Kharaa River
Drinking water extraction: Assessment of ground water quality

Result 2: Ground water quality

Legend
- Sampling points: (FhAST and IGB)
- Groundwater at risk
- Groundwater possibly at risk
- Groundwater not at risk
- Kharaa Subbasins
- Fissured aquifer, moderately productive
- Insignificant aquifer, limited groundwater
- Porous aquifer, highly productive
- Porous aquifer, moderately to highly productive
Drinking water supply in city of Darkhan

- 18 groundwater wells near the river Kharaa (depth 70m) with ~70,000 m³/d capacity
- 6 tanks
- 225 km network pipes
- ca. 18,000 m³/d demands
- Old and often broken down network infrastructure (pumps, pipes, valves)
- High water losses in the DWSN
- 3 distribution zones (Old Darkhan, New Darkhan and Industry)
- Rehabilitation of distribution network
Drinking Water Supply: Leakage detection concept

Water production and leakage detection in distribution network

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Network Monitoring and Leak Detection System
Water balance in city of Darkhan

Water balance Darkhan, Mongolia
View: based on the data from Sep.- Nov. 2011

Source: Fraunhofer AST Ilmenau
Drinking Water Supply: Leakage

Daily Demand Profiles Darkhan

- Largest Demand: 525 m³/h
- Indicator for high leak flow
- High nightly demand: 340 m³/h
Drinking Water Supply: Installation of sensors

Pin-Pointing of Leakages by Field Measurements

- Sensor Installation – 10 multiparameter sensors for darkhan water network [April-May 2011]
- Workshop with USAG employees in Summer 2012 in the Mangit area (Capacity Development)
- Training of usage of SebaKMT noise loggers, correlators and ground microphones
Drinking Water Supply: results from leakage detection

Detection of leakages by comparing the results between
• online measurement-data from sensors and
• simulation by HydroDyn

Proposal for rehabilitation of the pipe lines
(3 km in 2013 and 18 km in 2014
by local company USAG Darkhan

Reducing the leakages by 5%-7%
Waste water treatment: Tested SBR Pilot Plant

Task: Construction and operation of an SBR Pilot Plant

- Pilot plant site selected at the WWTP Darkhan
- Planning of the Pilot Plant completed
- Drawings submitted to USAG
- Machinery Parts ordered and packed for transportation to Darkhan
- PLC programming in progress
- Start-up planned in May 2011
- All actions in scheduled time and costs as submitted with proposal
Preliminary Design of Large-scale WWTP by SBR-Technology
WSB Small Waste Water Treatment
Decentralized Waste Water Management

Treatment Plant
- for a kindergarten
- in Orkhon soum
- Capacity 50 PE

Working plan
04.2011 – 06.2011 - construction work
06.2011 - start-up
07.2011 – 01.2013 - operating time

Modification
- Location adaptation
- plant size form 20 to 50 PE

Pre-treatment - Biological stage - Final clarification

Biological stage with Biofilm Carrier
**Objective:** Identify an affordable waste water treatment approach that is compatible with the harsh climatic conditions of the Darkhan region.

**Result:** Reuse waste water components for local environmental and economic benefit.

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**Location:** MUST University

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**Flow Diagram:**
- Inflow ($V = 1 \text{ m}^3/\text{d}$)
- Primary sludge
- Fance
- Outflow to sewage system
- Flow meter (Data collection)
Reuse 2: Production of Biogas by iPiT

- iPiT installation in bag 7 in Darkhan
- Installation of biogas plant on the CWWTP Darkhan
Capacity Development (2006-2014)

Mongolian Scientists and Stakeholders in Germany

- Project partners and key persons from Ministries, Kharaa River Basin Council, Water Administration and provincial Government Darkhan-Uul Aimag, local companies, like USAG and Universities (MUST, NUM)

University and Schools

- Lectures (MUST Darkhan and NUM)
- Mongolian diploma student - cost analyses of a new WWTP, at FhAST-Ilmenau
- Supervision of Ph.D. master/bachelor theses to Mongolian students
- Master Program: Environmental Engineering & Management (EEM)
- Water Fun Programm at schools (UBZ)
- Technical training course for decentralized waste water systems (Fraunhofer and UFZ)
Thank you very much – Баярлалаа