Institute of Geo-ecology, Mongolian Academy of Science, Mongolia

Environmental Diplomatic Leadership Education Program,
University of Tsukuba, Japan

The 2nd International Symposium

International Multidisciplinary Conference on Environment

-Natural Resources and the Role of Environmental Leaders-

September 1-2, 2011

Venue:
Mongolia-Japan Center Building,
Ulaanbaatar, Mongolia

Intentionally blank

PROGRAM

Venue: Mongolia-Japan Center Building, P. O. Box 46A-190 Ulaanbaatar, Mongolia

Thursday Sep.1

Opening Session

Chair: **Naomi WAKASUGI,** *University of Tsukuba*

9:30-9:40 Opening Remarks
Jamsran TSOGTBAATAR, *Director of Institute of Geo-ecology, MAS*

9:40-9:50 Keynoted Address
Implementation of IHP in Mongolia
D. BASANDORJ, *IHP Mongolian National Committee*

9:50-10:00 Objectives of the Symposium
Maki TSUJIMURA, *University of Tsukuba*

10:00-10:40 Keynote Address
How to Cope with Groundwater Contamination by Nitrate?
Norio TASE, *University of Tsukuba*

10:40-10:50 Coffee break

Session 1 Environmental Problems in Mongolia

Chair: **Naomi WAKASUGI**, *University of Tsukuba*

10:50-11:20 Hydrology Systems, Specificity and Their Tendency of Changes in Mongolia
Gambo DAVAA, *Institute of Meteorology and Hydrology*

11:20-11:50 Flooding in Ulaanbaatar City and Reducing Risk Assessment Issues
Dambarajaa OYUNBAATAR, *Institute of Meteorology and Hydrology*

11:50-12:20	Digestive Disease Incidence Trands in Mongolia **Idesh BOLORMAA, S. Tsegmed PHI, Ch. Solongo PHI, S. Anand NCCD,** *Scientific Secretary of Institute of Public Health, Ulaanbaatar City*
12:20-12:50	Water Use in Mongolia: Problems and Challenges **Lunten JANCHIVDORJ,** *Institute of Geo-Ecology, MAS*
12:50-13:00	Discussion
13:00-14:30	Lunch

Session 2 Environment Diplomatic Leader Program

Chair: **Badamgarav ERDENECHIMEG**, *Institute of Geo-ecology, MAS.*

14:30-15:00	Environment Diplomatic Leadership (EDL) Program: A New Integrated Capacity to Solve Global Environmental Issues **Maki TSUJIMURA,** *University of Tsukuba*
15:00-15:30	Reconsideration of the World Population of the 21st Century -Reproductive Health & Gender as a Key- **Naomi WAKASUGI,** *University of Tsukuba*
15:30-16:00	A Legal Perspective for Surface Water and Groundwater Interaction: Groundwater Problem in Saijo City, Japan **Takahiro ENDO**, *University of Tsukuba*
16:00-16:20	Coffee break
16:20-16:50	Discussion (including general discussion) Chair: **Maki TSUJIMURA,** *University of Tsukuba*
16:50-17:00	Symposium Closing **Takahiro ENDO,** *University of Tsukuba*

Friday Sep.2

Poster Session Dialogues with Young Scientists

Chair: **Takahiro ENDO**, *University of Tsukuba*

9:00-9:05 Objectives of the Poster Session
Takahiro ENDO, *University of Tsukuba*

9:05-9:10 Prospect of Success in Afforestation: Forest Management in India
Kazuyo NAGAHAMA, *University of Tsukuba*

9:10-9:15 Windbreak Trees for Reduction of Evapotranspiration in Agricultural Land in the Nile-Delta, Egypt
Tatsuki SHIMIZU, *University of Tsukuba*

9:15-9:20 Use of Hydrological Tracers to Assess Groundwater and Surface Water Interaction in Lebna Watershed, Cap-Bon, North-East Tunisia
Mizuho TAKAHASHI, *University of Tsukuba*

9:20-9:25 Investigation on Groundwater Flow Systems in Ulaanbaatar, Mongolia
Kohsuke TOMIMATSU, *University of Tsukuba*

9:25-9:30 Isotopic Mapping across the Whole Tunisia
Wataru YAMADA, *University of Tsukuba*

9:30-9:35 Application of Life Cycle Assessment to Evaluate Two Wastewater Treatment Plants in ChongQing Province
Wenyu HUANG, *University of Tsukuba*

9:35-9:40 The Impact of Forest Management and Forest Concession on the Local Livelihood of Papua Province, Indonesia
Maria Ludia SIMONAPENDI, *Uuniversity of Tsukuba*

9:40-9:45 Study on Photocatalytic Treatment of Activated Sludge with TiO2
Jie CHEN, *Uuniversity of Tsukuba*

9:45-9:50 Nuclear Concentration of Subsurface Water in Small Catchments, Covered by Forest, Grassland and Farmland in Kawamata Town, Fukushima
Ishwar PUN, *Uuniversity of Tsukuba*

9:50-9:55	Interaction between Shallow and Deep Groundwater in Baiyangdian Lake Watershed, China **Jie ZHANG,** *Uuniversity of Tsukuba*
9:55-10:00	Study on Adsorptive Removal of High Ammonium Nitrogen of Organic Wastes Using a Novel Ceramic Adsorbent **Yingxin ZHAO,** *Uuniversity of Tsukuba*
10:00-10:05	Modeling Water Quality Dynamics in a Tropical Inland Wetland: Case Study Abras de Mantequilla, Ecuador **Batdelger ODSUREN** *Institute of Geo-ecology, MAS*
10:05-10:10	Modeling of Morphodynamic Effects of Dam Construction in the Tuul River of Mongolia **Sukhbaatar CHINZORIG**, *Institute of Geo-ecology, MAS*
10:10-10:15	Study of Quality and Chemical Composition of Precipitation around the Ulaanbaartar City **Gerelt-Od. D**, *Institute of Geo-ecology, MAS*
10:15-10:20	The Managed Aquifers Recharge Groundwater Resources for Water Supply ULAANBAATAR city. **Narantsogtyn NASANBAYAR**, *Hydraulics and Hydro Construction Professor Team , School of Civil Engineering and Architecture, Mongolian University of Science and Technology*
10:20-10:30	Drinking Water Quality in Mongolia **Chsolongo Chuluunbat**, *Scientific Secretary of Institute of Public Health, Ulaanbaatar City*
10:30-10:40	Coffee Break
10:40-12:10	Poster Session

Opening Session

How to Cope with Groundwater Contamination by Nitrate?

Norio TASE

Graduate School of Life and Environmental Sciences, University of Tsukuba, Ibaraki, Japan

tase@geoenv.tsukuba.ac.jp

Groundwater contamination by nitrate has been one of the most serious environmental problems in both developed and developing countries around the world. Nitrate may affect human health such as blue-baby syndrome and also environments such as eutrophication.

Although many measures such as the enactment of environmental conservation laws, proper application of fertilizers, and proper treatment of animal wastes have been taken, the improvement or restoration of environments are seldom noted. In particular, the remediation of contaminated groundwater has shown little progress. The establishment of effective in-situ or on-site remediation methods for restoring groundwater environments is urgently needed.

This lecture introduces two possible measures, that is, permeable reactive barrier (PRB) and phytoremediation.

The permeable reactive barrier (PRB) is one of the possible in-situ methods to remediate contaminated groundwater by many contaminants including nitrate with relatively low construction and maintenance costs. There have been only several cases of PRB applied to nitrate-contaminated groundwater, but they could show their possibility. In order to make many good examples of applications, there are several essential conditions such that the method has a clear or chemical remediation process. Dimensions of the structure of PRB are also important factors, especially a length of the barrier should be large enough to environmentally treat contaminated groundwater. Reactive products through denitrification may be harmful sometimes.

The phytoremediation uses plants to clean up contamination in the environment. Plants can help clean up many kinds of contamination such as metals, pesticides, explosives, nitrate and oil. The remediation or uptake does not necessarily progress quickly, but it is a cost-effective method. Therefore, effective local plants or trees need to be found and used for good applications. Poplar and Caragana may be possible species available in Mongol.

Keywords: groundwater contamination, nitrate, remediation, phytoremediation, permeable reactive barrier

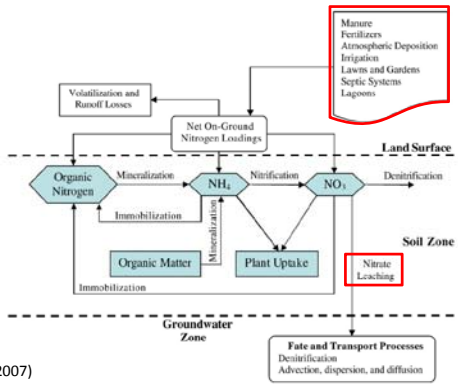
Environmental Diplomatic Leader Education Program University of Tsukuba

Ulaanbaatar, Mongolia
Sep 1, 2011

How to cope with groundwater contamination by nitrate?

Norio TASE
(University of Tsukuba)

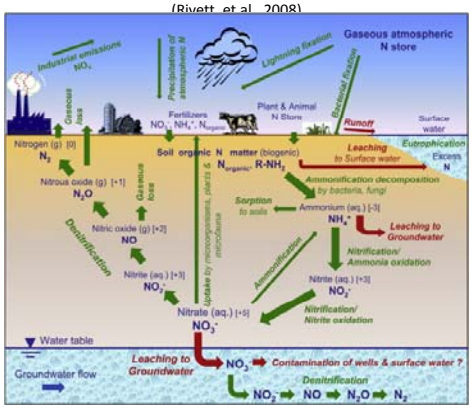
Dynamics of nitrogen



Sources

Almasri(2007)

The nitrogen cycle and its influence upon the water environment.
(Rivett, et al., 2008)



Sources of nitrate to groundwater

- **Fertilizers**
  - Chemical fertilizers
  - Manure or Composts
- **Animal wastes**
- Human wastes
  - Septic tanks Sewage system
- Industrial wastes
- Others or natural

Treatment options for nitrate in drinking water

Health problems, especially for babies
Methemoglobinaemia or Blue baby syndrome

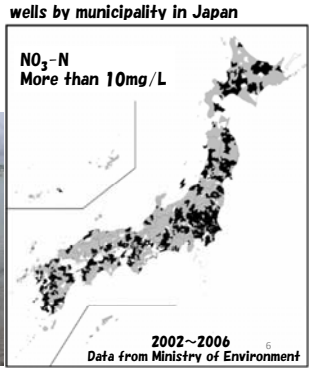
- Simple household treatment methods for other contaminants such as boiling, filtration, disinfection, and water softening are not effective for nitrate removal.
- The three in-home water treatment methods that can effectively remove nitrate are distillation, reverse osmosis, and ion exchange.

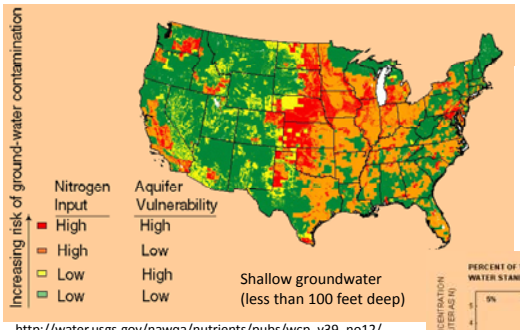
Threatening all over the world !

- Japan
  - Intensive farming
  - Animal wastes
- Korea
- China
- EU
- USA

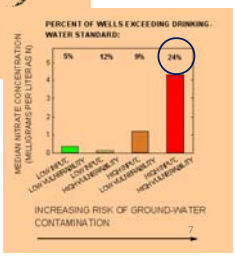
Green algae show springs of nitrate contaminated groundwater in the coast of Guam Islands

Distributions of nitrate contaminated wells by municipality in Japan





http://water.usgs.gov/nawqa/nutrients/pubs/wcp_v39_no12/



How about Mongolia ?

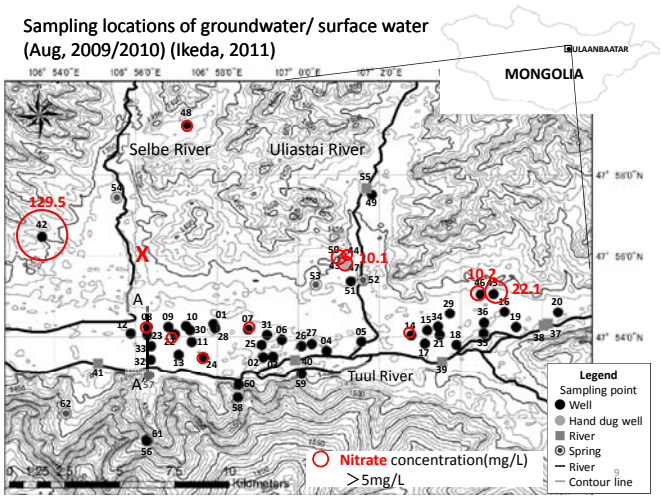
- **May not be serious at present**

According to Ikeda(2011), there are a few nitrate contaminated groundwater around Ulaanbaatar, one of which has nitrate(NO_3^-) concentration of 129.5mg/L (WHO standard is 50mg/L), though fifty of all 62 samples show less than 5mg/L.

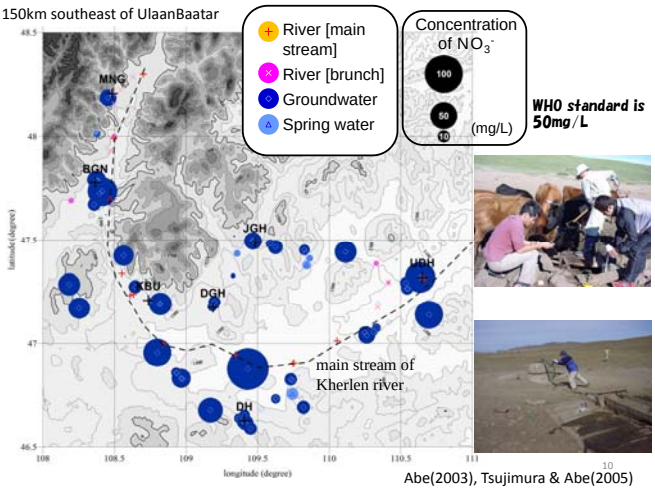
Abe(2005) reported more serious situations of nitrate contaminated groundwater around the Kherlen River.

- **Getting serious and critical in near future**

Sampling locations of groundwater/ surface water (Aug, 2009/2010) (Ikeda, 2011)



150km southeast of UlaanBaatar



Abe(2003), Tsujimura & Abe(2005)

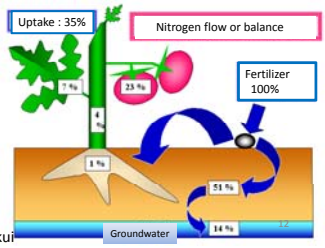
Nitrate contamination !!!

Public spring in Ulaanbaatar

EC=640μS/cm NO_3^-=60mg/L > 50mg/L

How to minimize nitrate leaching? Nitrogen balance

- **Source control**
  - **Managing fertilizers and animal wastes**
  - **Minimizing storage of nitrogen and leaching of nitrate**
- **Without severe economic consequences.**



After Fukui

How to remediate contaminated Groundwater by nitrate?

- Removing nitrate or nitrogen.
  Denitrification $NO_3 \rightarrow N_2$
  Uptake by plants
- Without severe economic consequences.
  Inexpensive means

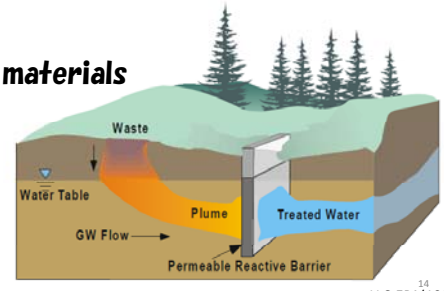
There are several technologies, possibly
Permeable reactive barrier
Phytoremediation

13

Permeable reactive barrier (PRB)

One of possible means of restoration or cleanup of contaminated groundwater

- Reactive materials



U.S.EPA(1998)

14

Merits and demerits of PRB

- Merits
  - In-situ remediation
    for point and non-point sources
  - Relatively easy maintenance
- Demetrits
  - Relatively high construction cost
  - Effect of byproducts such as TOC and SO_4^-

15

Reactive materials for denitrification

- Reduced conditions
- Carbon or sulfides as an electron donor
- Microbes
- Carbon or organic material

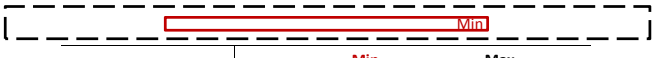
$$4NO_3^- + 5CH_2O \rightarrow 2N_2 + 5HCO_3^- + 2H_2O + H^+$$

- Sulfur or sulfide

$$2NO_3^- + 2S + 2CaCO_3 + 2H_2O \rightarrow N_2 + 2CaSO_4 + 2HCO_3^-$$

16

Literatures	Soejima *et al.* (2002)	Lee and Tase (2007)	Lee *et al.* (2010)、Takagi *et al.* (2010)
Design & width	1m	1.1m	3.74m
Depth	15m	1.5m	4.00m
Nitrogen loads around PRB	Fertilizer	Non	Non
Flow direction	⇩	⇩	⇩



Necessary dimensions of practical PRB		Min	Max
	Length	>5 m	>10 m
	Width	>20 cm	>50 cm
	Depth	Depending on aquifer	

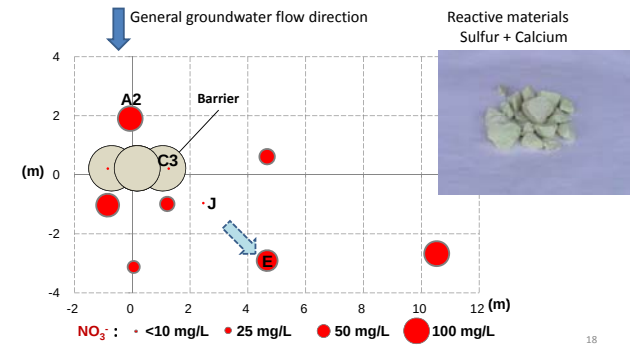
17

Nitrate concentration around PRB in Tsukuba

Lee *et al.* (2010)

Basic reaction

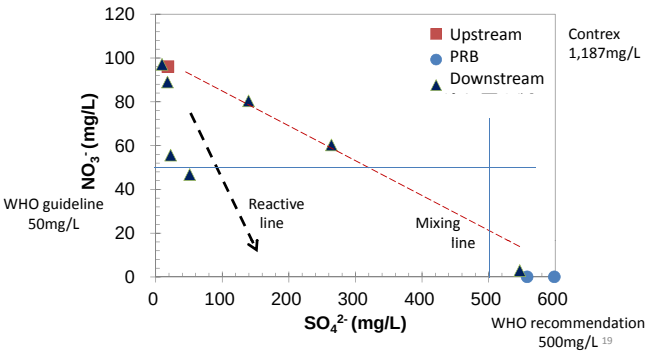
$$2NO_3^- + 2S + 2CaCO_3 + 2H_2O \rightarrow N_2 + 2CaSO_4 + 2HCO_3^-$$



18

NO_3^- vs SO_4^{2-}

$$2NO_3^- + 2S + 2CaCO_3 + 2H_2O \rightarrow N_2 + 2CaSO_4 + 2HCO_3^-$$



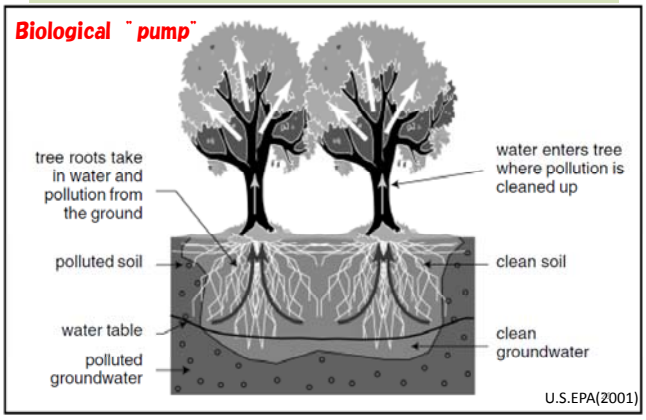
19

Phytoremediation

- Phytoremediation uses plants to clean up pollution in the environment. Plants can help clean up many kinds of pollution including metals, pesticides, explosives, and oil.
- The greatest merit is cost effective or inexpensive, but it might take longer time.
- The plants also help prevent wind, rain, and groundwater from carrying pollution away from sites to other areas.

20

Phytoremediation



U.S.EPA(2001)

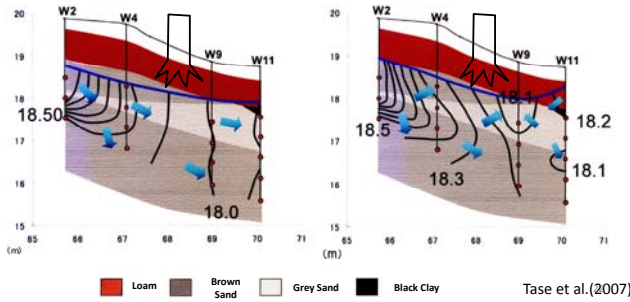
Case study in Tsukuba

Aphananthe aspera

Hydraulic potential and groundwater flow

Feb Leafless period
Horizontal flow

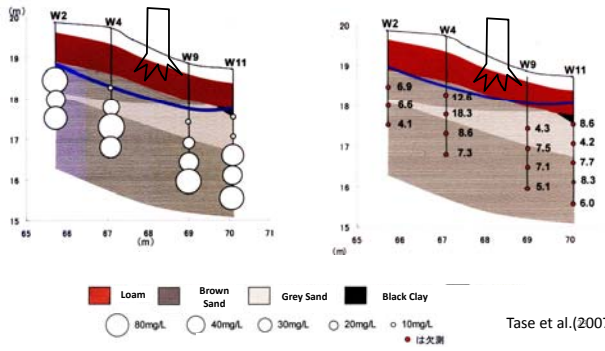
July Growing period
Upward flow by uptake



Tase et al.(2007)

Aphananthe aspera

Nitrate(mg/L) Aug. 2006 Nitrogen isotope(‰)



Tase et al.(2007)

Qualities of trees evaluated for groundwater remediation

- Daily water uptake
- Growth rate
- Planting density
- Area of water extraction
- Root depth
- Reproduction
- Salt tolerance

24

Scientific name	Eucalyptus	Tamarix	Poplus	Caragana
Common name	Eucalyptus	Tamarix/ Salt cedar	Poplar/ Cottenwood	Chinese pea tree
Growth form	Tree	Shrub/Tree	Tree	Shrub
Salt tolerance	Very high (1,200-15,000ppm)	Very high (6,000-15,000ppm)	Very high (3,600ppm)	
Water uptake	20-150 L/day	50-700 L/day	30-150 L/day	
Growth rate	Rapid(0.9-3.6m/y)	Rapid(3-3.6m)	Rapid(1.2-3m/y)	
Planting density	500-3,000/ha	2,000-3,000/ha	1,500-2,500/ha	
Area of water extrac-tion (extent of root)	4.5-12m diameter	1.5-3.6m diameter	3-9m diameter	
Root depth	0.6-6m	0.9-2.7m	0.9-3.6m	
Leaf retension	Evergreen	Deciduous	Deciduous	Deciduous

By Leigh et al.(2003)

Remarks

- **Groundwater contamination by nitrate is and will be serious problem in the world.**
- **Source controls, that is, managing fertilizers and animal wastes, are the first and most important means.**
- **Phytoremediation, biological pump is most cost effective and should be developed locally. Find your own trees and schemes.**

26

Remarks added

My tentative perspective about Mongolia,

- **Groundwater contamination by nitrate may be serious and will be more serious problem in Mongolia.**
- **Source controls, that is, managing human and animal wastes, are the first and most important means.**
- **Zoning of well head protection area may be easy and important.**
- **Well installation and maintenance is very important.**

27

References

Abe., Y.(2003) Study on Groundwater Flow System in the Kherlen River Basin, Mongolia. MS thesis submitted to the Graduate School of Life and Environmental Sciences, the University of Tsukuba, 63p.

Almasri, M.N.(2007):Nitrate contamination of groundwater: A conceptual management framework. *Environmental Impact Assessment Review*, 27-3, 220-242.

Ikeda, K.(2011):Interactions between groundwater and river water in the neighborhood of Ulaanbaatar, Mongol. MS thesis submitted to the Graduate School of Life and Environmental Sciences, University of Tsukuba.

Lee S.W., et al.(2010):Evaluation of nitrate removal effectiveness of permeable reactive barrier. 16th Symposium on Soil and Groundwater Contamination and Remediation, 539-544.

Leigh, D., Matos, L. and Brooks, P.(2003):Evaluation of Phytoremediation for Groundwater Control at a Landfill Site in California.

Rivett, M.O., et al.(2008):Nitrate attenuation in groundwater: A review of biogeochemical controlling processes. Water Research, 42, 4215-4232.

Tase, N. and Lee, S.W.(2011):Toward Building up Good Examples of Remediation of Nitrate-Contaminated Groundwater. *J. Jap. Assoc. Hydro. Sci.*, (in press)

Tsao, D.T.(2003): Overview of phytotechnologies. Advances in Biochemical Engineering/ Biotechnology, Vol.78.

USEPA(2001):A Citizen's Guide to Phytoremediation. EPA 542-F-01-002.

USEPA(1998):Permeable Reactive Barrier Technologies for Contaminant Remediation. EPA/600/R-98/125.

28

Thank you for your attention!

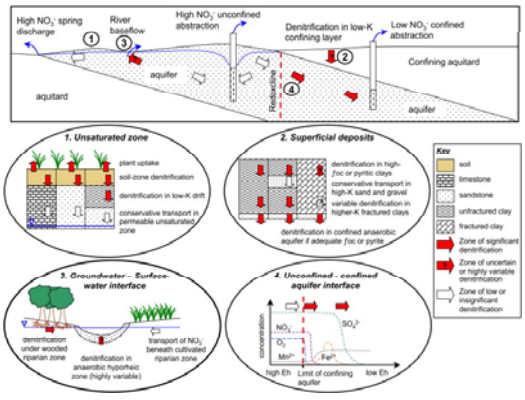
If you have any more queations,

please contact me.

tase@geoenv.tsukuba.ac.jp

29

Conceptual model of denitrification occurrence in the subsurface environment (Rivett, et al., 2008)



30

Intentionally blank

Session 1
Environmental Problems in Mongolia

Hydrology Systems, Specificity and Their Tendency of Changes in Mongolia

Gambo DAVAA, Dashzeveg BATKHUU[1], Janrai SONINBAYAR[1], Jigjsuren ODGARAV[1], Khalzan PUREVDAGVA[1], Tsutomu KADOTA[2], Hironori YABUKI[2]

1 Institute of Meteorology and Hydrology, Ulaanbaatar, Mongolia,

2 Research Institute for Global Change, JAMSTEC, Japan

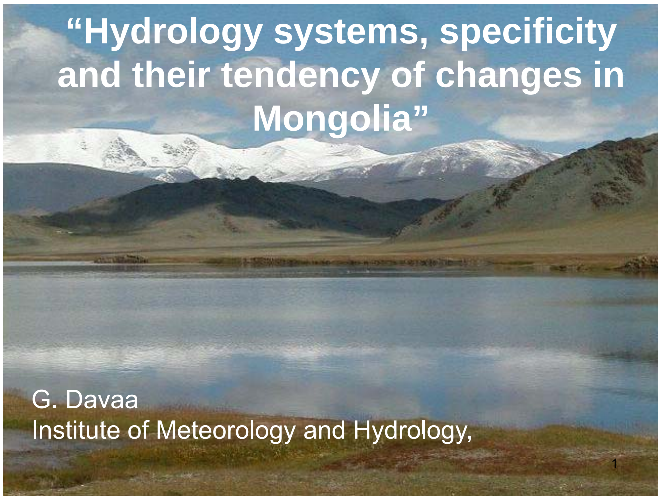
Analyses of drainage networks and changes in morphology of lakes and glaciers are certainly very dependent on the quality of the data sources. A large number of studies indicate that unreliability of standard topographic maps in many parts of the world. Mongolia as country with large territory and less population density has necessity and problems in defining the extent of the hydrologic network and particularly the identification of fingertip tributaries, tiny lakes and spot of disappearing glaciers.

Hydrologic indices vary in both space and time. Hydrologic indices are a function of topography, vegetation, land use, soils, geology, and the stream network across the drainage basin. These indices are related to the actual measurement of stream flow and include peak discharge, runoff volume, timing of runoff, and base flow. The hydrologic properties which impact stream flow include interception, infiltration, evaporation, transpiration, and erosion (Singh 1992).

The purpose of this investigation is to gain knowledge on specificity of hydrologic network characteristics and may be applied to the practical problem to reveal changes in hydrology systems and to determine when either a distributed or lumped model may be expected to function well given a set of hydrologic conditions.

In order to develop hydrological models and make lake and glacier inventories we have analyzed and developed GIS based hydrological, glaciological data base and illustrated results and changes in lake and glacier areas. As for lake and glacier variations in Mongolia, compilation of lake and glacier inventories are desired, using reliable materials, especially vertical air photographs, which is to be basic information for development of climate-hydrology-glacier study.

Key words: channel order, drainage density, basin centroid, mass balance, stream flow



Used data and methods:

❖ Digitized topographic map data (Information and Computation center) scaled S1: 100000 map
❖ Landsat ETM data

Methods: ArcView, ArcGIS, ENVI softwires, DEM (SRTM-90, 30)

❖ Morphmetric characteristics and conventional methods

❖Results:

❖ Drainage basin and stream network system's GIS based hydrographic data base development
❖GIS based lake morphometery data base development
❖Glacier variation

2

Morphometric characteristics obtained for all rivers and streams

Name of river	2
Order of river, w	3
Number of streams, (N)	4
Length of stream, êì (L)	5
slope (I)	6
Average elevation of river, m (Hã)	7
Log(N)	8
Log(L)	9
Log(A)	10
Bifurcation ratio N, L, A — Rb	11
RL	12
RA	13
N=f(w)	14
L=f (w)	15
I=f(w)	16
Hã=f(w)	17
Drainage area, km²	18
watershed perimeter, km	19
Average elevation of watershed line, ì	20
Total length of steams, km	21
Density of stream network, km/km²	22
Coordinates of centre point of the basin	23
	24
Average elevation of the basin, m	25
Average depth of valley, m	26
Average width of basin, km, (B=F/L river)	27
Shape Factor of the basin, δ=L river/B	28
Compactness Coefficient, m= (0.28(S/F^0.5)	29
Õàæóóãèéí õýð÷èãäýë	30

3

Morphometric characteristics, obtained for all lakes

Classification of lakes.
Coordinates:
Water level or elevation:
length:
Width:
Circularity Ratio:
Water surface area (volume) bathimetric curve:
Water depth for selected lakes:
Water balance for lakes with observation record;

4

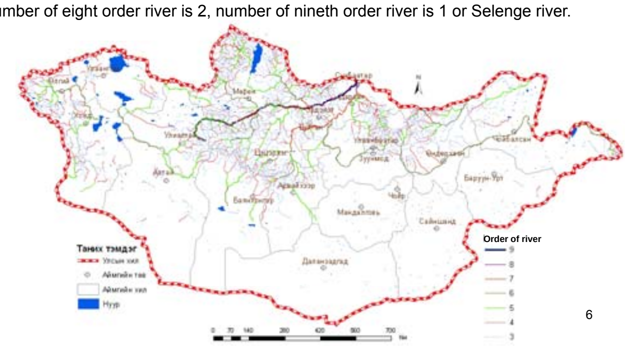
Glacier classification

1. Glacial complexes of conic summits (Khuiten and etc.)
2. Glacial complexes of high plateau (some in Tavanbogd)
3. Dendrite glaciers (…)
4. Compound valley glaciers (Potanin, Aleksandr and Grane)
5. Valley glaciers
6. Hollow basin glaciers
7. Corrie glacier (Munkhkhairkhan)
8. Corrie-valley glacier (…)
9. Hanging glacier (locally existing)
10. Slope glacier (There many)
11. Niche glacier (Burged)
12. Glaciers of the flat summits (Tsambagarav at upper Ulaan valley)

5

Stream and river network data obtained

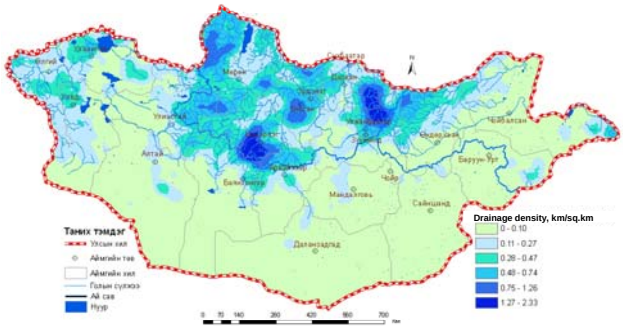
Number of first order stream is 31849, number of second order stream is 8406, number of third order river is 1976, number of fourth order river is 424, number of fifth order river is 100, number of sixth order river is 25, number of seventh order river is 6, number of eight order river is 2, number of nineth order river is 1 or Selenge river.



6

Drainage density

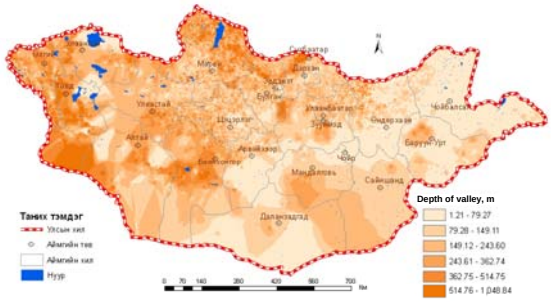
Its maximum reaches 2.1 km/sq.km minimum reaches 0.1 km/sq. km in Gobi region. Average density is 0.18 km/sq.km.



7

Depth of valley and basin

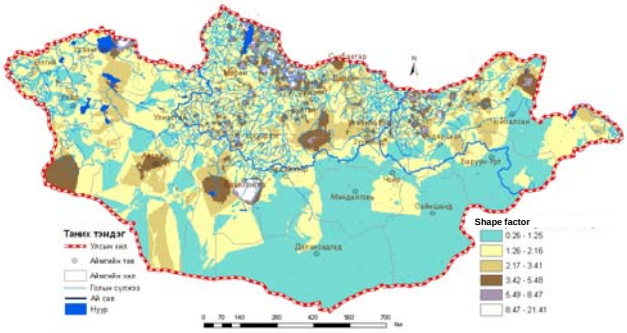
Its maximum reaches 1272, 1038 m in rivers draining from Harkhiraa and Turgen and minimum reaches 971 m in rivers draining from Khangai and Khentey Mts. The information is imporetant for estimation hydropower resource and infrastructure planing.



8

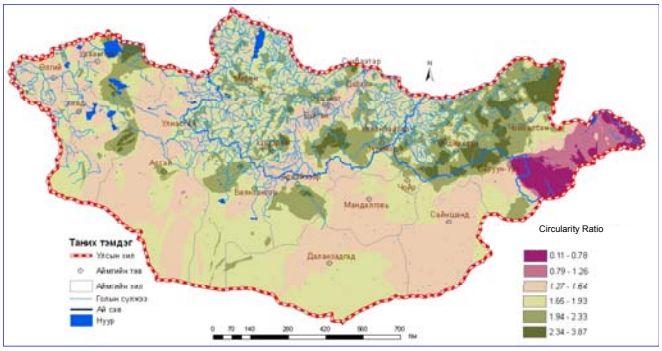
Shape factor of a basin

Its maximum value reaches in longest rivers as Kherlen, Orkhon and Zavkhan rivers. Its value vrs with flood wave attunation, interaction of ground and river waters along the river reach.



9

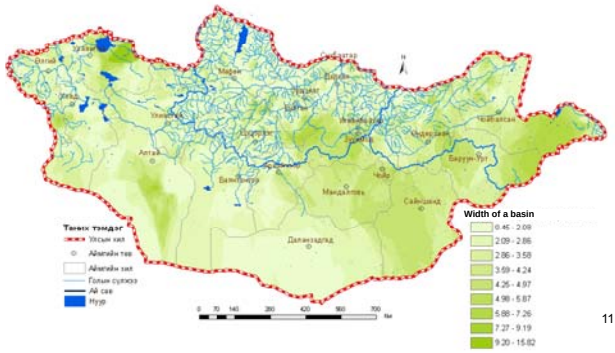
Circularity Ratio of a basin



10

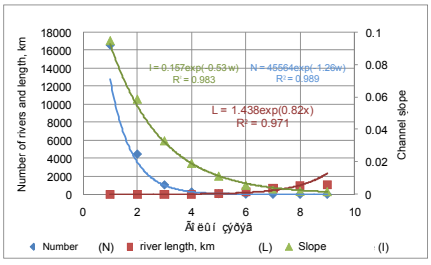
Width of a basin

Its minimum value reaches 2.1 km in up streams of rivers draining from the Altay, Khangai and Khentey Mts. And its maximum reaches 88-179 km in down stream site of bigger rivers.



11

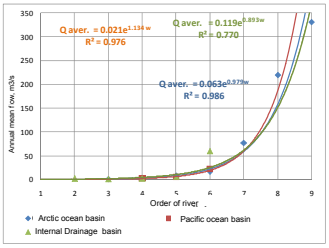
Morphometric characteristics vrs. with order of river

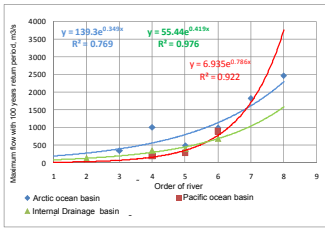


Slope, length and number vrs. with order of streams, equations were found for major 50 river basins

12

Order of river vrs. with mean flow and maximum flow of rivers





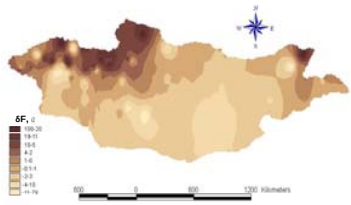
13

Changes in lake area and number of lakes

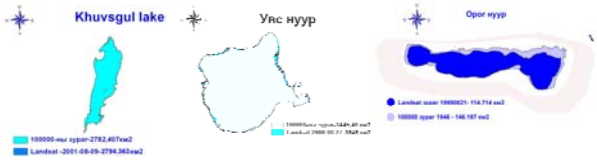
Size of lake	Size of lake area	Landsat ETM		Topographic map, scaled S1:100000		Difference of lake area, sq.km	Difference of number of lakes
		Number of lakes	Sum of lake area, sq. km	Number of lakes	Sum of lake area, sq. km		
Very big	>1000	4	8815.214	4	8801.343	13.7	0
Big	≥500.0-<1000.0	2	1196.1	2	1192.3	3.8	0
Bigger	≥100.0-<500.0	9	1913.55	8	1812.8	100.8	1
Medium	≥50.0-<100.0	11	760.62	12	851.8	**-91.2**	**-1**
Medium to small	≥20.0-<50.0	9	256.421	9	254.8	2	0
small	≥10.0-<20.0	30	419.23	29	383.4	36	1
Very small	≥5.0-<10.0	71	489.38	75	444.6	45	-4
Tiny	≥1.0-<5.0	239	556.01	287	531.2	25	-48
Very tiny	≥0.1-<1.0	1710	531.355	3399	964.4	-433	-1689
Шал тойром	0.1>	3081	96.79	1391	114.6	-18	1690
Total		5166	15034.70	5216	15372.07	-373.37	-50

14

Current changes



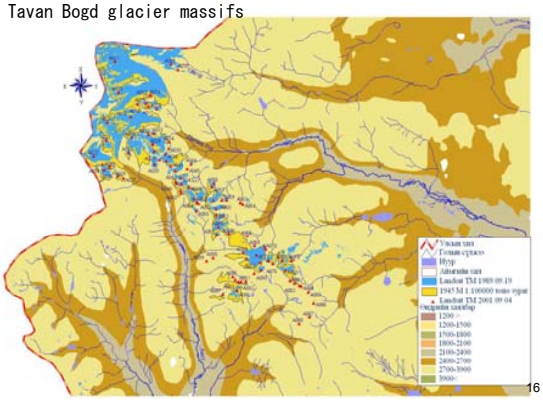
Change in lake water area (sq.km) determined from the topographic map scaled 1:100000 compiled in 1940th digitized in ICC and LandSat ETM, in 2000-2002. Total lake area decreased by 373.4 sq.km.



15

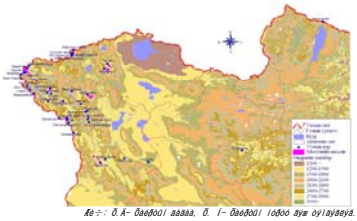
Glacier variations

Tavan Bogd glacier massifs



16

Glacier massifs are distributed in 43 Mts.



❖ Glacier mapped in topographic S1:100000 in 4 Mts. (Doush, Zurkh, Baga and Chuluut) aren't revealed by LANDSAT ETM.

❖ Existing 6 glacier massifs such as Siilkhem, Upper Salban river, Khokh serkh, Holagash, Ikh Turgen Mts (Syrgali), Otgontenger aren't mapped in topographic S1:100000.

Can be concluded that glacier area decreased by 12.3 % in the period from 1940th till 1989-1992 and by 9.8 % in the period from 1989-1992 till 1999-2002, totally 22 % in last 60 years.

❖ Area and shape of arial distribution of 7 glacier massifs located in Samartai, Chandmani, Tsagaan-Uul, Hairtiin davaa, Hajmiin salaa, 'Sutai and Khatuugiin Monkh tsast Mts. are precise in both topographic map and Landsat images of 1989-1992.

17

Current changes

There are 4 types of changes: 1. Runoff has been increasing trend in all seasons, and years (rivers draining from glaciers and permafrost zones). 2. Runoff has increasing trend in autumn, winter period (permafrost zones). 3. Runoff has increasing trend in only in winter (down stream site of bigger rivers. 4. Runoff has decreasing trend in all seasons and years (rivers flowing in steppe, desert steppe zones.

For the first type of rivers ice depth has increasing trend and date of maximum ice depth is being observed one month later than it's date in beginning of observation. Water gets colder. In the rest of areas of the country, the duration of ice cover period is being shrunk by 20 days and water temperature in July has been increasing by 1-4 oC, 2oC on average. Date of maximum ice depth occurrence gets earlier by 15 days, maximum is depth gets less

Future projections

Table 2.7. Future Climate Change Projected by Hadley Center Model, HadCM3

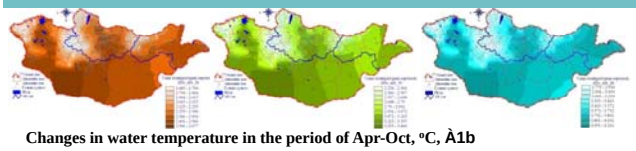
Period		Temperature Change , °C			Precipitation Change, %		
		2011-2030	2046-2065	2080-2099	2011-2030	2046-2065	2080-2099
Annual	A2	1.0	2.7	5.0	2	9	15
	A1B	0.9	3	4.6	0	7	16
	B1	0.8	2.1	3.1	3	6	11
Winter	A2	0.7	2.3	4.2	14	19	55
	A1B	0.2	2.5	3.8	0	23	41
	B1	0.2	1.6	3.0	7	14	32
Summer	A2	1.1	3.1	6.3	-2	4	7
	A1B	1.4	3.6	5.6	-4	3	11
	B1	1.2	2.7	3.7	2	0	8

Source: MARCC, 2009

Rainfall will be decreased by 2-4 % in 2011-2030, increased by 0-4 % in 2046-2065 and 7-11 % 2080-2099 periods.
Snow in winter is projected to increase by 0-14%, 14-23% and 32-55%, respectively in these periods. That indicates unfavorable winter condition is expected for traditional nomadic animal husbandry.

19

Future impact projections



Changes in water temperature in the period of Apr-Oct, °C, À1b

Water temperature will likely be increasing by °C:

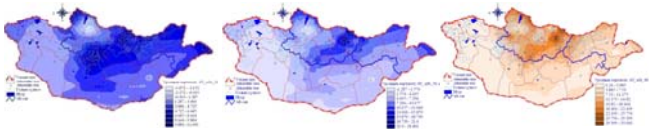
River basins	2020	2050	2080
Arctic Ocean basin	2.18	2.84	3.45
Pacific Ocean basin	2.27	2.98	3.78
Internal Drainage Basin	2.37	3.11	3.77

Evaporation from water surface or potential evaporation will likely be increasing, mm : À1B:

River basins	2020	2050	2080
Arctic Ocean basin	488	590	642
Pacific Ocean basin	538	626	894
Internal Drainage Basin	310	452	483

20

Future impact projections



Change in runoff depth, mm/year , A1B

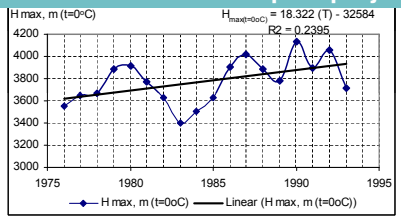
Increase in river runoff is much less than increase value of potential evaporation. That indicates most likely drying up process will dominate in future.

Runoff change: A1B: mm

River basins	2020	2050	2080
Arctic Ocean basin	3.5	7.6	13.0
Pacific Ocean basin	4.7	8.4	8.9
Internal Drainage Basin	2.1	2.7	4.3

21

Future impact projections



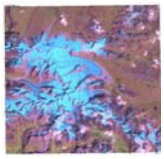
While, the altitude of location of the flat-top glacier ranges from 3600 to 4000 m. Analysis of annual maximum of 0oC GH in free atmosphere shows that since 1976 till 2005 the height has increased by 531 m, determined by the trend line, statistically significant.

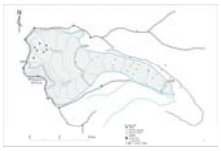
Glacier ablation

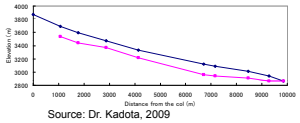
It is likely to increase glacier ablation rate till 131 cm/year by 2010-2039, till 371 cm/year by 2040-2069 and 739 cm/year by 2070-2099.

22

Glacier monitoring IRCC, JAMSTEC and IMH



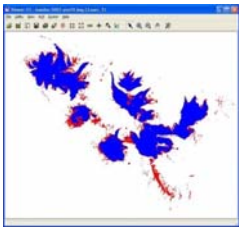


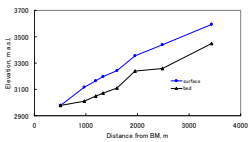


Source: Dr. Kadota, 2009

23

Tsambagarav Northern, IMH

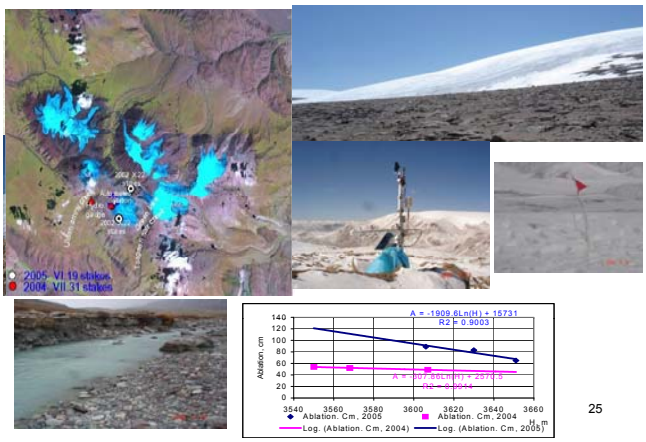




Source: Dr. Kadota, 2009

24

IMH Glacier monitoring, 2003-

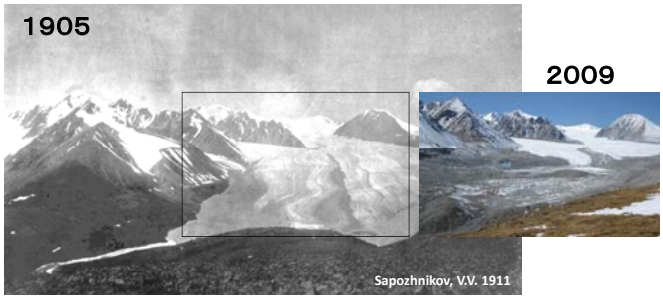


25

Monitoring at Munkhkhairkhan glacier IMN

26

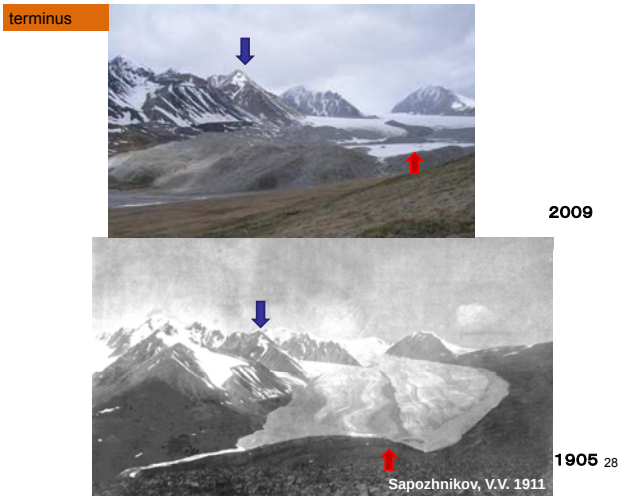
Terminus retreat of **Potanin glacier**



Terminus retreat：866m（1950 ～ 2000）
（by Aster image）

Courtesy of Dr. Konya K. RIGC

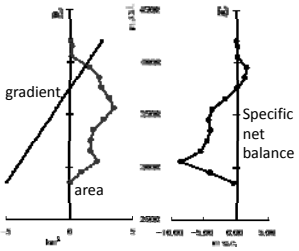
27



28

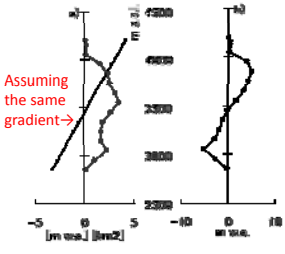
Net balance gradient and specific mass balance

2007 / 2008



Mass balance of Potanin glacier
2007/08
-1.37 m w.e.

2004 / 2005

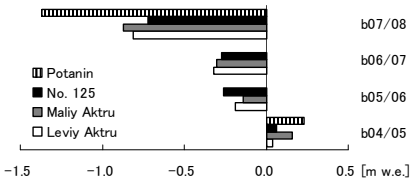


Mass balance of Potanin glacier
2004/05
+0.23 m w.e.???

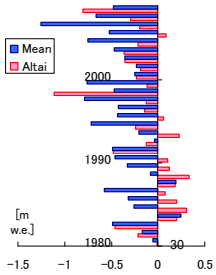
Source: Dr. Konya, JAMSTEC, Japan, 2009

29

Mass balance of glaciers in Altai



Potanin glacier is sensitive to climate change?



Adaptations

Adaptation to climate change

- ❖Intensification of Environment Monitoring (extension and modernization of observational network, modeling, remote sensing, integration and regional cooperation and etc.)
- ❖National strategy for adaptation to climate change
- ❖Implementation of Projects and Use of Clean Development mechanisms
- ❖Integrated River Basin Management (basin and national, coping with desertification)
- ❖Storage and regulation of glacier melting water in mountainous regions
- ❖ Protection of runoff formation zones through protected area network extension
- ❖Weather modification (rain generator,)

31

32

Intentionally blank

Flooding in Ulaanbaatar City and Reducing Risk Assessment Issues

Dambarajaa OYUNBAATAR
Hydrology section, Institute of Meteorology and Hydrology,
Juulchiny str-5, Ulaanbaatar-46, Mongolia
oytetuar@yahoo.com

In Mongolia, depending on natural and climatic conditions can be identified there are 3 types of floods including spring or snow melting flood, rainfall flood and flash flood. Due to its specific location surrounded by mountain, the Ulaanbaatar city much suffer from flash floods which drains from the mountain, nearly every year. Also some rare rainfall floods along the river Tuul treaths to the Ulaanbaatar City. Total economical damages of the mentioned flood of Tuul river in 1966 was estimated about 75 million dollar. In flash flood which occurred in Ulaanbaatar in 1982 have dead 87 persons, about 200 family left without shelter and total flood damage was estimated about 2.9 million dollar.

Flash flash is defined as high intensive turbulent flow with rocks and sediment and other surface materials due to high intensive rain along the steep dry beds and small rivers.

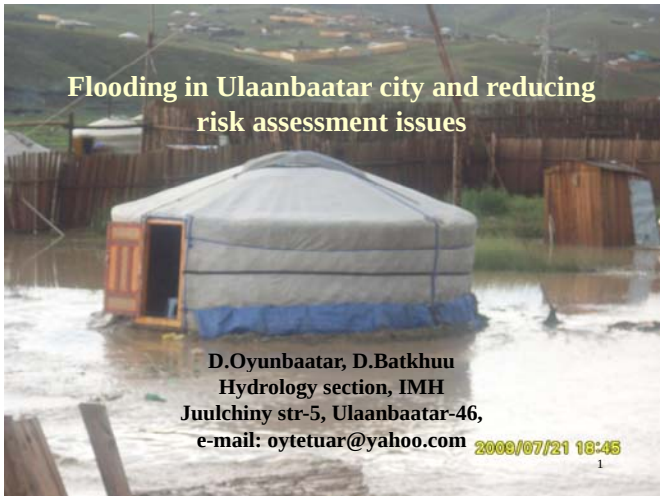
Due to global climate change, frequency of occurrence of heavy rainfall and their intensity have increased, rapidly, consequently, flash flooding. On the other hand, recent urban development, growth of population, disordered settlement, change of land surface around Ulaanbaatar city, intensity and amount of direct surface runoff has increased.

Risk (climate-related)- is the result of interaction of physical defined hazards with the properties of the exposed systems-.i.e., their sensitivity or (social) vulnerability. Flood risk assessment includes feature and understanding of physical hazards, occurrence vulnerability of system (social, economical) and flood protection ability, capacity assessment.

In terms of physical hazards, frequency and intensity of heavy rainfall have incerased much reaching up to 29-41 % of total events around Ulaanbaatar city area. Due to rapidly increasing of population of the city and urbanization, citizenship and properties becomes highly vulnerable for flood disasters. At same time flood forecasting and warning system and protection systems are needed to improve and invest.

Flash flood discharge with different return periods of the surrounded dry beds and small river around Ulaanbaatar city are estimated by the methods based on maximum rainfall amount and basin morphometry.

Keyword. Flood , rainfall, snow melting, climate change, runoff



1

Content of the presentation

- *Introduction*
- *Floods, causes, magnitude and frequency*
- *Ulaanbaatar city flood protection structure*
- *Flood damage*
- *Event study (some example)*
- *Need and aim of hydrological forecasting*
- *Forecasting methods and results*
- *Conclusions*

2

Introduction

Due to global climate change, **frequency of occurrence of heavy rainfall and their intensity have increased,** rapidly, consequently, flash flooding

On the other hand, recent urban development, growth of population, disordered settlement, change of land surface, **intensity and amount of direct surface runoff has increased**

3

Floods, causes, magnitude and frequency

According to some definitions flood is inundation of surrounding area due to quick and sudden rise of water level due to intensive rainfall or slow snow melting. river water level (A.I.Chebotarev). Cause of floods also could be earthquake, landslide, ice blocking, dam break etc.

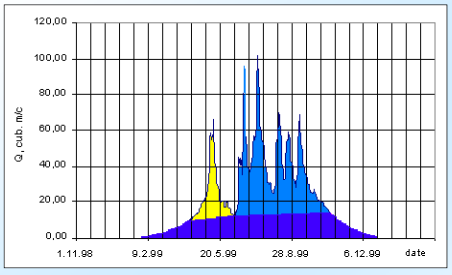
In Mongolia, depending on natural and climatic conditions can be identified there are 3 types of floods.

a. Rise of water level and over bank flow in relatively long period due to snow and ice melting is called **spring or snow melting flood.**

b. Quick rise of water level and over bank flow caused by intensive rainfall is called **rainfall flood.**

c. Finally **flash flood**- high intensive turbulent flow with rocks and sediment and other surface materials due to heavy rain along the steep dry beds and small rivers.

4



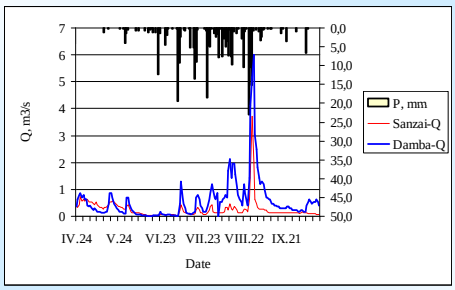
Yellow is spring flood,

Light blue is rainfall flood

Typical flow hydrograph of Mongolian rivers (river Tuul-Ulaanbaatar, after G.Davaa)

5

Runoff has clear response to rainfall amount and intesity in most rivers, especially in small river basins



6

Ulaanbaatar city:
Population: 1 million
Surrounded by Mountains
60 present so called ger area: flood prone area

7

Reducing flood risks

Risk (climate-related)- is the result of interaction of physical defined hazards with the properties of the exposed systems-.i.e., their sensitivity or (social) vulnerability.

Risk can also be considered as the combination of an event, its likelihood, and its consequences- i.e.,

Risk equals the probability of climate hazard multiplied by a given system's vulnerability (UNDP, 2005)

8

Reducing flood risks

Flood risk assessment:

1.Feature and understanding of physical hazards, occurrence ***(likelhood), damage (heavy rainfall, flash flood, damage, event study)***

2.Vulnerability of system (social, economical)

3.Flood protection ability, capacity assessment (estimation method, flood protection structures)

9

Reducing flood risks

1.Feature and understanding of physical hazards, occurrence *(likelhood), damage (heavy rainfall, flash flood, damage, case study)*

F**lash flood**- high intensive turbulent flow with rocks and sediment and other surface materials due to heavy rain along the steep dry beds and small rivers.

In Mongolia most of annual runoff up to 70-80 percent forms during **rainfall floods** in summer period. Rainfall floods occurs when daily rainfall exceeds 40-110 mm.

Hill slope, soil and sediment, intensity of rain, urbanization are key factors for **flash flood**

10

Reducing flood risks

Key factors of any floods including rainfall and flash flood are:
1. Climate and meteorological situation
2. Ground surface, basin cover

Recent years, frequency and intensity of heavy rainfall, conseqently flash floods have incerased. Heavy rainfall percentage of total rainfall is 29-41 % around Ulaanbaatar city area

Observed daily maximum was 74.9 mm (1967)

Estimated maximum daily rainfall in the Ulaanbaatar is 125 and hourly 45.5 mm

Heavy rainfall cases:

- 44 mm within 17 minutes and estimated intensity 2.58 mm/min, 3rd July, 1982
- 25-55 mm within 1.5 hours in 17th of July, 2009 etc

11

Reducing flood risks

Rainfall in 2007-2009

	Years	IV	V	VI	VII	VIII	IX	X	Warme period (V-IX)
1	2007	28.0	23.1	59.3	33.9	86.9	1.6	3.5	236.4
2	2008	1.4	16.4	89.9	66.2	49.6	16.6	12.2	252.2
3	2009	4.0	21.5	59.5	69.4	74.8	16.8	8.3	254.2
4	*3 year mean*	11.1	20.3	69.5	56.5	70.5	11.7	8.0	247.6
5	1998-2009	-	24.1	52.4	68.3	79.5	26.8	5.7	263.1
6	*Regional long term mean*	-	14.7	54.6	57.9	75.9	23.4	9.7	*236.2*

12

Reducing flood risks

One biggest rainfall in modern era is rainfall flood in 1966 in the Tuul river basin. On 10-11th of July 1966, in Ulaanbaatar area have recorded daily rainfall as 103.5 mm which was about 43 percent of total annual precipitation.

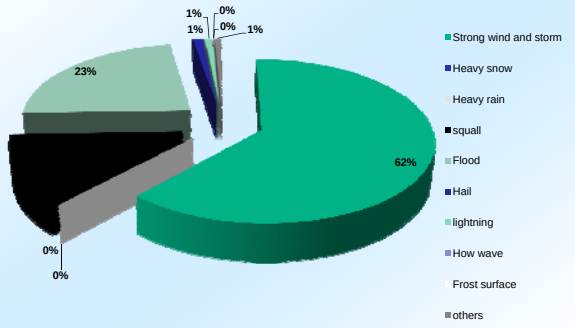
Flood water velocity have reached 4-5 m/sec, flood discharge **was 1700 cumec** and water level have rised **up to 151 cm for 1-2 days**.

Another example of flash flood also in Ulaanbaatar city. In 15th of August of 1982, was very high intensive rain which gave **44 mm (84 % percent of monthly sum) rain for just 20 minutes.** Due to this intensive rain there were huge flash floods along the 42 dry beds and small rivers around the Ulaanbaatar city, mainly from northern side and as consequences of the flood several tens of people dead and big economics losses to the Ulaanbaatar city's citizenship.

13

Reducing flood risks

The economical losses caused by different types of disasters /2004-2008/



(N.Otgonjargal, IMH, 2009)

14

Reducing flood risks

Total economical damages of the mentioned flood of Tuul river in 1966 was estimated about 300 million tugrik. During this flood in Ulaanbaatar city was shortage of drinking water, resettlement of 13 thousand family, 40 different state organizations have stopped their work for 5 to 30 days.

In flash flood which occurred in Ulaanbaatar in 1982 have dead 87 persons, about 200 family left without shelter and total flood damage was estimated about 14 million tugrik.

153 family lost their ger , 1800 ger and house inundated, 7 people died (July, 2009)

15

Reducing flood risks

Event study

Flash flood which occurred in 18th of July of 2003 in Ulaanbaatar

Cause of flood-heavy intensive rainfall

Rainfall has started at 15:15 and after about 10 minutes intesity of rainfall much increased and became heavy rainfall. Total amount of rainfall within about 3 hours which recorded at Takhilt meteo. station was 22.7 mm and 54 mm at University meteo. station.

Estimated flash flood discharge

Estimated flash flood discharge along the several dry beds in northern part of Ulaanbaatar city (catchment area varies from 10 to 25 km2) varies from 8.0-17.5 m3/sec and flow velocity reached 1.5-2.0 m/sec

16

Reducing flood risks

Flood damage

10 person dead, about 2 km paved road destroyed. 3 cars, 276 fence and gers seriously damaged and 30 families totally lost shelter. Total flood discharge is estimated to be 332 million tugrik

Flash flood along the dry bed western side of Mongolian TV

17

Reducing flood risks

Heavy flood water washes fence, other properties

Saving people's life and damaged flashing ger

18

Reducing flood risks

2.Vulnerability of system (social, economical)

Dense settlement in flood prone area, Improper Land use management and urban planning, construction and technological mistakes, weak poor preparadness of capacity building , poor public awareness

19

Reducing flood risks

Damaged flood protection structures and

20

Reducing flood risks

Solid waste damped in dry bed channels blocks flood diversion *pipe causing* artificial floods

21

Reducing flood risks

3.Flood protection ability, capacity assessment (estimation method, warnini system, flood protection structures)

Main flood estimation methods are:

1.Maximum rainfall intensity method (for small rivers and dry beds with cathment area of less than 200 km2)

$$Q1\% = q1\% \varphi H1\% \sigma \lambda 1\% F$$

2. Rational method:

$$Q,max = 0.278\varphi F I$$

¥

3.Shezy equation:

$$Q=\omega C\sqrt{RI}$$

22

Reducing flood risks

Some study's result

Maximum rainfall flood discharge with return period of 100 years were estimated at 75 small rivers and dry beds from surrounded mointains of Ulaanbaatar city (totally 125 measurement and estimation points)

Basic morphometric parameters as inputs to the estimation method were determined from topo map with scale of 1:25000 and 1:100000

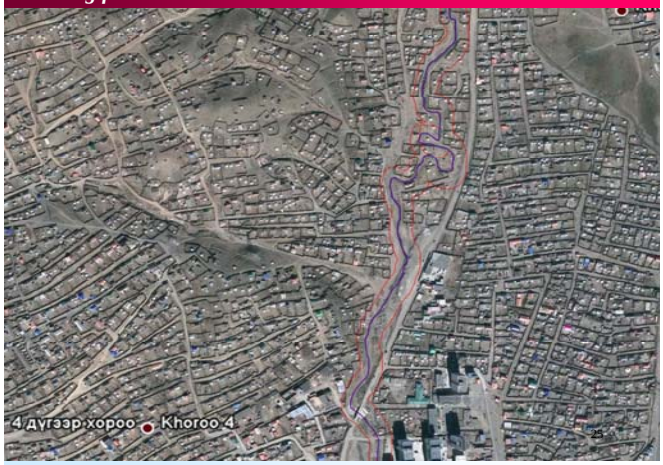
Inandation area mapping on the map with scale of 1:25000

23

Reducing flood risks

24

Reducing flood risks



25

Reducing flood risks

Main aim of flood forecasting and protection systems which provides answer for the question : **WHEN, WHERE, HOW MUCH** would expect flood events as much as possible accurate?

To have good operating flood forecasting and warning system, need to have:

Excellent **gauging network** with required density in terms of space and time.

Secondly, must have very operative and reliable **communication and warning system** for operative data transmission and exchange.

Finally need to have **forecasting models and methods** adapted for Mongolian condition, data quality (+flood protection structures)

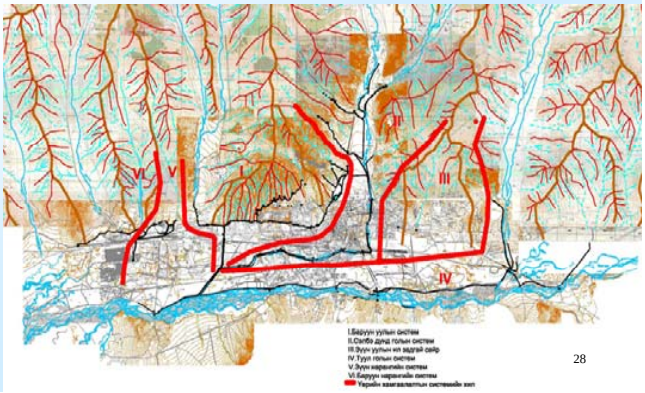
26

Reducing flood risks

27

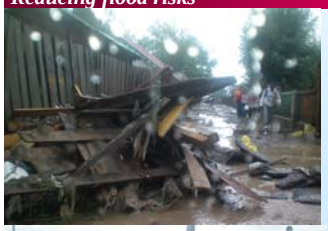
Reducing flood risks

Flood protection systems of the Ulanbaatar city



28

Reducing flood risks



Flash flooding in Ulaanbaatar in July 2009

29

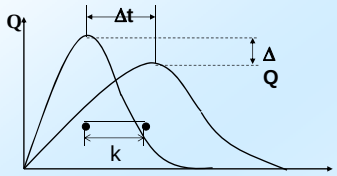
Reducing flood risks

Flash flooding in Ulaanbaatar in July 2009

30

Reducing flood risks

Basic principle of flood routing forecasting: Linear regression, Muskingum, Linear reservoir etc

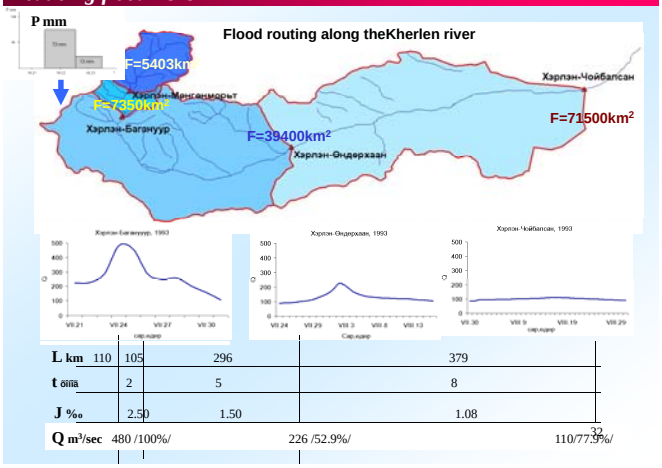


τ=f(L,h,J, k ,n)

Below one of derived forecasting equation for Terelj-Tuul river system with 1 day lag time and in is presented results of short range forecasting for the Tuul-Ulaanbaatar.

QTuul,j+1=2.39QTrlj,j+5.21

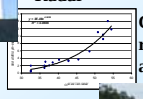
Reducing flood risks



L km	110	105	296	379
t цаг		2	5	8
J ‰		2.50	1.50	1.08
Q m³/sec	480 /100%/		226 /52.9%/	110/77.9%/

Reducing flood risks

Rainfall estimation by Radar



Conversation radar rainfall into ground amount

Flood amount estimation

Free passage of flood water through protection structures

Mapping inändation area

Warning system

Reducing flood risks

Thank very much for your kind attention and cooperation

Intentionally blank

Digestive disease incidence trends in Mongolia

Idesh BOLORMAA, *S.Tsegmed PHI, Ch. Solongo PHI, S.Anand NCCD,*
Scientific Secretary of Institute of Public Health, Ulaanbaatar City
bolroo_65@yahoo.com

Background

Worldwide, digestive diseases are common and contribute to the global burden of disease: 4% of total mortality and 5% of total disability are due to digestive disease.

In Mongolia in 2007, 6 types of digestive disease and 11930 total cases were registered, representing 29% of total communicable disease. In 2008, 7 types of digestive disease – including the newly presenting hand, foot, and mouth disease – and 15945 total cases were registered, representing 39.5% of total communicable disease.

Objective

Assess infectious disease trends in Mongolia.

Results

Hepatitis A, shigellosis and hand, food, and mouth disease (9 3.2%) were leading digestive diseases. Hand, food, mouth disease was newly registered in Mongolia in 2008.

In the last 10 years, the fraction of Mongolia's burden of disease due to digestive disease has steadily increased. However, incidence of some communicable diseases, like Hepatitis A, shigellosis, food related bacteriological poisoning and salmonelosis, were reduced.

By province, changes in digestive disease incidence have been varied. Comparing two five year periods (1999-2003 to 2004-2008), digestive disease incidence actually decreased in Ulaanbaatar, Arkhangai, Bayan-Ulgii, Bayankhongor, Bulgan, Govisumber, Darkhan-Uul, Orkhon, Ovorkhangai and Khuvsgul provinces by 0.09 to 2.68 percent. In contrast, digestive disease incidence increased in Govi-Altai, Dornogovi, Dornod, Umnugovi, Sukhbaatarm Selenge, Tuv, Khovd, and Khentii provinces by 0.46 to 3.86 percent. All told, the average level increased by 0.35 cases.

Digestive disease incidence trends in Mongolia

Dr. I. Bolormaa , Public Health Institute,
Ministry of Health, Mongolia

Content

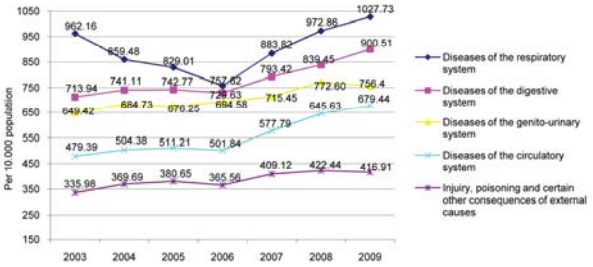
- Current situation of disease in Mongolia
- Distribution of digestive disease
- Distribution of Viral Hepatitis A
- Risk factor of transmitted digestive disease
- Discussion

Geographic coordinates: 46 00 N, 105 00 E

Area: total: 1.565 million sq km, water: 9,600 sq km, land: 1,555,400 sq km

Natural hazards: dust storms, grassland and forest fires, drought, and "zud", which is harsh winter conditions

5 Leading causes of the outpatient morbidity, 2009

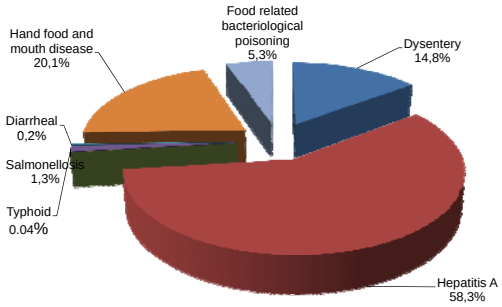


Mortality (per 10.000 population)

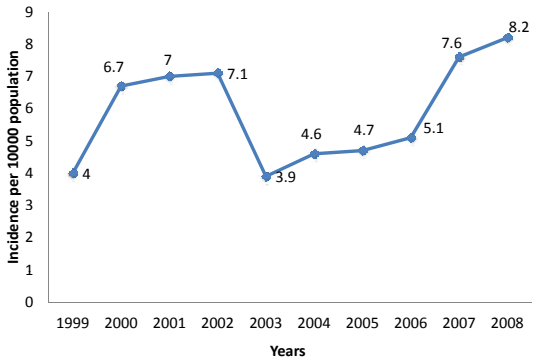
In 2008 the following diseases were the leading causes of death in Mongolia

- Diseases of the circulatory system – **20.5%**
- Neoplasm's – **11.8%**
- Accident, injury and poisoning – **9.3%**
- Diseases of the digestive system – **5.3%**
- Prenatal conditions - **2.4%**

Percent of digestive disease by type, 2008



Incidence of digestive disease among Mongolian population, 1999-2008



7

Distribution of incidence of digestive disease by province, 1999 – 2008 (per 10000 population)

8

Distribution of Viral hepatitis A

9

Characteristic of Viral hepatitis A, in Mongolia

- Viral hepatitis A has been reported since 1952 by National Communicable Disease center
- Mongolia is high endemic area viral hepatitis A
- Tendency of Viral hepatitis A will suggested steady high to 2017

10

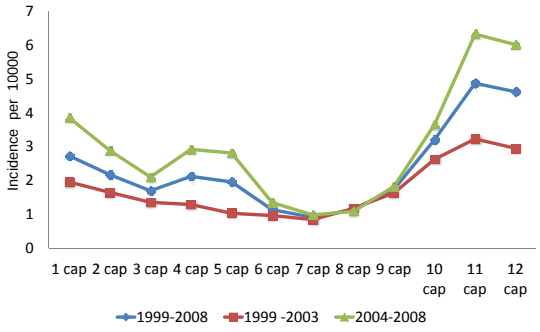
Tendency of Viral hepatitis A, Mongolia, 1952-2017

11

Distribution of Viral hepatitis A by province, 1999 – 2008

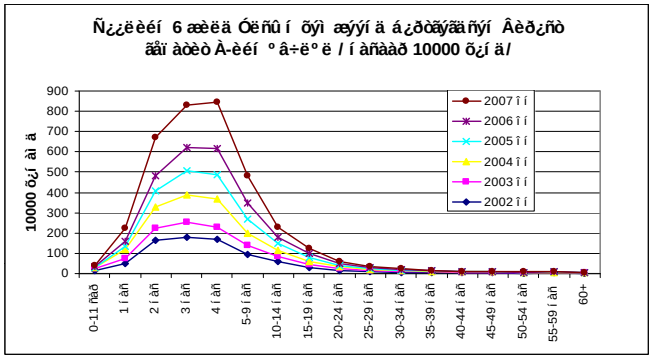
12

Seasonality of Viral hepatitis A by month, Mongolia, 1999 – 2008



13

Incidence of Viral hepatitis A by age group, Mongolia, 2002-2007



14

Risk factors of the digestive disease

RESULT OF KNOWLEDGE, ATTITUDE AND PRACTICE ON DRINKING WATER QUALITY AND SANITATION IN MONGOLIA SURVEY

15

Risk factors of the digestive disease

Water source

- The 48.3% of the total interviewed households take drinking water from WDPs,
- 23.4%- from deep well
- 14%- from hand-dug well
- 3.5-9.3% uses surface water such as spring and river.

16

Water consumption of Ulaanbaatar city, 1 person /day/ liter

Year	2001	2002	2003	2004	2005	2006	2007
Apartment	318	287	320	308	286	291	285
Ger district	5.3	5.7	5.8	5.8	6.6	7.2	7.8

Source: Authority of water utility in UB city.

Water consumption of ger district didn't increasing much by the years . It is still 3-6 times lower than WHO recommendation norm.

17

Result of rapid bacteriological test by province, UB city

Indicators	Result of test (Percent)						
	UB city	Khovd	Dornod	Dundgovi	Arkhangai	Sukhbaa-tar	Total
Water resource							
Coliform (-)	57.1	73.5	75	55.6	-	100	76.1
Coliform (+)	42.8	26.5	25	44.4	100	-	23.9
Water carriage container							
Coliform (-)	7.5	61.8	-	-	50	4	25.6
Coliform (+)	**92.5**	38.2	100	100	50	96	74.4
Water storage container							
Coliform (-)	1.9	58.8	37.1	-	19.2	15.4	16.3
Coliform (+)	**98.1**	41.2	62.9	100	80.8	84.6	83.7

Result of swabs:

53.8% of water storage containers, 51.1% Water carriage container, 68% specail ladles for pouring water containers were contaminated by coliform bacteria.

18

Risk factors of the digestive disease

Soil pollution

Total 543 samples collected by Inspection agency in Ulaanbaatar city. Laboratory evaluated indicators of bacteriological contamination which were divided 3 levels of contaminated.

Result:

- 12% - low level of polluted
- 44% - Moderate level of polluted
- 44% - High level of polluted

19

Viral hepatitis A outbreak mostly occurred schools and kinder gardens

- KAP on water quality, sanitation and hygiene among population has not enough even they receive the information from TV, radio.
- High percentage of consuming un boiled water especially among children, has been caused by wrong behaviors.

20

Risk factors of Viral hepatitis A outbreak in schools and kinder gardens

- Access of wash stand and seat per pupils 3-4 lower than hygienic norm in school and kinder garden

(Surveillance of NCCD, 2007) 21

Behavior washing hand

Insufficient hands washing behavior among the residents in ger districts was proved by our study.

50% of residents do not wash hands before cooking, eating and after using toilet

10% of residents wash hands before giving meal to children or after handling children's feces

22

Discussion

- Hepatitis A, shigellosis and hand, food, and mouth disease (93.2%) were leading digestive diseases. Hand, food, mouth disease was newly registered in Mongolia in 2008
- Risk factors of digestive disease expanding
- High level of contamination with coliform bacteria of water storage and carrying containers depends on cleaning level of water containers and its frequency
- Availability and utilization of sanitation facilities such as toilets and waste water holes and its hygienic requirements and waste disposal mechanism developed not enough
- KAP on water quality, sanitation and hygiene among population has not enough even they receive the information from TV, radio

23

24

Intentionally blank

Water Use in Mongolia: Problems and Challenges

Lunten JANCHIVDORJ,
Institute of Geo-Ecology, MAS.
Baruun Selbe-15, P.O.B-81. Ulaanbaatar, Mongolia
janchivdorj_mn@yahoo.com

Mongolia is a sparsely populated country, landlocked between the Russian Federation and Peoples Republic of China. Population of 2.7 mln people spread over an area 1,564,100.0 km2.

Mongolia belongs to not rich country in terms of water resources. Water resources in the country is unevenly distributed in space and time. The amount of water resources of the Northern part of the territory is sufficient for all water users. In the Gobi and Steppe zone, which of covered 68 % of the territory, the permanent flow is very rare. Depending on the geographic condition range and water availability, rivers and all surface water freeze out in winter and spring season (about 7mounts) so the population must use ground water, 80% of water consumption from it. From these situations, it can be concluded that detailed water management and policy is needed to solve such problem in Mongolia. In 68 % territory of Mongolia, surface water resources are so rare and only from ground water resources used for human life. This dry region has many natural resources, but there are difficult due to the limiting nature of water supply.

Since Mongolia is adopting free market economy system and the changes occur in fundamental economical structure. And at present time Mongolia going to from Nomadic life of Pastoralism to Sedentary life of life. Mining industry is developing very past as is policy of Mongolian government. Social economic changes that happened in Mongolia over two decades equally affected all constituent members of the country, their major agrarian and industrial branches and row materials. Primarily, these changes affected the scale of fresh water consumption and volume of waste water disposal.

Last years the reduction of water consumption was fixed as a result of economic destabilization that has led to the decrease of industrial production, decreasing of agricultural efficiency and irrigated areas. In last years 20 the structure of the water use has been changed as well: water consumption for the production needs has decreased by 4%, for irrigation and watering by 3 per cent. But due to the migration of herders to the urban centers drinking water supply has increased in cities like Ulaanbaatar, Erdenet and Darkhan.Consumption of fresh water has increased three times between 1960s and 1990. In these time consumed 671 mln. M3 water. However ,

water consumption has decreased over the last two decades due to economic failure in the ongoing transition period. Totally in 2007 in the Mongolia 0.5km3 of fresh water used, the use structure is on the fig-1

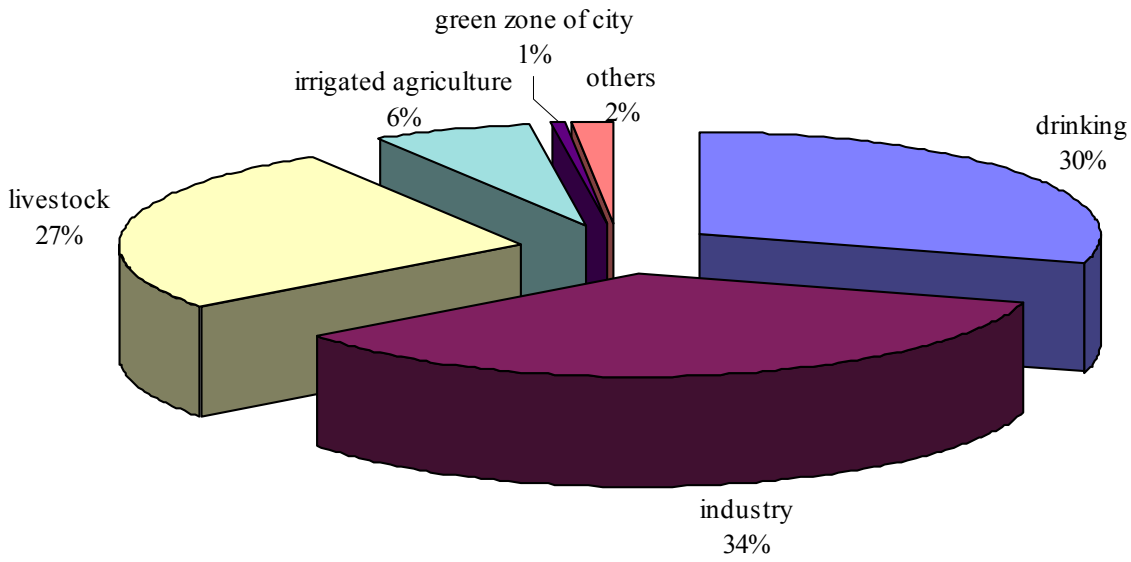


Fig-1. The use structure of fresh water

Keyword. Water resources, water consumption, irrigation, watering, water availability

International Student Exchange Program Supported by the Asia Cultural Center for UNESCO/ Japan.

1-2 Sept. 2011.. **Ulaanbaatar, Mongolia.**

WATER USE IN MONGOLIA:PROBLEMS AND CHALANGES

Dr. JANCHIVDORJ. L,

Head of Water Resources and its use Department,

Institute of Geoecology of M A S.

Chair Holder of the UNESCO Chair program " Sustainable GWM in Mongolia

Topic of the presentation

- **Brief Information of Mongolia**
  - **Geography**
  - **Climate**
  - **precipitation**
  - **Population**
  - **Economy**

  Water resources management of Mongolia

  Largest river basins

  Existing laws and regulations relevant to water quality
- **Water management problems**
- **Water consumption**
- **Status of water pollution**

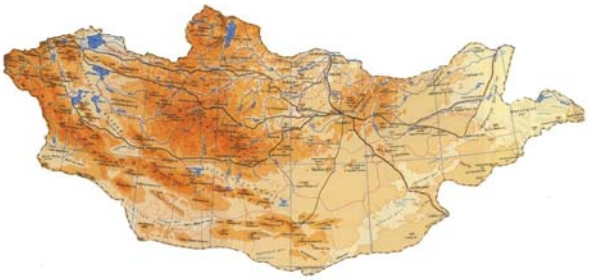
  -Natural contamination of Water.

  -Anthropogenic sources of water pollution.
- **The current Water management practices**
- **Water management challenges**
- **conclusions**

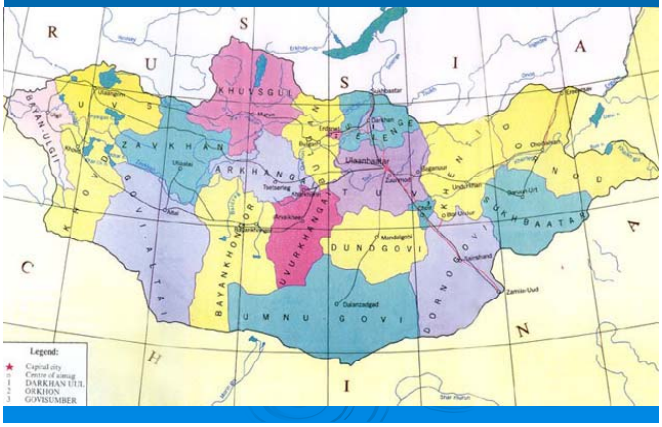
Brief Information of Mongolia

- Mongolia is situated on a highly elevated plateau surrounded by mountains. The total territory is 1.564 million km2. The territory is divided into 4 geographic areas: The Altai mountain area, The Khangai– Khentii mountain areas, the East Mongolian (Steppe) area and Gobi area.
- Mongolia has 4 different seasons. The climate is very extreme continental and harsh. This means that, temperatures can exceptionally cold as well as hot.

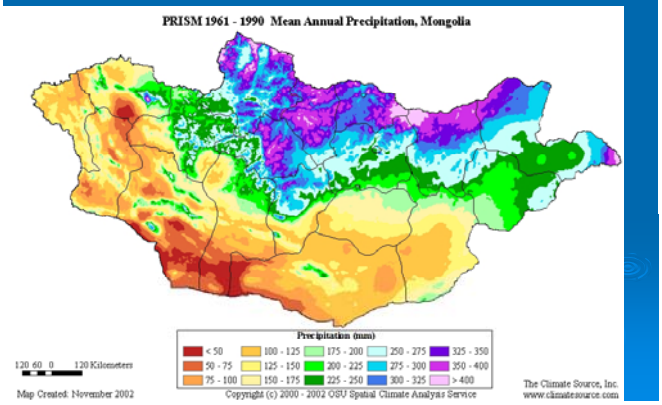
Physics geographycal map of Mongolia

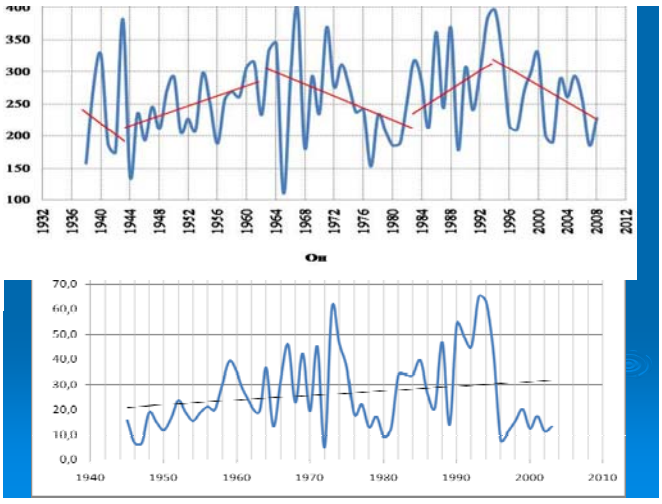


Brief Information of Mongolia



Precipitation is also very low. Average annual precipitation varies from about 400 mm in the northern regions to less than 100-50 mm in the southern Gobi region. Precipitation also varies with altitude, with annual totals higher than 400 mm confined to the mountainous areas where growing seasons are also the shortest. Distribution is strongly seasonal throughout the country, with two-thirds to three-quarters of the annual precipitation occurring during June- August.

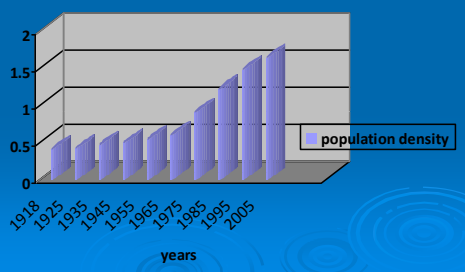




Brief Information of Mongolia

Population

In compare with other countries the population of Mongolia is very few, but the population growth was not so low before. Until 1990 the population growth was about 3.5 % a year. By the end of 2006, the Mongolian population reached 2700.3 thousand an increase of 1.3 per cent compared to the previous year.



Brief Information of Mongolia

Economy

- Until 1990, the Mongolian economy was strictly based on the centrally planned model that had been adopted almost seven decades earlier. To accelerate the transition process the Government of Mongolia launched a series of reforms starting in 1991.
- The old main branch of industry is agriculture, hunting and forestry;
- GDP of these branches is 249bln. Togrog/money unit/ in 1999.
- All the time of social economy system, the main element of GDP was agriculture and trend of this branch is also keeping own tradition.
- **But a mining and quarrying industries become make more influence at GDP of country.**

Institution — Water resources management of Mongolia

Modern water management history in Mongolia goes back more than 60 years.

- **The ministry's role in water resources development dates from 1938, when the Department of Water Supply under the then Livestock Ministry had responsibility for the provision of water for livestock. This role was expanded until in 1965 the Ministry of Water was established as a separate entity. In 1968, however, this ministry was absorbed within the Ministry of Agriculture, under which a Board of Water Development was established, with the main function being water supplies for livestock.**
- **The Ministry of Water was re-established in 1971, but was again joined to the Ministry of Agriculture in 1986,**

Institution — Water resources management of Mongolia

Since the 1986s, the management of water resources has been fragmented between the 7 ministries

Government of Mongolia was declared the year of 2004 as a Year of Water Policy Reform.
The Government of Mongolia established the Water Authority Agency (WAA) in 2005.

Legislations — Water resources management of Mongolia

Government of Mongolia was declared the year of 2011 as a Year of Water Policy Reform and adopted the following Laws and Policy programs:

- **Law on Water, 2004**
- **Law on Fees for Utilization of Water and Mineral Waters,1995 2004**
- **"Water Renovation – XXI" Strategy Plan**
- **The National Water Program, 2009**
- **The Draft Law on Wastewater Discharge and it's Fee**
- **and more than 20 water standards and regulations.**

Water resources management of Mongolia

- **The territory of Mongolia is divided into three large watersheds of the World namely:**
- **Northern Arctic Ocean Basin,**
- **Pacific Ocean Basin, and**
- **Central Asian Internal Drainage Basin,**
- **The total water resources in the country is 38.8 km3 and potential water resources is 34.6 km3. Surface water resources are 22.0 km3 and ground water resources are 6.8 km3. There are about 4113 rivers approximately 3500 lakes, 6898 springs including over 120 mineral water springs with medical properties and 240 glaciers with a total area of more than 500 km3. /Master plan 1975/**
- **Due to the high mountain conditions of the country, almost all rivers, which are fed by abundant rainfall, run to the Arctic and Pacific Ocean basin and disappear in a short time. Most of the surface runoff flows (70%) out of the country, while a small portion flows into the Central Asian Internal Drainage Basin.**

Water resources management of Mongolia

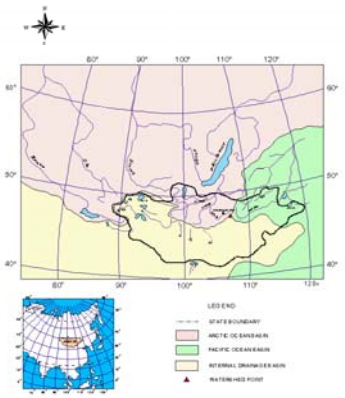
Annual water resource for possible use is 34.29 sq. km.
Surface water resources 28.22 km3
ground water resources-6.07km3

The territory of Mongolia is divided into three large watersheds of the World namely:

-Northern Arctic Ocean Basin,

-Pacific Ocean Basin,

-Central Asian Internal Drainage Basin

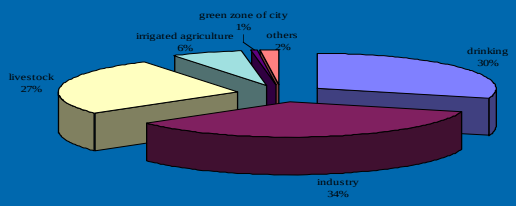


Water resources management of Mongolia

The first comprehensive water resources evaluation was undertaken as part of the Master plan for the Complex utilization and Conservation of Water resources in Mongolia. Subsequently, six Regional Water sub Plans were prepared between 1978 and 1991 and partially published by Institute of Water Economy (now the Institute of Geoecology). The product awarded the Parliament prize for scientific work of the XX century.

Name of the basin	Territory, %	W R, cube. km
Basin of Northern Arctic Ocean	20.5	16.9
Basin of Pacific ocean	11.5	13.9
Central Asian internal Drainage	68	3.8

Water Utilization

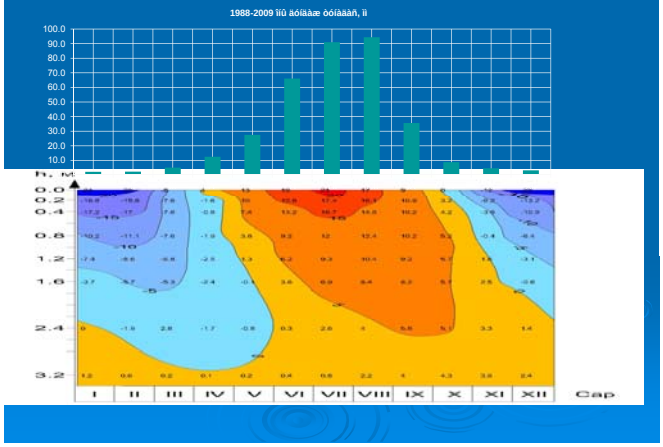


The total water use is 0.5 km³. Although the actual water use seems small compared to the water resources available, in the southern part of Mongolia (Gobi) the water availability is 10 time less than the world average , because of water resources are unequally distributed over the country.
Only 30.8% of total population is provided with water from the centralized distribution systems.
24.8% gets its water from tank distribution systems.
35.7% from wells
9.1% still uses rivers, stream, spring and other surface water.

Water use

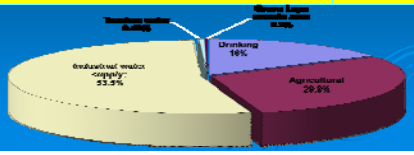
- **Main Water use sub sectors are:**
  - 1- Pasture water supply- for herders and domestic animals
  - 2- Irrigation - for the development of agriculture;
  - 3- Water supply constructions, for the supply with water of the population, the industrial enterprises
  - 4. Flood control constructions – for the protection of settlements and objects of economy against harmful influences of waters, decrease in risk of occurrence of extreme situations;
  - 5- Waste water treatment plants, tailing ponds - for nature protection requirements
  - 6. -Hydropower plants- for electricity in rural areas

Precipitation and soil temperature



Consumption of water resources

No	Water-consumer sectors		Total water consumption (million meter cube)
1	Individual consumption (drinking and home)		71
2	Agriculture	Animal husbandry	80
		Water-irrigated fields	52
3	Industries	Manufacturing industries	36
		Exploration and mining plants	94
		Energy sector, power plants	27
		Hydro-electric stations	80
4	Tourism		2
5	Horticulture		<1
	Total		443



Brief information about GW,

- Mongolia is unique in that more than 90 % of total water consumption is supported by GWR.
- In 70 % of the territory of Mongolia surface water resources are only very rarely available.

This situation arises from natural conditions, including geographic high location and cold extreme climate condition.

- Mongolian water management is difficult , because of the long freezing period, which lasts for 7 months of every year. In Mongolia at cold season of year GWR are the only resources used for human life and all needs including water supply for Animal husbandry and industries.
- Studies in the Gobi Desert under comparable conditions showed a recharge of 1-2mm per year. A study in the Mandalgobi area also found the presence of recharge no higher rate, researchers found fossil water with 5000 years old,
- Water level dropped down up to 5 meter and it has been calculated, that since 1996 till 2007,
- GW table is decreasing under ecological limited level in the Central water source of UB after dry water cycle 1980,
- Since 1997, a scarce of stream was registered in the vicinity of Tuul river.

Pasture irrigation and historical events Mongolians

Mongolia has been for a long time an agricultural country.
About 30.2 mln.head
Main economic branch of Mongolia is animal husbandry, nomadic style of life and pasturalizm.

Information on water resources and water usage takes us back to XII century thanks to travel journal and some historic notes written by researchers who travelled across the country. Article 12 of Mongolian Secret History, being a basic historic document of Mongolians says that "*Ugoodei Khaan said: My service since I have been sitting on the throne is ... Thirdly, I made dug wells in waterless areas and provided with water and grass to residents".* This certifies that even at that time State policy focused on water supply issue.

Nowdays, in many countries of the world basic documents say that water supply and access are under State responsibility.

Pasture watering

- Pasture livestock breeding is important economic sector in terms of employment, export revenues, production of GDP and is a core issue in historic development of the nation. Past, present and future of livestock breeding has been an interesting issue of Mongolian civilization and fortunately, the sector has overcome hardships of transition economy with relatively less losses and has been successfully adopting to market economy relations.
- In 1990, livestock breeding made up to 87.6% of agricultural production, while in 2005, it made up to 85%. The figures indicate that Mongolian economy is greatly dependant on the sector development. While in 1990, agricultural production made up to 33.4% of GDP, in 1995 it made up to 38% and in 2000 it was 29.31%, in 2005 it declined down to 21.7%. The decline was due to severe dzud in 2000-2002, which took a considerable number of livestock and negatively affected production growth.

Water supply issues and pasture degradation

•From early times livestock breeding has not changed in each formation of the society. In recent times this type of livestock breeding can't develop, any further due to changing life conditions.

Ground water is the primary source of drinking water for expanding population of nomadic herdsmen and herds in Mongolia.

90% of population of Mongolia are supplied by ground water and 10% from springs, rivers In the cold time.

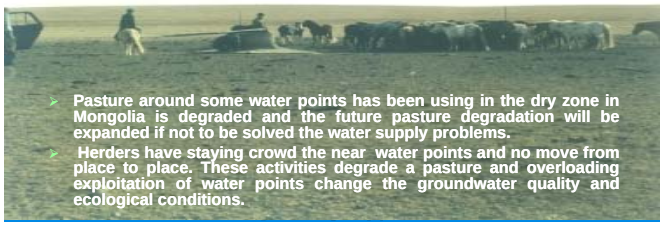
Water supply issues and pasture degradation

- At present the future of nomadic civilizations has become the subject of discussions between many researchers. The future of nomadic civilizations is dependent not only on social problems but also on water resources and supply.
- The water resources of Mongolia are unevenly distributed especially in the steppe and Gobi regions which make up 70 percent of the territory of Mongolia. In these regions ground water is the source of water supply.
- Groundwater water level is located in the depth of 4-70 meters in the north regions and 6-200 meters in the south regions.
- Also the groundwater quality /hardness/ is one of actual problems within in Mongolian water policy

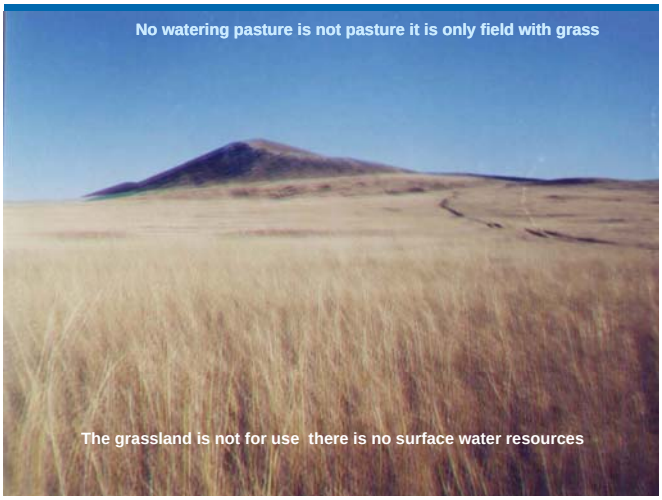
Irrigated pasture.
Water point effect radius- Water point effect radius impluens an area animals to walk till watering point

The main reason of pasture degradation is scarcity of water supply

- . Due to the large shortage of water, herders tend to live near existing water well's and the result is that this appreciably worsens the pasture land and has been proven to be the cause of local desertification.



- Pasture around some water points has been using in the dry zone in Mongolia is degraded and the future pasture degradation will be expanded if not to be solved the water supply problems.
- Herders have staying crowd the near water points and no move from place to place. These activities degrade a pasture and overloading exploitation of water points change the groundwater quality and ecological conditions.



Water supply condition past and present

. Pastoral water supply received large amounts of government investment until 1990 and almost 65.4 % pasture land until that time was watered.

For the purpose of watering pastoral land 42925 wells several types /bore hole -7542, short tube wells- 7850, pit wells -10154 and 17185 simple mine wells were built.

At the present there are 25296 wells in the pasture 17629 wells which are unused. It means rate of watered land reduced more than 33%

Plundered and destroyed bore hole-wells, have broken pumps of the equipment pit-wells. In this situation only one choose for herders Hovoo. It is a hand lift water from the wells which are suitable for hand lift

- By statistic information in 2007 by foreign investment were rehabilitated 1226 breaking wells and built 3 new wells and by national budget /investment/ 2272 old wells were reconstructed.

No watering pasture is not pasture it is only field with grass

- Besides most of all degradation of pasture around centre of items, small rivers, springs, and well's of a different type, which depend from over concentration livestock near water sources. In opinion researcher Dr. G.Purebtseren herders / near Ulanbatar/ holds 4,5-5,8 times more heads livestock against optimum norm.
- In those times/1990/, when are constructed numerous well's for uniform use pastureland. But in time privatisation of fixed capital in the beginning 1990 majority from them are destroyed to the different reasons.
- On this because of strong shortage of water objects Herders live near water existing well's and result that appreciably worsens pasture and already is arisen attributes local point of desertification.

Water harvesting for water supply

The rational use of local water potential resource can be a factor for reducing of pasture degradation

One of the new methods to watering pasture is water harvesting.

At present time there are about 10 small reservoirs to collect rain water

Also there is importance to construct water reservoirs of the rainwater and in some places use pipelines for water distribution.

The rational use of local water potential resource can be a factor for reducing of pasture degradation.

Nomadic style of livestock breeding is a battle to grassland and water sources

Irrigated farming

- Historical tradition of the irrigated farming
- However, Mongolia was a country of the nomadic and grassland, livestock husbandry, and Mongolians used to engage in the irrigated farming in all its stages of the historical development. It is the country with interesting history and a tradition of the irrigated farming. Mongolian traditional farming was rehabilitated sometime, it was deteriorated sometime because of the process, and condition of Mongolian national historical development but the path of the traditional work of the farming have being continued interruptedly.

Irrigated farming

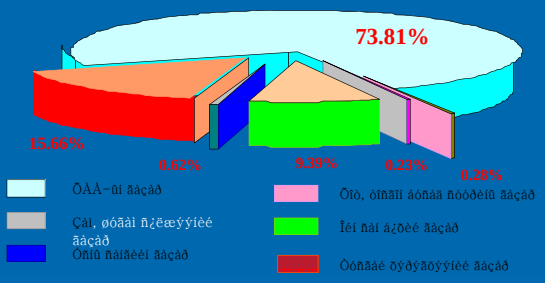
- In 1957 the biggest irrigation systems named "first half engineering" with 17000 hectare squire were built in Kharkhorin, Zuunkharaa and Erdeneburen. After having engaged in the farming and bringing the virgin soil under cultivation since 1960s, the irrigation system was focused to plant potato and vegetables in dry regions but since 1980s, the irrigation system was focused to plant barley in Gobi and western provinces, to prepare the fodder plant for animals and to strengthen livestock husbandry and material technical base. The much improvement were done to supervise on the utilization of the irrigation system, make investment, to create the technological management, and to prepare the peasants.
- As the statistics of 1990, we have 45.0000 hectare squire with engineering constructed artificial rain watering, 16.000 hectare squire with surface irrigation method, through the whole country, 100% of vegetables and fruit, 20% of potato, 15-18% of cultivated fodder, 2.5 % of grain were prepared from irrigated squire.

Irrigated farming

water Availability

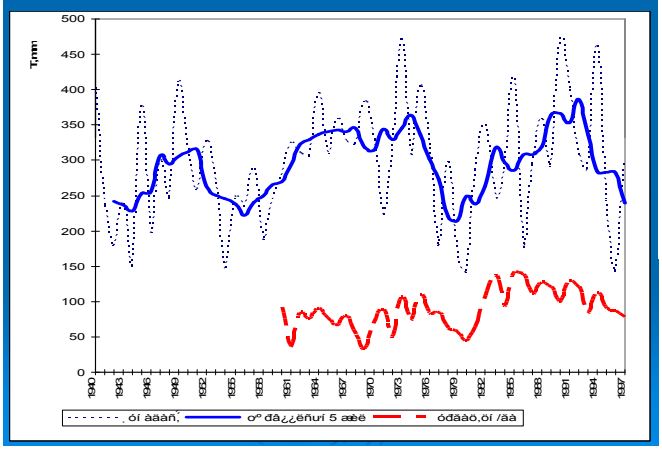
- Water resources are abundant relative to present and anticipated uses within Mongolia. Total runoff averages 38,800 million m3 per year. Surface water accounts for 2,700 million m3 (84%) and net groundwater replenishment 6,100 million m3 (16%) per ear. In contrast, total water demand in 1990 was only 800 million m3 per year, or 2% of total availability. Irrigation represented 30% of demand. Even if 418,000 ha of land were developed for irrigation, as assumed in the National Water Master Plan of 1975, water demand would still represent only 16% of resources.
- About two-thirds of surface runoff leaves Mongolian territory, with about half into Russia via the Selenge River alone. While Mongolia has a formal understanding with Russia on water quantity and quality, there is little at this stage to constrain the exploitation >f the water resources in Mongolia.
- However, the uneven distribution of water resources limits the development potential largely to the northern, central and western regions, where both surface and groundwater can be readily exploited. In the southern region, groundwater s essentially the only water resource, but requires pumping from considerable depths.

Land fond of Mongolia



Land Availability. Of Mongolia's total land area of 1,564,100 km2, only 1.3 to 1.8 million ha (about 1%) is considered arable. The greatest limitations on successful cultivation are climate, altitude and slope. Most irrigation schemes are located on the latter, which appear to offer the greatest potential for future development. About 418,000 ha of potentially irrigable land was identified at reconnaissance level in the early 1980s, of which 117,000 ha has been studied in more detail for potential development. Sufficient land resources would therefore appear available to meet Mongolia's irrigation needs for the foreseeable future

Precipitation and yields /Rain fed agriculture/



Irrigated farming

Main type of irrigation in Mongolia are:

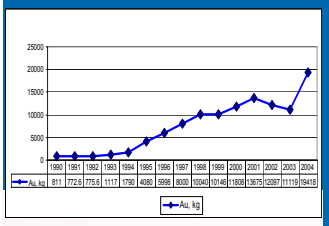
surface

sprinkler

Irrigated farming

Water consumption

Impact of mining on the Water environment



Status of water pollution

-Natural contamination of Water.

Very good quality water in Mongolia is found in mountainous areas. Mineral contents of rivers of the country changes mainly from 100-up to 500mg/l and hence the quality of river water, with regards to mineralization, is always is good.

The Gobi and steppe regions have limited surface water, and all water sources in this region, due to natural factors are highly mineralized and have high levels of hardness, making it unsuitable water for drinking purposes. In this region mineral contents increases to 1500-2000mg/l and more . About 40 per cent of the water resources of Mongolia do not satisfy drinking water standards because of very high hardness and mineral contents. Most lake water is not polluted, and 80 per cent of the rivers are pollution free. Mineral content of river waters of the country changes mainly from 300 to 500mg/l, and in terms of mineral contents, the quality of river water remains good.

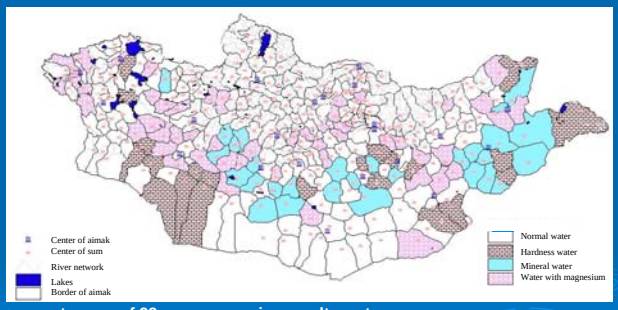
However depending on the geographic range and water availability (rivers (which are the source of all surface water) freeze up in winter and spring time is melting) and population must use mineral water .

-Anthropogenic sources of water pollution

1. The effluent from the waste water treatment plant which treats all domestic waste water as well as pre-treated or untreated industrial waste water.
2. Gold mining activities located in lower catchments areas.
   -This includes Illegal gold mining activities, some which is using hand extraction methods .
3. Mining industry.
   -Pollution from tailing Pont /reservoir/ at the Erdenet copper mine plant is also problem /white dust/
4. Agricultural run-off from the crop land and cattle husbandry activities.
5. Thermal pollution via the discharge of cooling water of the thermal power plants.
   - Pollution from ash storage Reservoirs at the Power Stations is also problem.

Drinking water quality

- main source of water supply is ground water



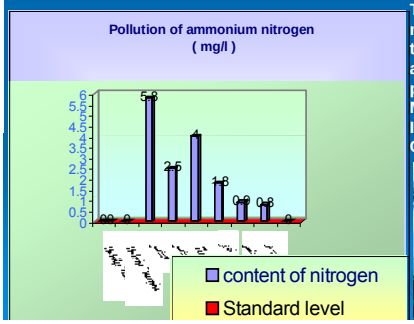
- customers of 99 soum are using a salty water;
- customers of 47 soum are using a high mineralized water;
- customers of 27 soum are using a component with high hardness water, depending from the situation of uneven water resource's distribution and mutually different recharge of water resources.

Environmental issue and water

- Mongolian people have given more attention for protection natural system from the ancient time. However, recent situation of natural system is not fully satisfied the human life condition. There was conducted many studies on natural system especially on water resource as its quality and quantity changes in Mongolia. But there was not paid much attention to trans boundary water object as ecology economy system. To determine or to get good idea about water use and its changes we have to investigate socio economy condition of whole basin, but not part of the natural system. It can be giving us much good formulated picture of water management in given region. To get good understanding of link between economy and ecology in context of water resource we need to pay much attention to socio economy condition of country also.
- Resulting from transition period from a centrally planned economy to a market economy, Mongolia faced with many challenges. One of the main challenges is environmental degradation, which greated as a result of human impact on environment components. The Mongolian Government gives more attention for this changes, but not yet found a good way to solve this problem.

Status of water pollution

Water treatment of Mongolia



There are 120 waste water treatment plants throughout Mongolia. The major cities and most province centers are served by sewerage systems. Associated sewage Treatment plants provide mechanical and biological treatment in larger systems and primary settlement or pond systems in smaller ones. Most industrial wastewater Is discharged to the UB CWWTP

Status of water pollution, illegal gold mining

Impact of mining on the Water environment

Also the water resources polluted by influence of illegal gold mining activities. Some peoples, who is used hand extractive method for gold catch activities are moving many hundred ton soils-earths to river water

Status of water pollution

Impact of mining on the Water environment

Illegal Gold Mining Activities

- Due to mining activities the water sedimentation increases by 8 times than the permitted standard. Also heavy metals such Zn, Mn, Fe, As, Au, Pb are found in the river water.

Summary of possible effects of gold mining on river ecosystems

Effects of increased sediment load in rivers for:

- decrease in their livelihoods due to decrease in fish stocks;
- potential harmful effects of recreational swimming;
- shortage of drinking water for humans and animals, etc

River ecology and biocoenosis

Increased sediment load can lead to the accumulation of suspended matter on the gills of aquatic organisms, macroinvertibrates and fish which may cause fungal diseases eventually leading to death;

- benthic organisms can experience difficulties in obtaining adequate food supply;
- reduction in oxygen input in river sediments;

effects on spawning habitats of fish, etc.

Summary of possible effects of gold mining on river ecosystems

- Effects of morphological alterations to river hydrology through the creation of diversions and impoundments
- degradation of water quality;
- possible barrier for the migration and spawning of fish, etc.
- Decreased areas of land that can be used as pasture land for animals and change of endemic vegetation cover.
- Accumulation of fines and sediment transport downstream in river systems.
- Effects of toxic substances on human health and the environment when chemicals (such as Mercury) are used to extract gold from soil.

The Tuul River

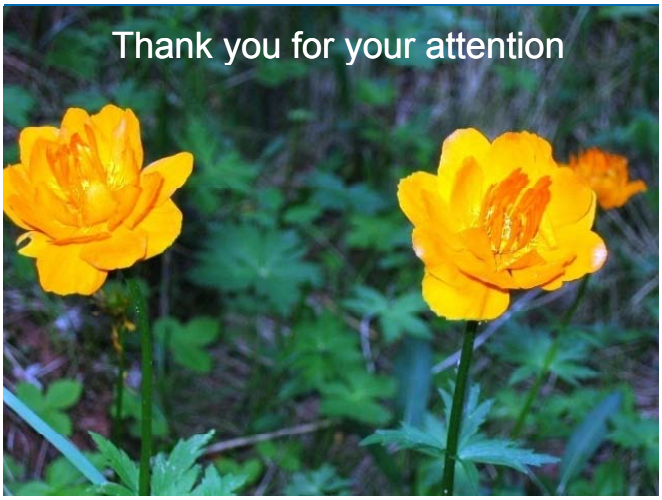
Morphology changes of the river bed

Conclusion

1. Water scarcity, the gap between human demand for and the availability of water in the required quantity and qualities, is the fundamental issue of the water supply in Mongolia.
2. Many users and communities are dependent on groundwater, the flow and availability of which are inherently more stable than of surface water.
3. At the present time water pollution is serious problem in Mongolia, especially in urban areas and the gold placer mining. Over half of the population of Mongolia at an immediate risk from urban air and water pollution and actions for reducing water pollution must include following issues: improving sewage and waste removal, improving and expanding wastewater treatment facilities including mitigation measures of most polluted rivers, and improving water quality monitoring.

Conclusion

4. The quality of water is concerning issue. Every group of users requires water of different quality, and total demand is increasing. There is very important to separate users by group: high quality drinking water must not use for industry and agriculture needs or for this reason there was not unnecessary treatment of water for purposes which do not require it.
5. Water quality degradation is an increasingly important issue. Water quality in Central and Northern part of Mongolia is heavily degraded, because of high population density, urbanization, comparatively high industrialization, and the general lack of pollution control facilities.
6. The allocation of responsibility is also unclear between institutions with regard to policy making, research, monitoring and managing. Also chiefly due to financial limits, the enforcement of laws and regulations is not adequate.
7. The human development report from 2003 provided Water consumption estimations for apartment dwellers in UB averaging 240-450 liters of water daily compared to 8-10 liters in Ger districts/ national house of Mongolian herders/.



Session 2

Environmental Diplomatic Leader Program

Environment Diplomatic Leadership (EDL) Program: A New Integrated Capacity to Solve Global Environmental Issues

Maki Tsujimura
Executive Leader of EDL
Graduate School of Life and Environmental Sciences, University of Tsukuba, Japan
mktsuji@geoenv.tsukuba.ac.jp

1. Background

Global environmental issues are not only on the direct natural environmental aspects but also include governances on food security, natural resources management, energy sustainability, health, development & urbanization, economy and other social matters such on ethics, etc. Therefore, it is cardinal to enforce the human resources development with multidisciplinary talent having capacity of environment science and technology, principle of environmentology and common sense of human based on science and culture should be necessary to alleviate the environmental issues. The education program of Environment Diplomatic Leader (EDL) consists of curriculum corresponding to these necessities. The curriculum includes Master course (2 years) and Ph.D. course (3 years), and the trainee can get the titles of Senior Environment Diplomatic Leader (Ph.D. course) and Environment Diplomatic Leader (Master course) in addition to the Ph.D. and Master degrees, when he/she completes the program.

2. Course Structure

The program accepts 10 students for master course and 6 students for Ph.D. course. Every course is lectured by English, and also student must speak in English throughout the courses. The curriculum especially focuses on a special lecture by Top-leader, field excursion, and workshop on site where the environmental issues occur. Also, internship should be encouraged at international organizations and/or administration offices. Every student must learn scientific environmental technology in relation to the water resources, bio-diversity, and environmental health. In addition, the students have to learn international law, environmental policy, comparative culture, environmental communication, and presentation and debate ability.

Master students must make thesis regarding the themes of water resources or bio-diversity/bio resources or environmental public health. Master thesis has to also include a review of environmental policy regarding the theme.

Foreign Ph.D. students are encouraged to bring a local environmental issue to be solved from their home country, and they are expected to make thesis regarding that

issue. They are encouraged to perform field survey and monitoring in situ where the issue is occurring throughout their Ph.D. work.

3. Frame of the Program

Under a direction of the president, the Major in Sustainable Environmental Studies, Graduate School of Life and Environmental Sciences, University of Tsukuba takes an initiative of the program in cooperation with Graduate School of Humanity and Social Science, Graduate School of Comprehensive Human Sciences, Alliance for Research on North Africa, International Center for Central Asian Research and Education, University of Tsukuba, and Research Institutes in Tsukuba Science City. Also, the program proceeds in collaboration with International Institutes such as UNESCO Paris Office, UNESCO Office Beijing, Borj Cedria Techno Park in Tunisia, Institute of Geo-ecology and Institute of Meteorology and Hydrology, Mongolia, Institute of Geographical Sciences and Natural Resources and Institute of Genetics and Developmental Biology, China, Bogor Agricultural College, Indonesia.

Tsukuba Environment Diplomatic Leaders International Consortium (TEDLIC) will be established with these institutes and universities for international internship and international cooperation research activities. TEDLIC will include institutes which are counter parts to send the students to the University of Tsukuba, and the TEDLIC can support the students after they complete the program and go back to their home country.

筑波大学 University of Tsukuba

The 2nd International Symposium
"International Multidisciplinary Conference on Environment"
1st - 2nd September , 2011; Mongolia-Japan Center, Ulaanbaatar

Environmental Diplomatic Leader (EDL) Education Program

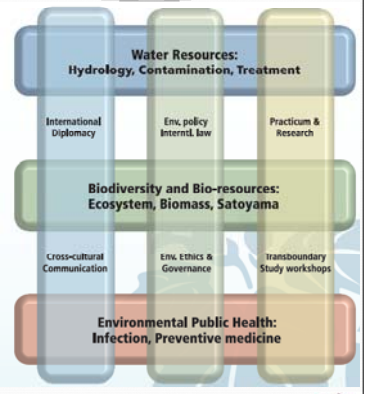
-A New Integrated Capacity to Solve Global Environmental Issues

Maki TSUJIMURA, Ph.D.
Leader of EDL Education Program
Co-Chairholder, UNESCO-Chair on Sustainable Groundwater Management in Mongolia
Associate Professor in Hydrology and Hydrogeology,
Doctoral Program in Sustainable Environmental Studies,
Graduate School of Life and Environmental Sciences,
University of Tsukuba

戦略推進費
Strategic Funds for the Promotion of Science and Technology

What's EDL?

- Analytical and problem-solving skills in environmental issues germane to water resources, biodiversity/ bio-resources, and public health in Asia and Africa.
- Env ethicks, env governance, policy making, management, and interpretation



EDL should be a intern negotiator?

EDL should learn skills of negotiation and debate, but not need to be a negotiator

EDL — Negotiator

Global issues, Sci info, Culture

Regional Interest — National Interest

Source: Earth Negotiations Bulletin (ENB); http://www.iisd.ca/climate/cop16/

Why should EDL learn Global Public Health?

-EDL can save human life by their own work- (by Dr. Wakasugi)

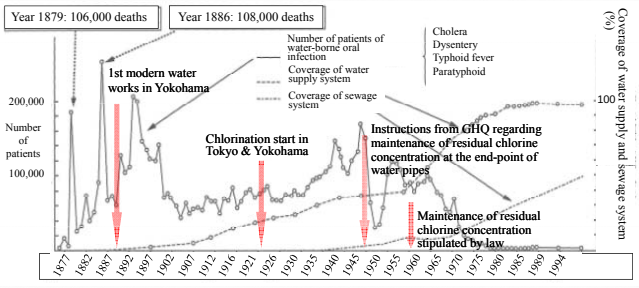
- Four million deaths of children could be saved by preventing environmental risks (Dr. Hirabayashi; Source: WHO)
- Human lives are lost by air pollution (1.2 million), water contamination (2.2 million), food shortage (3.5 million) and infectious diseases (12 million) per year (Source: WHO)

Four Major Pollution Diseases in Japan

(by Prof. Hashizume (Tama Univ))

Name of disease	Cause	Blame	Year
Minamata disease	mercury poisoning	Chisso chemical factory	1932 - 1968
Niigata Minamata disease	mercury poisoning	Shōwa Electrical Works	1965
Yokkaichi Asthma	sulfur dioxide and nitrogen dioxide	air pollution in Yokkaichi	1961
Itai-itai disease	cadmium poisoning	Mining in Toyama Prefecture	1912

Public Health Improvement and Water Supply in Japan (by Prof. Hashizume (Tama Univ))



- Improvement of water supply and sewage system
  → Breaking the fecal infection
  → Drastic decrease of oral infection (especially the highly virulent infection which decreases the mobility of the patients)

(Source: Water Supply Division, Ministry of Health, Labor and Welfare)

What should EDL learn from Watermaster?

(by Dr. Endo)

Watermaster: A group of people appointed by the court to help regulation of water supply and water quality necessary in a river basin / groundwater basin

- Watermaster board
- Advisory committee
  - Stakeholder 1
  - Stakeholder 2
  - Stakeholder 3

An ideal watermaster would have knowledge of.....


Hydrology


Civil engineering


Law

Solutions by which every stakeholder is NOT satisfied in 100% BUT in 50%

Why should EDL think globally and act locally in field? -Desertification- (by Dr. Sun)

As a global issue	*As a local issue*
Over-grazing, Soil degradation, Desertification	Mobility & Flexibility of pastoral people
Reduce livestock, Market economy	Small scale support: Mobile school...
Refugees Economic differentiation	Local adaptation with scientific technology

Respect of local society and adaption strategies by local people

Facts to Wisdom

-We should think based on facts but fact is not always truth-

- **Wisdom**
  - Insight
  - Integration
  - Interpretation
  - **Knowledge**
  - **Knowledge**
    - **Information**
    - **Information**
    - **Information**
      - Facts
      - Facts
      - Facts
      - Facts
      - Facts

Wisdom Infrastructure

Global Environmental Issues

- Complex causality
- Trans-boundary problems

The abilities to coordinate various stakeholders can be exerted well where there is **"wisdom infrastructure"**

EDL Program: Fostering wisdom based on natural/social/human sciences


No wisdom infrastructure


Wisdom infrastructure

Source: Dr. Endo

A tree of EDL

Branches:
Application
Balance
Performance

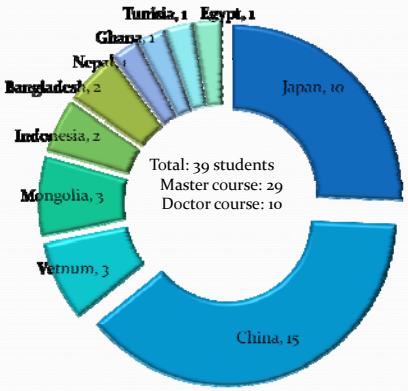
Fruit:
Solutions
Interaction
Maintenance

Trunk:
Skills
Wisdom
Insight

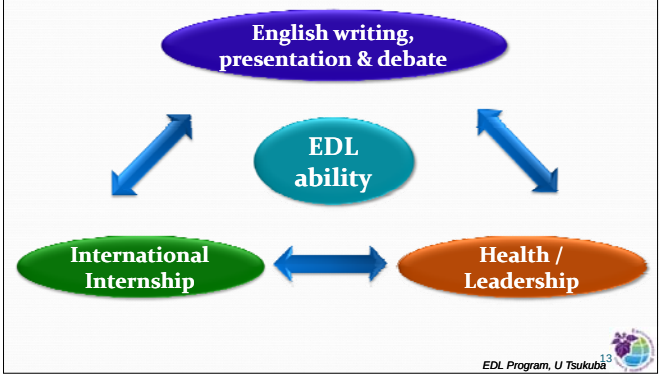
Roots:
Ethics
Respect
Vocation / Justice

Revised from Gordon & Berry (2006)

EDL students from Asia and Africa



Education Focusing



A Model Study Plan in Master's Program (2 years)

	1st term	2nd term	3rd term
Practical Knowledge	International Internship / Domestic Internship		
	EDL Seminar / EDL Special Lecture		
Theoretical Knowledge	Cultural Ecology	Public Health	Environmental Policy
	Bio-diversity Forest conservation Bio-resources	Ethics/ English debate Sustainability Studies International Law Environmental Health	Water Science & Tech. Water Environment Environmental Policy Appraisal

× 2 years → Master thesis → Master degree + EDL certificate

Bio-diversity　Health　Water

A Model Study Plan in Doctor's Program (3 years)

	1st term	2nd term	3rd term
Practical Knowledge	International Internship / Domestic Internship		
	EDL Seminar / EDL Special Lecture		
	Forum on Sustainable Environment Studies		
Theoretical Knowledge	Ph.D. Thesis Research		

× 3 years → Doctor thesis → Doctor degree + EDL certificate

Bio-diversity　Health　Water

Internship Program in Tunisia / Paris

Participants: 13 Students and 4 professors
Date: July 11 - 22, 2011

◆Visiting list
- **UNESCO Headquarter Office, Paris**
- **Pasteur Institute, Tunis**
- **National Agency of Solid waste**
- **Desalination plants in Jerba**
- **Geothermal production and local water resources management in Gabes**

◆Activities
- **Experience what "water scarcity" is like**
- **Opportunity to make interviews to governmental officials and commercial community to collect data on water, public health and biodiversity issues**
- **Deepen understanding on characteristics of landscape in arid area**


Desalination plants in Jerba


Traditional water harvesting in Oasis

Internship Program in Mongolia

Participants: 6 students and 4 Professors
Date: October 25 – November, 1, 2010

◆Visiting list
- **Institute of Geo-ecology, MAS**
- **Institute of public health, UB**
- **Water treatment plant in west UB**
- **Farmland in Bayanchandmani, Tuv Province**


Interview to a farm owner in Bayachandmani

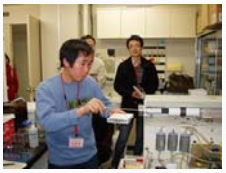
◆Activities
- **Deepen understanding on common property resource problem in dry area (grassland management)**
- **Offer students opportunity to think of linkage between water and sanitation problem**


On-site education on groundwater flow

Internship Program in Minamata

Participants: 15 students and 3 professors
Date: December 2, 2010 – December 4, 2010

◆Visiting list
- **National Institute for Minamata Disease**
- **Minamata Disease Municipal Museum**
- **Crane museum in Izumi**
- **Local Farm in Aso area**


Gauging methyl mercury content in hair

◆Activities
- **Gauging experiment on methyl mercury content in hair**
- **Direct conversation with a Minamata disease patient**
- **Deepen understanding on the tragedy of Minamata disease**


Direct conversation with a Minamata disease patient

EDL Special Lectures 2011
"Meet the Leaders"

- Mr. Koichiro Matsuura (Prior Director General, UNESCO)
  - Humankind and Civilization
- Prof. Francois Dabis (Professor of Public Health, Bordeaux University)
  - HIV and AIDS in the World Current State and Future
- Dr. Kiyoko Ikegami (Director General, UN Population Foundation Tokyo Office)
  - Environment , Population and Women
- Prof. Mitsuo Ichikawa (Kyoto University)
  - The Conservation of Tropical Rainforest and Human Environment
- Prof. Shunji Matsuoka (Waseda University)
  - Effective Environmental Management in Developing Countries

EDL Special Lecture II (21st – 22nd December 2010)
Project Cycle Management (PCM) Workshop

Task: How to stop excessive uses of water resources

- Participatory class
- Students assumes the roles of stakeholders.
- Communication skills to coordinate different opinions among students
- Planning under constraint of budget and time
- Opportunity to learn practical problems that are likely to occur in reality

Student activities: EDL cafe

- Building personal connection between students
- Face-to-face dialogue with snacks
- Debate on environmental problems

Ex.
- How to manage Nuclear Power Plant?
- How to settle disputes on international rivers?

The 1st Environmental Diplomatic Leaders on 26th July 2011

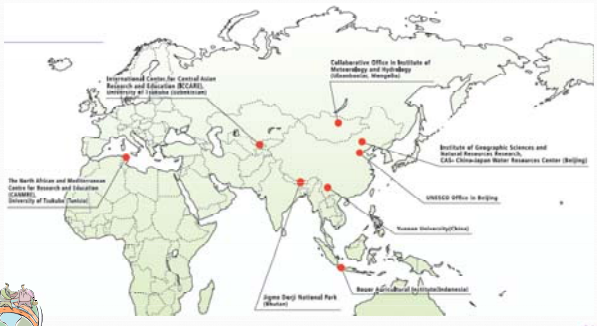
Certificate

The 1st EDLs received certificate by President Prof. Yamada.

Certificate Supplements

TEDLIC

(*T*sukuba *E*nvironmental *D*iplomatic *L*eader *I*nternational *C*onsortium)



Conclusions

- Environmental Leadership needs abilities of S & T, communication / implementation and wisdom.
- Importance of knowledge bridging natural science and human / social science.
- Solutions are found in the field / region.
- EDL Program of University of Tsukuba aims to be one of the best graduate course educating Environmental Leadership all over the world.

Intentionally blank

Reconsideration of the World Population of the 21st Century
-Reproductive Health & Gender as a Key-

Naomi WAKASUGI
Graduate School of Life and Environmental Sciences, University of Tsukuba, Ibaraki, Japan
nwakasu@envr.tsukuba.ac.jp

Population is a global issue that is often discussed with a sense of crisis as 'Population explosion'; from a concern that the world population might exceed its seating capacity due to limited food resources in near future.

However, we discern two different trends in today's world population growth statistics. Continuous population growth is seen in southern countries such as Africa, while low birth rates have been observed in developed countries since the 1960's. In fact world annual population growth rate has decreased to less than 1.2% from around 2% during 60's.

Demographic transition theory suggests that a population at a stage with high birth & high death rates will be followed by a stage with high birth & low death rates, and then by a stage with low birth & low death rates. If this theory is correct, then we can be optimist about future population growth rates in developing countries by assuming that their stage is only a little bit behind developed countries and will spontaneously stabilize. But, demographic transition theory emphasizes death as the determining factor in population statistics namely that people become dying less often than before, while the various factors influencing birth are not fully considered. What determine the death rate are medical factors, such as diseases and life expectancy; and economic factors, such as poverty and war. But those factors that determine the birth rate are more complex, namely; what is the reality of the sexuality and the reproduction of people. In other words, how men and women live their live in society. Such socio-cultural and gender specific consideration influence the reproduction of the population qualitatively as well as quantitatively, and deserve a very attentive analysis.

Recently, it has been recognized that the common key to solving both the population explosion and the low birth rate problems is to pay closer attention to women's issues; in particular, their reproductive health and also to gender inequality. Only decreasing death rate or forced birth control policies to control the population is not sufficient. Population issues should be tackled through improving reproductive health & rights and gender issues. The fact that there are both many unwanted pregnancies and lower birth rate than desired indicates the importance of promoting a society in which man and woman, especially woman, can choose "when" and decide freely "how many" children they have. It must be noted that woman's empowerment, such as increased literacy and work participation, has been playing a key role in the resolution of population demographic problems and it should be promoted as a primary importance.

Keywords: Population explosion, Demographic transition, Birth rate, Reproductive Health & Rights, Gender

Reconsideration of the World Population of the 21st Century

-Reproductive Health & Gender as a key-

1-2 September 2011, Ulaanbaator, Mongolia

Pr. Naomi WAKASUGI

Graduate School of Life and Environmental Sciences, University of Tsukuba, Ibaraki, Japan

nwakasu@envr.tsukuba.ac.jp

Population in the world

- **Three triggers for population growth in history**
  1. Discovery of agriculture
  2. Industrial revolution & SocioEconomic development
  3. Medicine and Public health
- **Two different tendencies coexist**
  - Population growth (Explosion)（in developing countries）
  - Population decrease/Low birth（in developed countries）
- **Inconvenience of "too many"?**
  - Food production/ supply
  - Effect on Environment
- **Inconvenience of " too few"?**
  - Workforce/Economic activity

World Population will exceed its seating capacity on earth in the future ?

"Overpopulation"

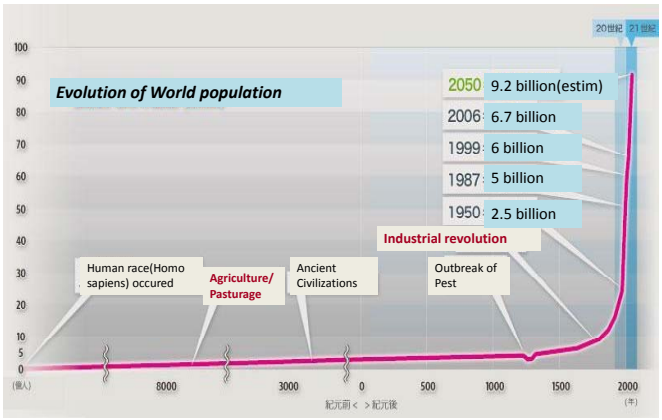
Malthus; Absolute Surplus-Population

Marx; Relative Surplus-Population

Food and Population

According to FAO,

- **Land not covered with ice: 13 billion ha.**
  - **can use for culture: 5 billion ha. about half can be possible: 2~3 billion ha.**
- **Actually, 1.5 billion ha. are cultivated and 2 billion tons grain every year is produced.**
- **1 ton grain can feed 6.7 persons/year (1 ha. can feed 20persons).**
- **Food produced now can feed 30 billions population normally.**
- **But, 1 to 10 persons in the world are suffering from hunger.**



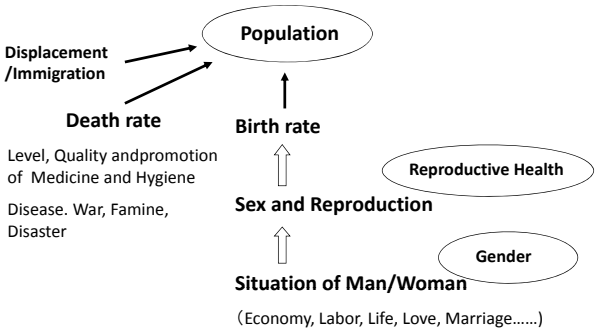
UN population division (2005）

The World at 7 Billion

Change of population growth rate(%)

Year	World	Developed	Developing
1800～1850	0.5	0.7	0.5
1850～1900	0.5	1.0	0.3
1900～1950	0.8	0.8	0.9
1950～2000	1.9	0.9	2.2
1950～1960	1.79	1.18	2.06
1960～1970	1.99	0.96	2.41
1970～1980	1.85	0.72	2.25
1980～1990	1.73	0.59	2.07
1990～2000	1.44	0.38	1.73
2000～2010	1.20	0.32	1.40
2010～2020	1.05	0.17	1.22

What determine population?



Demographic transition Theory,
Correct? Spontaneous ?

High Birth & High Death → High Birth & Low Death
→ Low Birth & Low Death

Emphasis on "death rate ", "How people become dying less than before."
"Death rate is a driving factor for Birth rate".
Determining factors for Death rate; Quality of life, Disease, Quality and access to medical care, War, Disaster etc; are less complex than Birth rate.

Birth rate….. More complex. It reflects individual choices of woman and man, sexuality, religion, culture, economy and politics……..

The Millennium Development Goals (MDGs)
(Sep 2000 → 2015)
189 countries signed

Goal 1: **Eradicate extreme poverty and hunger**
Goal 2: **Achieve universal primary education**
Goal 3: **Promote *gender equality* and empower women**
Goal 4: **Reduce child mortality**
Goal 5: **Improve maternal health**
Goal 6: **Combat HIV/AIDS, Malaria, and other diseases**
Goal 7: **Ensure environmental sustainability**
Goal 8: **Develop a global partnership for development**

International cooperation for Health

1. **Hospital-based Medical Approach**
   Improve medical aspect
   (level of diagnosis and treatment of diseases)
   (Build hospitals, Equipment, Human resource training)
2. **Public Health Approach**
   Primary Health Care, Health sector reform
   Infectious disease control(Vaccine program, DOTSetc)
3. **Specific Issue Approach**
   Population, Reproductive Health and Gender
   Drug revolving fund, Income Generation
   Community Health/ Community Health Volunteer

State of Women's Health in the world

- 600.000 Maternal deaths a year. 99% of them in developing countries.
  Maternal mortality rate (MMR) mean of developing countries : 488/100.000 delivery vs 30/100.000 in developed countries.
- Proportion of births attended by skilled health personnel: 27%
- Hidden Morbidity
  Women 30 fold more than deaths suffer from sequelaes and accompanied health problems
- Rapid increase in HIV/AIDS among women and children.
- Proportion of women with Iron deficiency anemia:
  40% in Africa, 60% in South Asia, 83% in India.
- Higher U5MR among girls than boys in some countries
- Severe malnutrition: 21% of girls vs 3% of boys in low income households

Social /Economical situation of women in the world

- Population with poverty (below $1) is 1.3 billion (a quarter of world population). 70 % of them are women.
- 53% of labor in the world is carried on women's shoulders. But 2 thirds of them are non-paid.
- Two thirds of 900 million illiterate people are women.
- Mean salary of women is 3 quarters of that of men.
- More women lose their jobs than men.
- Proportion of women in management posts is less than 1 to 7.
- Domestic/Sexual violence etc.

「Gender and Human Development」
UNDP1994

Why Reproductive Health & Rights was needed to be advocated?

～ It was an antithesis to forced intervention into people's reproduction～

- **Long history of Eugenics**
  Eugenics aiming at eradicating "bad gene" sustained the intervention into fertility.
- **Industrial revolution and modern state have been basically "Pro-natalist" to secure workforce, and strictly controlled the abortion.**
- **Sense of crisis as " Population explosion" has lead to anti-natalistic pressure from "North" to "South"**

These are reflected ⇒ 1994 ICPD(International Conference on Population and Development) in Cairo and 1995 4th World Conference on Women in Beijing

「Reproductive Health & Rights」was advocated as a fundamental basis of world population policy.

13

Concept of Eugenics-Basis and history

Eugenics=Excellent seed

- **Aiming at reforming human race by social intervention, intentionally increase excellent gene and decrease inferior gene.**
- **The germ can be seen in "Politeia" of Platon. In ancient police Sparta, weak babies were abandoned outside of city and killed.**
- **The concept of Eugenics has been started by Francis Galton, cousin of Charles Darwin.1883「Inheritance of intelligence」**
- **He thought that protecting weak people disturbe "Natural selection"**
- **"Science"based racism=Eugenics has been prevailed world wide during 1930~1990s typifying Nazism. Almost all western countries adopted law or policy of sterilization.**

14

(continued)

- After WWII, criticism of Eugenics for its viewpoint of human inequity along with Universal Human rights declaration and civil rights movement(60s).
- Classical genetics has been replaced by molecular biology after discovery of DNA and Human genome decoding.
- Late 1990s～, "Reproductive Health & Rights" has been advocated as an anti-thesis to forced intervention into reproduction.
- It seems that also Japan has swept off "Eugenics" by changing the name of law, national eugenics(1940)⇒Eugenic protection(1948)⇒Motherhood protection(1997)
- But,….."Low birth trend "facilitates ART(Artificial Reproduction Technology), and leads new era when people can choose "Reproduction without sex", diagnosis of fertilized egg before implantation, and selective abortion.
  ⇒ risk of **「Eugenics inside of ourselves」**

15

"Reproductive Health & Rights" to overcome

Forced population policies*(sometime forced encouragement of giving birth, and other time eugenic birth control) and *Health impairment caused by gender inequality and women's socioeconomic situation.
It should be based on protecting reproductive rights.

Reproductive health implies that people are able to have a

① **responsible, satisfying and safer sex life** and that

②they have the capability to reproduce and the freedom to decide **if, when and how often** to do so.

Implicit in this are ③ **the right of men and women to be informed of and to have access to** safe, effective, affordable and acceptable methods of birth control of their choice; and

④ **the right of access to appropriate health care services** that will enable women to go safely through pregnancy and childbirth and provide couples with the best chance of having a healthy infant.

(WHO 1996)

Objectives of Reproductive Health

1. Family Planning

- Reduce Unwanted, Unplanned pregnancies. Contraceptives, Birth spacing.
- Access to contraceptives and Information/Education to Women, Men, Young people

2. Safe and secured Pregnancy & Delivery (Safe motherhood)

- Reduce Morbidity and Mortality related to pregnancy and delivery.
- By Prenatal consultations
- Assure the infrastructure and referal system for Risk delivery (Obstetric emergency)
- Human resource capacity building

17

3. Information and Education on Sex/Reproduction

- Inform the danger of illegal, Self abortion
- Sex education in school, home and peer education
- Training of Traditional Birth Attendant and collaboration

4. Sexually Transmitted Infection/HIV&AIDS

5. Sexual Violence, Harmful traditional practice

6. Assisted Reproduction Technology

18

GDI (Gender Development Index)
= Revised HDI considering gender gap

HDI (Human Development Index); Income + Health + Education

GDI rank	Country	Contraception rate（%）
1	Sweden	71
2	Finland	78
3	Norway	72
4	Denmark	72
5	USA	67
6	Australia	56
7	France	70
8	Japan	53
9	Canada	65
10	Austria	56
・		
・		
121	Burundi	1
122	Chad	1
123	Mozambique	5
124	Ethiopia	1
125	Guinea	1
126	BurkinaFaso	4
127	Niger	2
128	Mali	5
129	Sierra Leone	—
130	Afghanistan	—

19

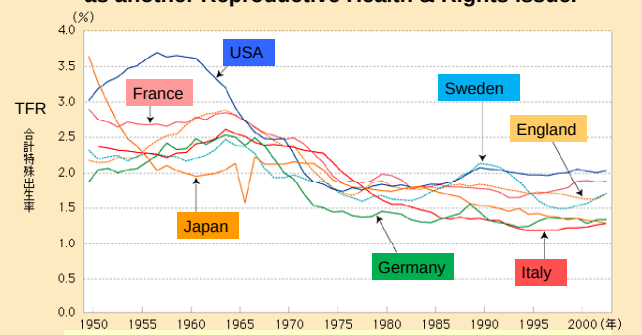
Low birth rate(Few children) in developed countries as another Reproductive Health & Rights issue.

Low birth is a problem to be solved?
Or, is logically inevitable phenomenon?

Demographic transition
Many Birth & Many Death → Many Birth & Few Death → Few Birth & Few Death

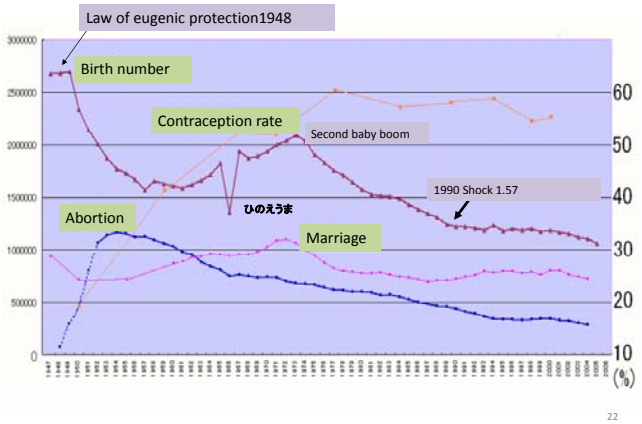
20

Low birth rate (Few children) in developed countries as another Reproductive Health & Rights issue.



資料： 諸外国：U.N. "Demographic Yearbook", Council of Europe "Recent demographic developments in Europe", E.U., "Eurostat", U.S.Department of Health and Human services "National Vital Statistics Report"。日本は厚生労働省「人口動態統計」。

21



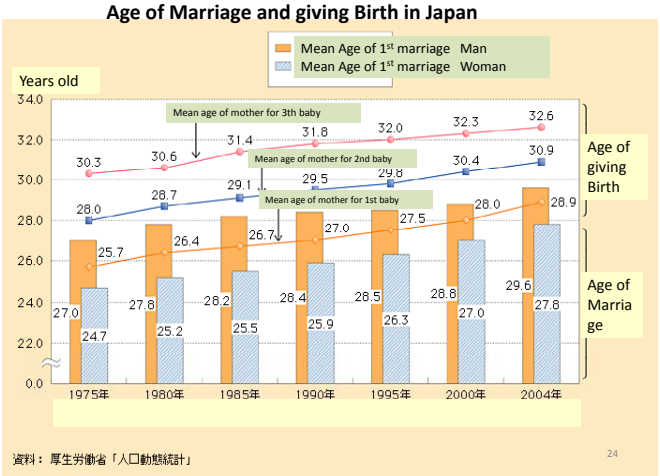
22

Then, people does not want to have children ?

- **Not want (now) (Unplanned)**
  「今は産めない」「とても育てられない」と、子作りをしないか、避妊を続けるか、妊娠した場合「授かりものだから産もう。できちゃった婚」、ではなく中絶にいたる例。
- **Can not, despite want**
  妊娠したいのに妊娠できない。
  生殖補助医療の利用増加。100人にひとりの赤ちゃん。
- **Not accepted (by the society)**
  （社会から）望まれない妊娠。婚姻外の出生児、未婚の母はあいかわらず白眼視、困難に出会う。

23

Age of Marriage and giving Birth in Japan



資料： 厚生労働省「人口動態統計」

24

Evaluation and political stance for Birth rate in developed countries

	1986			2003		
	Total Fertility Rate	Evaluation	Stance	Total Fertility Rate	Evaluation	Stance
France	**1.83**	Too low	Recover	**1.89**	Too low	Recover
Germany	**1.41**	-	-	**1.34**	Too low	Not intervene
Italy	**1.34**	satisfied	Not intervene	**1.29**	Too low	Not intervene
Sweden	**1.80**	Too low	Not intervene	**1.71**	satisfied	Not intervene
England	**1.78**	satisfied	Not intervene	**1.71**	satisfied	Not intervene
USA	**1.84**	satisfied	Not intervene	**2.04**	satisfied	Not intervene
Japan	**1.72**	satisfied	Not intervene	**1.29**	Too low	Recover

出典：United Nations, "World Population Polices 2003".合計特殊出生率はE.U.,"Eurostat", U.S.Department of Health and Human services"National Vital Statistics Report",厚生労働省「人口動態統計」。

ART (Assisted Reproductive Technology)

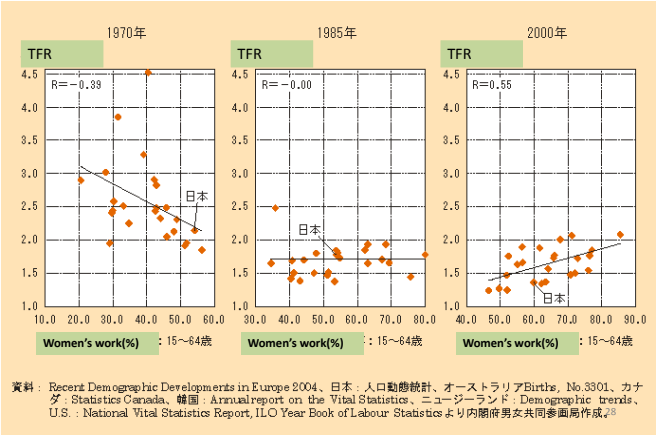
- **Artificial insemination** (mainly for man-side sterility)
  (Heterologous insemination： 1949～)
- **IVF** (In vitro fertilization)(started for woman-side sterility)
  the first was in 1978 England, 1983 in Japan.
- Technology developed
  - ovulation promotor, hormones
  - Freezing and defrost of sperm, egg, fertilized egg
  - technology to take egg from body (laparoscope, echo)
  - **Cloning technolgy** (remove nucleus of egg and replace with nucleus of somatic cell etc)
- As a result, "**Pregnancy and delivery by surrogate mother**" became possible. Technological possibility of "Cloned human"

=> But, ART can contribute to increase children only partially.

How women's socioeconomic states relate with Population ?

Women's literacy ↑ ⟺ Family planning ↑

Women's work ↑ ⟺ Giving birth ↑



資料： Recent Demographic Developments in Europe 2004、日本：人口動態統計、オーストラリアBirths, No.3301、カナダ：Statistics Canada、韓国：Annual report on the Vital Statistics、ニュージーランド：Demographic trends、U.S.：National Vital Statistics Report, ILO Year Book of Labour Statistics より内閣府男女共同参画局作成。

	Total population (millions) 2010	Projected population (millions) 2050	Growth rate 2005-2010	Total Fertility Rate 2010	Contraceptive prevalence rate	Maternal mortality rate	Under 5 mortality rate M/F
Mongolia	**2.7**	**3.4**	**1.2**	**1.97**	**61**	**46**	**49/40**
World Total	6708	9150	1.2	2.52	55	400	71/71
More developed regions	1237	1275	0.3	1.65	58	9	8/7
Less developed regions	5671	7946	1.4	2.67	55		78/78
Least developed countries	854	1672	2.3	4.23	22		138/126

A Legal Perspective on Surface Water and Groundwater Interaction: Groundwater Problem in Saijo City, Japan

Takahiro Endo
Graduate School of Life and Environmental Sciences, University of Tsukuba, Ibaraki, Japan
endo@envr.tsukuba.ac.jp

The concept of the hydrologic cycle has significance not only for the natural sciences but also for the social sciences. In regard to this cycle, an upstream water diversion may place external diseconomies on downstream water uses. A conflict of interest can result. A well-designed institution overseeing water resource management would have a function to prevent or resolve such externality problems.

Such preventions or resolutions are often hindered by artificial boundaries on water resources. A country upstream in an international river does not always recognize the negative impacts on the downstream countries. National borders often hinder information sharing and cooperation between riparian countries. Further boundaries can be found inside a country, for example, sectionalism within a government. Fragmented policy-making between waterworks and wastewater treatment authorities can be problematic; for example, it may create a situation where a series of wastewater outlets are located above drinking water intake facilities. The biological effects of dam construction are often ignored when the administration of water quantity and quality are fragmented. As these examples show, human-made boundaries often become obstacles to effective water management.

From among these examples, this paper deals with a boundary that has so far been paid little attention; i.e., the legal boundary between surface water and groundwater. This investigation is based on a case study of a groundwater problem in Saijo City, Ehime, Japan. Under the Japanese legal system, while surface water is defined as “public water” and is subject to governmental regulations, groundwater is regarded as “private water” and goes with the land ownership. This boundary between surface water and groundwater, which does not exist in the natural hydrological cycle, can hinder internalization of external diseconomy between surface water and groundwater users. It is often vaguely asserted that integrated management of surface water and groundwater is necessary in arguments on integrated water resources management. This paper shows that efficient use of water resources provides a basis for that assertion.

Keywords: Externality, public water, private water, integrated water resources management, Saijo City.

IGE-University of Tsukuba 2nd International Symposium
"International Multidisciplinary Conference on Environment"
2011.9.1-2 (Ulaanbaatar, Mongolia)

A Legal Perspective on Surface Water and Groundwater: Groundwater Problem in Saijo, Japan

Takahiro Endo

Graduate School of Life and Environmental Sciences,
University of Tsukuba

Boundaries on water resource

National Borders

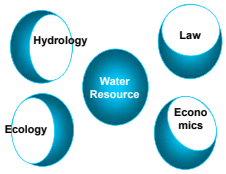
Sectionalism

Headwater management: Ministry of Agriculture, Forestry and Fisheries

Flood control, Sewerage: Ministry of Land, Infrastructure, Transport and Tourism

Waterworks: Ministry of Health, Labor and Welfare etc.

Academic Boundaries



A legal boundary between surface and ground water

2

Hydrologic Cycle and Water Law

Hydrologic Cycle: A's water uses affect B, C・・・・etc.

→Rule for prevention / Solution of conflicts＝Water law

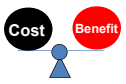
× Relationship between human and water

○ Relationship between people connected by water

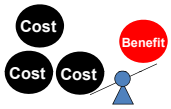
3

Question

Diversion of a unit of water



A's calculation



Calculation from social viewpoint

An Upstream diverter does not always take account of external cost to downstream users.

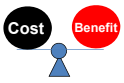
↓

The diversion may be optimal for A, but it is excessive for society as a whole. (The diversion may pay for A, but B, C… may lose more than A gets.) :Inefficient (Wasteful) use of water

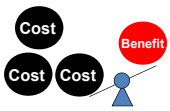
4

Question

Diversion of a unit of water



A's calculation



Calculation from social viewpoint

If there is a rule that forces A to compensate the loss, that will lead to less diversion and overall welfare will be improved. (Internalization of external diseconomy)

*How can we give user A incentive to think of external costs ?
----institutional arrangement for internalization of external cost

*Can we give user A such incentive where there is a legal boundary between surface and ground water?

5

Outline

1 Question: What kind of role does a legal boundary between surface and ground water play in promoting efficient use of water ?
2 A legal boundary between surface and ground water in Japanese legal system
3 Saijo groundwater problem
4 An impact of the legal boundary
5 Conclusion

6

2 A boundary between surface and ground water in Japanese legal system

1、1868～1896

- **Flood control as a priority issue**
- **Water allocation rule with less importance**

2、1896: The (Old) River Law

- **Centralized management of rivers**
- **Subsidy from national government**
- **The main concern : Flood control**

3、1964: The River Law

- **Economic development after WWII**
- **: The necessity of water allocation rule in addition to flood control policy**

4、1997: Amendments on The River Law

- **Environmental factors**

*** Surface water is subject to public regulation: public water**

7

An Overview of Judicial Decisions on Groundwater

Absolute ownership (1896 ~ 1920's)

- **Right of use groundwater belongs to the ownership of land.**
- **A landowner can make free use of groundwater that lies below its land.**
- **Civil Code § 207 : Subject to limitations by laws and ordinances, the ownership of land extends both above and below its surface**

Groundwater as a "private water"

Restriction on a theory of "right abuse" (1920's ~ 1930's)

- **A landowner can use groundwater as far as the use does not significantly injure other person's right to use groundwater.**

Recognition of groundwater flow (1960's ~)

- **Groundwater is a fluid resource.**
- **Because groundwater is a resource commonly owned by land owners, the pumping can be restricted in reasonable way.**

8

Laws Related to Groundwater

Preventive Measures

Land Subsidence

Industrial Water Law

Law concerning control of groundwater extraction for building use

Water Quality

Law on prevention for Water quality degradation etc.

Wastes

Law on wastes disposal

Chemical Materials

Law on fertilizer etc.

No Unified Groundwater Law

Ground Water

Recovery Measures

Law against soil pollution

Law on prevention for Water quality degradation

Law on wastes disposal

etc.

Rules for Resource Utilization

Hot spring s law

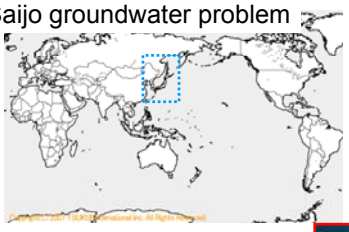
Mineral industrial law (Natural gas)

The river law, The sediment flow prevention law etc.

(Yanagi (2002))

9

3 Saijo groundwater problem



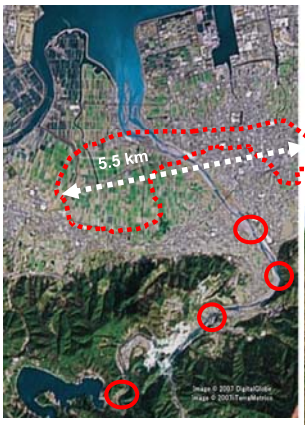
Saijo City

- **Population: 58110 (2000)**
- **Average precipitation 1413mm (1909~2001)**
- **Kamo River**
  Catchment area:229 km2
  Class-B River)

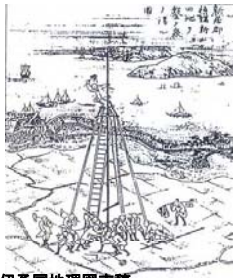
(Saijo City 1984:505,Saijo City 2003:19)

10

Kamo River : A losing stream



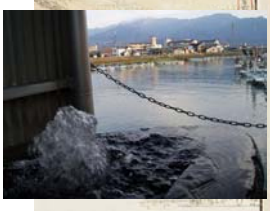
Groundwater with long history

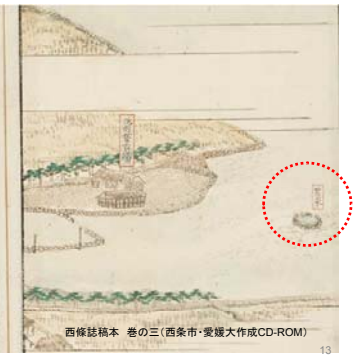


伊予国地理図志稿

12

弘法水（Kou-bou water）

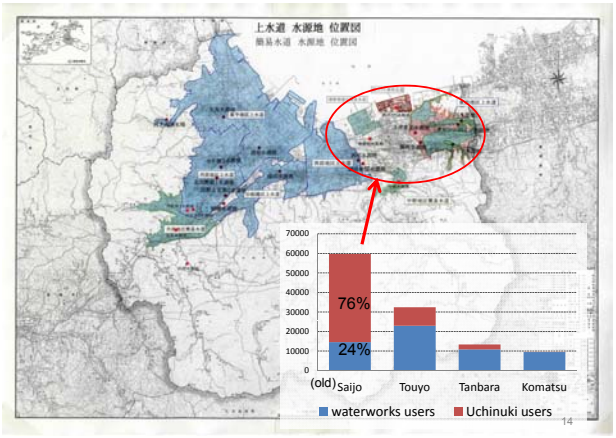




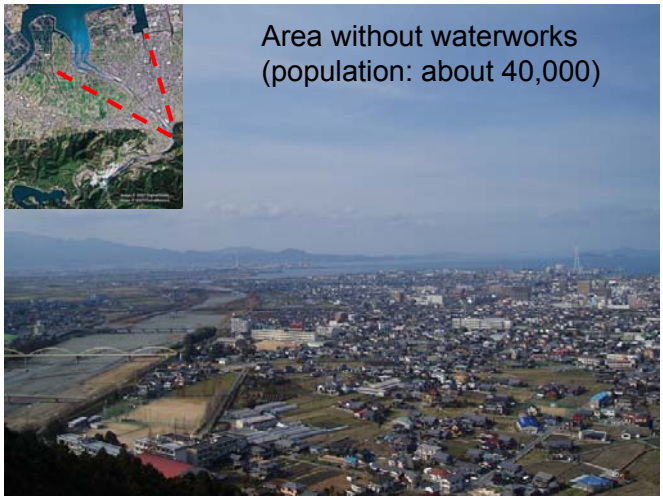
13

西条市提供

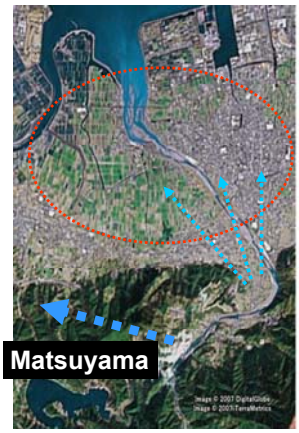
Waterworks in Saijo city



14



4 An impact of the legal boundary



A Water Conflict Between Saijo and Matsuyama

2006 A water diversion plan for Matsuyama city

↓

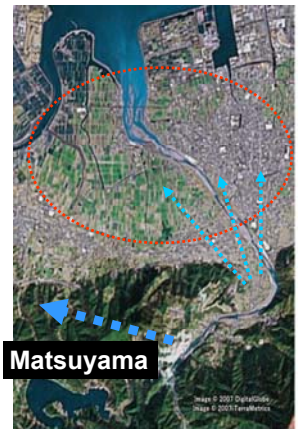
Saijo Government opposed this plan with anxiety that the plan may affect groundwater recharge in Saijo Area.

↓

Saijo Government is worried about negative externality on groundwater.

16

What is problem?

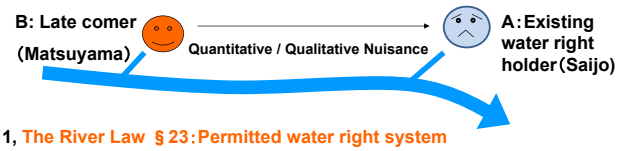


Case 1 : Saijo city governmet has a water right and takes water for various uses from Kamo River.

Case 2: Saijo city residents pumps up groundwater and use it for various uses.

17

Hard and Soft Measures for Conflict Prevention



1, The River Law § 23: Permitted water right system
→ Free access is not allowed.
2, The River Law § 38-43: Water Conciliation
→ A late comer is required to get consent from concerned river users and compensate them for losses caused by the planned diversion.
3, Dam
→ A late comer is usually required to make a dam not to injure senior water rights.
4, The River Law § 53: Drought Conciliation
→ In drought, concerned river users are supposed to make negotiations to settle water allocation.

18

Concerned River Users are……

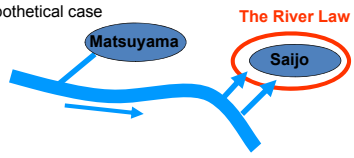
1、Those who get permissions on the River Law § 23-29

2、Fishermen

＊Groundwater users outside of a river channel are not included.

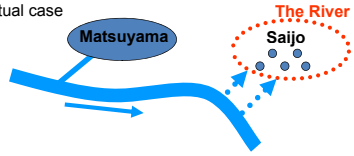
（Groundwater = Private Water ）

Hypothetical case



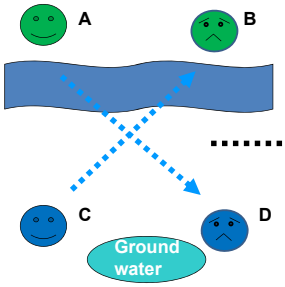
- **Surface water diversion**
- **Concerned River User**
- **Protection by water conciliation and drought conciliation is available.**

Actual case



- **Groundwater pumping**
- **Protection by water conciliation and drought conciliation is not available.**

Institutional pitfall



River Law

: Surface water user

× Surface Water User

Surface Water User

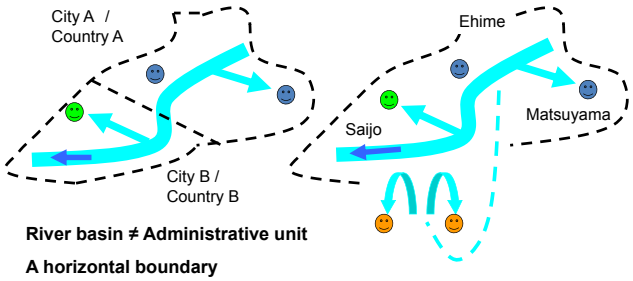
×Groundwater user

Judicial decisions and civil code:

Groundwater user

×Groundwater user

Implications of Saijo Groundwater Problem



River basin ≠ Administrative unit

A horizontal boundary

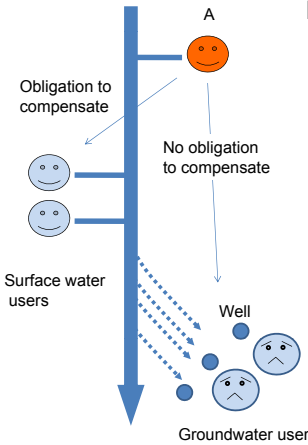
↓

Inefficient use of water ←

Legal status of surface water ≠Legal status of groundwater

A vertical boundary

The necessity of three dimensional management of water resource



Boundary and stakeholders

Boundary divides potential stakeholders into two groups.

Boundary prevents some users from being stakeholders.

Another way to give user A incentive to divert less
=side payments from groundwater users
→collective action problem

Conclusion

Q: What kind of role does a legal boundary between surface and ground water play in promoting efficient use of water ?

A: The boundary plays a negative role, especially when externality takes place between surface and ground water users.

Implication: “Efficient use of water resource” can be a justification of integrated water resource management.

Main References

- Babel, M. S. (2003). Integrated Water Resources Management (IWRM). In L. Lehr (Ed.), *Water Encyclopedia* (pp.574-576). New Jersey: John Wiley & Sons, Inc.
- Endo.T.(forthcoming), A Boundary between Surface Water and Groundwater in Japanese Legal System - Its Consequences and Implications-, in M.Taniguchi and T.Shiraishi eds. Dilemma of Boundaries, Tokyo, Springer..
- Global Water Partnership. (2000). *Integrated Water Resources Management.* TAC Background Papers no.4.
- Grigg, N.S. (1999). Integrated Water Resources Management: Who Should Lead, Who Should Pay. *Journal of the American Water Resources Association,* 25, 527-534.
- Mankiew, N.G. (1998). *Principles of Economics.* Fort Worth: Dryden Press.
- Mitchell, B. (1990). *Integrated Water Management.* New York: Belhaven Press.
- Mitchell, B. (2005). Integrated Water Resource Management, Institutional Arrangements, and Land-use Planning. *Environment and Planning A*, 37, 1335-1352.
- Miyazaki A. (2006). Landownership and Groundwater Law with Special Focus on the Legal Characteristics of Groundwater. in *Urban and Land Use (Essays in Honor of Professor Inamoto Yonosuke)* (pp.47-73). Tokyo: Nihon Hyoronsha. (In Japanese).
- Piper, A.M. and Thomas, H.E. (1958). Hydrology and Water Law: What is Their Future Common Ground? In *Water Resources and the Law* (pp.7-24). Ann Arbor: University of Michigan Law School.
- Saijo City. (2000). *The Result of Investigation on Saijo Groundwater Resource 1996-1999* (In Japanese).
- Saijo City. (2001). *Natural Treasure……Together with Uchinuki* (In Japanese).
- Saijo City. (2003). *Sixty Years History of Saijo* (In Japanese).
- Saijo City. (2006). *Bulletin Saijo* (In Japanese).
- Wiel, S. C. (1929). Need for Unified Law for Surface and Underground Water. *Southern California Law Review,* 2, 358-369.

Intentionally blank

Poster Session

Dialogues with Young Scientists

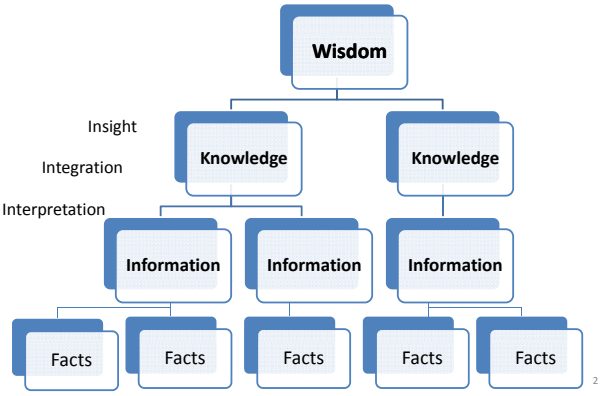
International Multidisciplinary Conference on Environment
Mongolian-Japanese Center, Mongolia, 2011/9/2

Objectives of Poster Session

Takahiro ENDO
EDL Program, University of Tsukuba

Facts to Wisdom

-We should think based on facts but fact is not always truth-

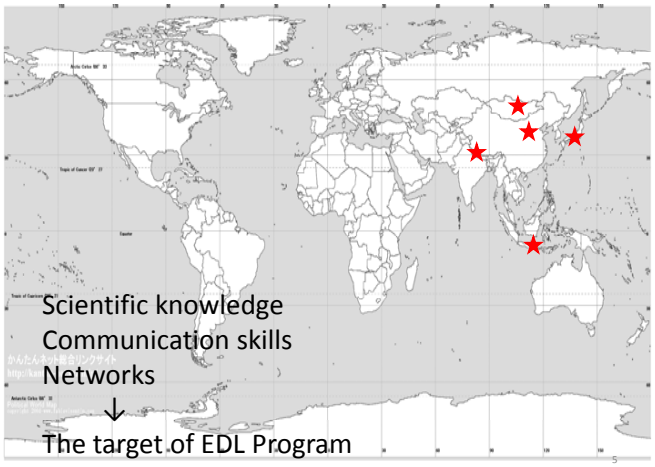


目利き（Me-ki-ki）

Discussion based on theoretical knowledge

文殊（Monju）

http://jyofukuji.net/syabutsu/monjyu.html



Scientific knowledge
Communication skills
Networks
↓
The target of EDL Program

Relay between generations

Environment=An asset borrowed from next generations
Sustainability = Keep environmental asset at certain level
and hand it over to next generations

Scientific knowledge
Communication skills
Networks
↓
The target of EDL Program

http://www.sozai.rdy.jp/shirokuro/09/undoukai3/sozaitext/02.htm

Prospects of Sustainable Forest Management: Community-based Forest Management in India

Kazuyo NAGAHAMA
Graduate School of Life and Environmental Sciences, University of Tsukuba, Ibaraki, Japan
kazuyona@zpost.plala.or.jp

It has been widely recognized that forests have various functions, i.e. forest products, soil and water conservation and recreation, or CO_2 sequestration and deforestation leads to deterioration of these functions. To cope with deforestation the Indian government has taken several initiatives.
In 1988, the new Indian National Forest Policy went through a drastic shift away from economic exploitation toward the conservation of forest resources. This new policy also recognized the importance of the needs of the forest-dependent population for firewood, livestock feeding, non-timber forest products and timber for domestic use. Following this new agenda, the Ministry of the Environment and Forests issued a directive to adopt the policy of Joint Forest Management (JFM).
JFM is a concept of developing partnerships between forest user groups and the State Forest Departments (SFDs) on the basis of mutual trust, jointly defined roles and responsibilities with regard to forest protection and development. It also aims at decreasing serious poverty among forest dependent people.
The formal recognition of local villagers as co-managers of forests and legitimate users of forest products has been accepted by local communities, and since its inception, the area under JFM has increased. As of 2006, 27% of Indian forests (17.3 million hectares of forest land) have been reserved for 85,000 JFM scheme under FD/FPC partnership control. The Japan Bank for International Cooperation and the World Bank have also provided financial support to JFM initiatives.
In spite of the proliferation of JFM across India, however, this policy has been the subject to growing criticisms and concerns among many scholars and non-government organizations (NGOs). It is said that committees receive few benefits from JFM, and concerns about the inequitable distribution of benefits among committee members, which could have an adverse impacts, are also presented.
On the other hand, there is a region in which decentralized forest management had been adopted almost 60 years before the initiation of JFM, i.e. self-initiated forest protection groups, Van Panchayats (VPs) in Uttarakhand.
The question in this study is to what extent such local institutions have successfully achieved sustainable forest management. VPs are the best example of age-old institutions, and therefore they may provide useful insights to the implementation of JFM.

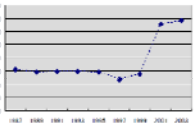
Keywords : Community-based forest management, Joint Forest Management (JFM), Van Panchayats (VPs), Forest Protection Committee(FPC), Forest Department (FD)

Prospects of sustainable forest management: community-based forest in India

Kazuyo Nagahama
Univ. of Tsukuba
Graduate School of Life and Environmental Sciences
E-mail: kazuyona@zpost.plala.or.jp

1

Background



Forest cover in India is increasing, (690,899km² 21.2%. in 2007)although it is the second populous country in the world. India is abundant in forest resources, and it reaped a rich benefits from the forest as well as living and culture .

Policy Context in India
1980 Indian Forest Act,
1984 Social Forestry Project,
1988 National Forest Policy,
1990 JFM Circular,
2002 Revised JFM Guideline,

Resource :Forest Survey of India 2009

2

What is JFM(Joint Forest Mamagement)?

- **A program in which local JFM committees undertake management and protection of state forests with official rights and authority**
- **As of 2006, around 220,000km², around 29.2% of the total state forest**
- **Expansion based on the demarcated forestland**

- **Strong restrictions on the felling and conversion**
- **Shift from revenue-oriented to public and environmental-oriented**
- **Recognition of the importance of people's participation**

3

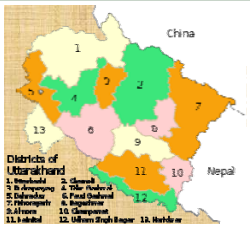
Van Panchayats (VPs) in Uttarakhand longest standing example of JFM.

Increasing number of VPs
1995 5000 VPs
2000 7100 VPs
2006 about 12000 VPs

VPs are best example of age-old institutions of participatory forest management in Uttarakhand.

Study Site

Uttarakhand



4

Objectives

- This study will discuss the reality situation of forest land for communal use under VPs and the factors leading to such actual conditions and contradictory between local people in Forest Protection Committee and Forest Department.

Methodology

- The selected VPs will be surveyed to clarify reality between local people in Forest Protection Committee and Forest Department. Based on the result, analyze the factors and find the mechanism under VPs, and also based on the previous study about forest policy, VPs rules and the development. By the data collection from the organizations and governments, interview with the local people in the villages under VPs .

5

Hypothesis

- Results of the case study from two districts that the same policies under VPs will produce different processes and diverse effects at the local level.
- VPs policies in Uttarakhand will offer a beneficial arrangement for local villages who participate in VPs.
- Local villages will be able to reap benefits depends on various factors in addition to policies.

6

Windbreak Trees for Reduction of Evapotranspiration in Agricultural Land in the Nile-Delta, Egypt

Tatsuki SHIMIZU[1], Michiaki SUGITA[1] and Rushdi El-KILANI[2]

[1] University of Tsukuba Graduate School of Life and Environmental Science（Ibaraki, Japan）

[2] Faculty of Agriculture, Cairo University（Giza, Egypt）

ttk.shimizu@gmail.com

Egypt has a typical arid climate and its basic industry is agriculture. For its water resources it is almost completely reliant on the Nile River. Also, the population is rapidly increasing and so demand for agricultural land with adequate water supplies is also increasing (NWRP 2005).

One method for reducing water evaporation from agricultural land is the windbreak. Windbreak trees reduce water evaporation from land by reducing the wind velocity. But to be beneficial the total evapotranspiration from both the windbreak trees and the land must be less than the original level of evapotranspiration.

In this research project, over a period of ten days, we quantitatively evaluated the transpiration of windbreak trees and the reducing effect they had on the land evapotranspiration. The transpiration rate of an individual windbreak tree in the Nile Delta was calculated measuring the sap flow rate and the sap wood area and using their product as a measure of tree transpiration. We also measured the level of transpiration with respect to tree diameter, foliage area and tree height, and also with regard to the intensity of short wave radiation and vapor pressure deficit (VPD). We combined the ten days data with one year climatic data and applied the Penman-Monteith equation to give the trends over a year.

Our data show daily fluctuation in individual tree transpiration rates, which is consistent with previous research, but at a lower rate. We also used our data verify a relationship between windbreak tree porosity and the reduction in evapotranspiration.

Our research showed that transpiration from windbreak trees produce only 1% of the total evapotranspiration from agricultural land, while reducing evapotranspiration by 22 – 54% at porosities of 76 – 0% respectively.

This shows that windbreak tree do, indeed, reduce total evapotranspiration from agricultural land, but the reduction is strongly dependent upon the windbreak tree porosity.

Keywords: Windbreak trees, Casuarina, sapflow measurements, Evaporation reduction, Porosity

Windbreak trees for reduction of evapotranspiration in agricultural land in the Nile Delta, Egypt

Tatsuki SHIMIZU[1], Michiaki SUGITA[1] and Rushdi El-KILANI[2]

1 University of Tsukuba Graduate School of Life and Environmental Science（Ibaraki, Japan）

2 Faculty of Agriculture, Cairo University（Giza, Egypt）

1. Background

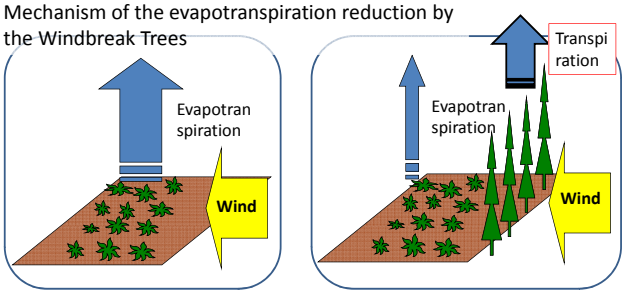
- Egypt has a typical arid climate and its water resource is completely reliant on Nile River.
- Recently its population increases dramatically.

NWRP PROJECT, 2005 was set up.
"Sharing water resource with desert areas by reducing evapotranspiration in agricultural area."

Reduction of Evapotranspiration by Windbreak Trees is one of the methods.

Objective

Mechanism of the evapotranspiration reduction by the Windbreak Trees



By setting Windbreak trees, its transpiration is added to the water output of agricultural area.

To evaluate the total water output of agricultural area, **evaluating Windbreak Trees' transpiration is important.**

Study areas

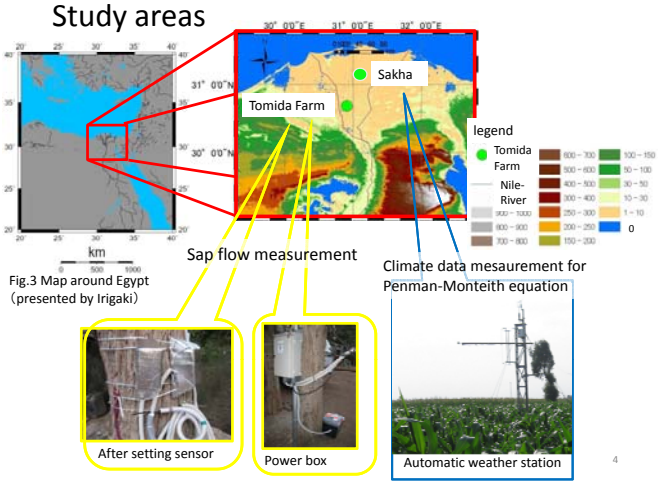


Fig.3 Map around Egypt（presented by Irigaki）

Method

- Transpiration

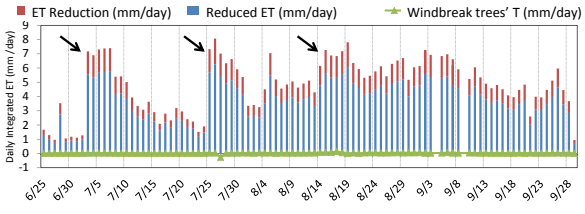
  Multiplication of the sap flow velocity and the sap wood area (Granier method)

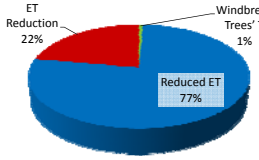
- Evapotranspiration

  Penman-Monteith equation

Result

Porosity 73 %





↑The ET reduction effect of Windbreak Trees (porosity 73 %) Arrow line shows irrigation. Broken line shows 5 days gap.

← Daily integrated ET Ratio in growth period of Maize

Use of Hydrological Tracers to Assess Groundwater and Surface Water Interaction in Lebna Watershed, Cap-Bon, North East Tunisia

Mizuho TAKAHASHI
Graduate School of Life and Environmental Sciences, University of Tsukuba, Ibaraki, Japan
s1121272@u.tsukuba.ac.jp

Groundwater is usually the major water resource in semi-arid regions, such as the Lebna watershed in Cap-Bon, North-East of Tunisia. But sea water intrusion into coastal aquifers, decline in groundwater levels and the deterioration of water quality due to excessive groundwater usage are on-going problems. For sustainable use of water resources and to understand the process of groundwater recharge it is important to understand the surface and groundwater interaction.

This project used hydrological tracers to map the groundwater flow system in Lebna watershed; and clarified the surface water and groundwater interaction the groundwater recharge process and influence of the sea on the Lebna dam and this area water balance.

In May and July of 2010, water samples were collected from rivers, dams and the wells in the Lebna watershed and their pH, electrical conductivity, water temperature, and groundwater level were measured. The Groundwater level data was combined with data on the spatial distribution of stable hydrogen and oxygen isotope ratios to clarify the groundwater and surface water interaction.

Our findings show that on the left bank of the dam, the groundwater seems to flow into the Lebna dam, but on the right bank 2 flow systems seem to exist. In one system, the groundwater flows from the uplands to the lowlands, while in the second system groundwater flows from the dam to the lowlands and recharges the groundwater watershed.

In 2010 and 2011 I will focus on the lower basin of the dam and make a more detailed map of the water table. In addition, I will investigate seasonal differences because of the precipitation between summer and winter. Furthermore, I will investigate change in quality and quantity of irrigation water before and after construction of the dam by questionnaire.

Keywords: surface water and ground water interaction, semi-arid area, stable isotope of δ18O and δD , Cap-Bon, Tunisia

Use of Hydrological tracers to assess Groundwater and Surface water interaction Cap-Bon, North East Tunisia

Graduate School of Life and Environmental Sciences,
University of Tsukuba
Mizuho TAKAHASHI

1

Introduction-Background

- **Semi-arid regions** are characterized by limited **water resources** and expanding of urban, **industrial and agricultural water requirements** will further increase the usage of accessible groundwater. (De Vries and Simmers, 2002).
- Problems
  - Sea water intrusion into Coastal aquifer
  - Pollution by human action
  - Over exploitation
  - Dam construction effects
- A quantification of groundwater recharge is therefore a prerequisite for efficient and **sustainable groundwater resource management**.

2

Introduction-Background

- **Groundwater and surface water interaction** is important to understand the hydrological process
- Despite many study with hydrological tracers were conducted in the semi-arid regions(ex. Hunt *et al* (2010)) , **there are few in Tunisia**

Objective

- **Use hydrological tracers** to map the groundwater flow system in Lebna watershed.
- Clarify the surface water and groundwater interaction the groundwater recharge process and influence of the sea on the Lebna dam and this area water balance.

3

Study area

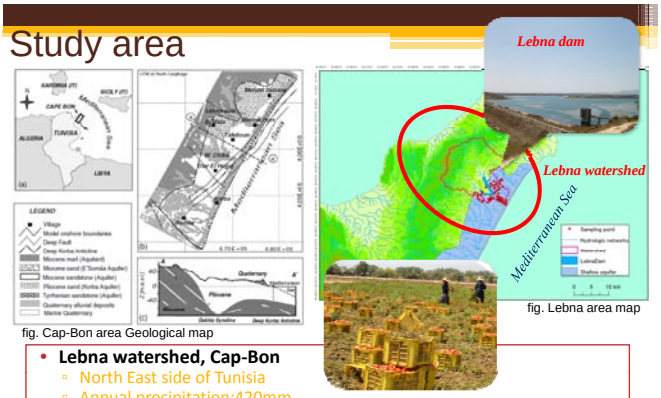


fig. Cap-Bon area Geological map

fig. Lebna area map

- **Lebna watershed, Cap-Bon**
  - North East side of Tunisia
  - Annual precipitation:420mm
    (Rain season: November-March, Dry season: July-August)
  - Annual temperature: 24degree
  - Agriculture is active by irrigation water

4

Methodology

- field surveys in Lebna
  -July 4th,5th,12th 2011
  -July 14th -17th,2010
  -January, 2012

- Field measurements
  -pH, T, EC, ORP,
  -water table depth
- Collect groundwater and surface water samples

- Laboratory analysis
  -Stable isotopes($\delta^{18}O$,δD) by Mass Spectrometer
  -Anion and Cation by IC/ICP
- Make Groundwater contour map
- Combine Water quality data and Ground water level data

To clarify GW and SW interaction and seawater effect

5

Previous result Conclusion and Future work

- From stable isotpe data there seems to be evaporation effects
- We **need investigation in rain season**
- On the left bank of the dam, the groundwater seems to flow into the Lebna dam, but on the right bank 2 flow systems seem to exist.
- There **seems to be seawater intrusion** on the lower dam basin
- **2011investigation focus on the lower basin of the dam** and make more detailed map of groundwater table.

Lebna watershed
- Compare with 2010 and 2011 and near watershed
- Make questionnaire
  - What people think about dam and water quality
- Compare seasonal effect
  - Rain season field survey
- Consider dam effect

6

Investigation on Groundwater Flow System in Ulaanbaatar, Mongolia

Kohsuke TOMIMATSU
Graduate School of Life and Environmental Science, University of Tsukuba, Ibaraki, Japan

The groundwater plays an important role in our life. In the arid and semi-arid regions, groundwater is often the major source of water supply for industrial, agricultural and domestic uses. Recently, industrialization and population growth have caused the excessive groundwater pumping to lower groundwater table. Mongolia is located in a semi-arid regions, the north eastern Asia. The groundwater is the most important water resource, and approximately 90 % of the population uses the groundwater for domestic uses. Now, four wells supply 241000 m^3/day of water in Ulaanbaatar city for domestic uses. However, excessive over exploitation of the groundwater in quantity and quality caused the serious problems. Improvement of integrated water management system is necessary in Ulaanbaatar. However, little attention has been paid to the groundwater in Ulaanbaatar city except for a few studies.

Yoshizawa (2010) focused a shallow groundwater, which is the source of water supply and tried to estimate usable volume of the groundwater by calculating the shallow groundwater balance.

Also, Ikeda (2011) investigated interaction between surface water and groundwater with special focus on Tuul River basin in Ulaanbaatar city. As a result, he shows Tuul River is dominant notice of the groundwater in the flood plaing, also the groundwater in the north and the south mountains contribute partly groundwater recharge in Ulaanbaatar. In addition, he shows an extremely little precipitation in winter might affect on the groundwater in Ulaanbaatar, though the mechanism of the groundwater recharge by winter precipitation is not cleared.

Therefore, the author would like to estimate the contribution of groundwater by the precipitation in winter around Ulaanbaatar in Mongolia and clear flow systems of groundwater recharge.

Keywords : groundwater, semi-arid regions, groundwater recharge,

Investigation on groundwater flow system in Ulanbaatar, Mongolia

Kohsuke TOMIMATSU
Graduate School of Life And Environmental Science, University of Tsukuba, Ibaraki, Japan

Introduction

- The groundwater plays an important roles in our life.
- In the arid and semi-arid regions, the groundwater is often the major source of water supply for industrial, agricultural and domestic uses.
- Recently, industrialization and population growth have caused excessive groundwater pumping to lower groundwater table.

Study Area

- Mongolia is located in a semi-arid region, north eastern Asia
- More than about 90 % of the population uses the groundwater for domestic uses.

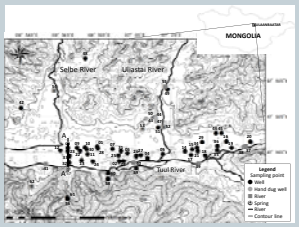


Fig 1: Study area and previous sampling points (Ikeda, 2011)

Previous study (Ikeda, 2011)

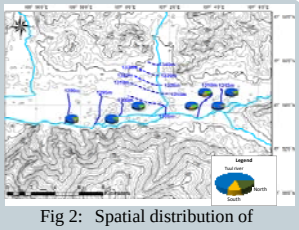


Fig 2: Spatial distribution of relative contribution rate of groundwater recharge from Tuul River, the groudwater in souh and norh mounains (Ikeda, 2011)

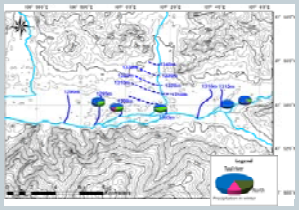


Fig 3 : Spatial distribution of relative contribution rate to consider precipitation in winter (Ikeda, 2011)

Objectives

- To estimate the contribution of groundwater by the precipitation in winter around UlanBaatar, Mongolia
- To clear flow systems of groundwater recharge

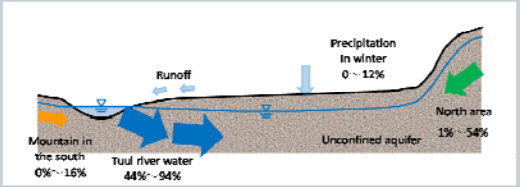


Fig 4: The concept of groundwater recharge in Ulanbaatar (Ikeda, 2011)

Reference

- Ikeda, K. (2011) Investigation interaction between surface water and ground water in Ulanbaatar , Mongolia, *Master Thesis, University of Tsukuba*.
- Yoshizawa, S. (2008) Study on renewable uses in arid and semi-arid regions, Mongolia, *Master Thesis, University of Tsukuba*.
- Horiuchi, K. et al (1999) Water in arid area. *Journal of Japanese Association of Hydrological Sciences* ,29,3,111-122.

Isotopic mapping across the Whole Tunisia

Wataru YAMADA
Graduate School of Life and Environmental Sciences, University of Tsukuba, Ibaraki, Japan
wtyamada@gmail.com

Large scale spatial isotope studies of water flow can provide important insights into groundwater recharge process. This presentation shows the need for and effectiveness of large scale isotopic mapping studies of water flow in arid regions.

Except for limited coastal areas, most parts of Northern Africa are arid or semi-arid area. The forth report of Intergovernmental Panel on Climate Change (IPCC) warned about the possibility of decrease in the rainfall of Northern Africa in the near future. In Tunisia, which is located in the Northern tip of Africa, the ground water is one of the most important water resources; but as there has been a drawdown of groundwater levels in recent years. For the sustainable use of groundwater, it is important to grasp the groundwater system quantitatively.

Stable isotopes of water, such as 18O and 2H are effective tracers for estimating the process of groundwater recharge. With them we can follow the water flow patterns and discern the ratio of various water resources to the groundwater recharge process. In the phase transition such as evaporation, deposition and melting, these stable isotopes show the different behaviour by isotopic fractionation result from the difference of mass. This fractionation varies with the temperature and humidity, leading the various isotopic ratios. Using this mechanism, we can estimate the process of groundwater recharge quantitatively. If the water is not affected by phase transition in the groundwater, the ratio could be maintained until the water is discharged on the ground. Comparing the groundwater with the water from the rainfall, river and lake in the recharging area, we can calculate the contribution ratios of various water courses from the recharging area to the groundwater recharge.

For these reasons, stable isotopic mapping across the whole of Tunisia could provide hydrologically important data. High resolution isotopic mapping also could be very useful for designing large-scale monitoring programs because isotopes can often be used to identify the important sites in the groundwater flow system.

In July 2011, I conducted the preliminary survey mainly in Medjerda watershed located in northern Tunisia. I took 64 water samples from river, and collected the geographical data. In the future, I will widen the survey area in the whole of Tunisia.

Keywords: stable isotope, groundwater recharge, Tunisia

Isotopic mapping across the whole of Tunisia

Wataru Yamada*・Maki Tsujimura*・Atsushi Kawachi*・Anis Chekirbane*・
Hiroko Isoda*・Jamila Tarhouni**
*: University of Tsukuba, **: National Institute of Agronomy of Tunisia

- The feature of semi-arid area
  low rainfall, high potential evapotranspiration
  → groundwater as resource is important
  The over exploitation with increasing of irrigation water
- Northern Africa (the forth assessment of IPCC)
  increase in temperature
  decrease in rainfall especially in Mediterranean coastal area
- The appropriate management of groundwater
  → figuring out the process of groundwater recharge

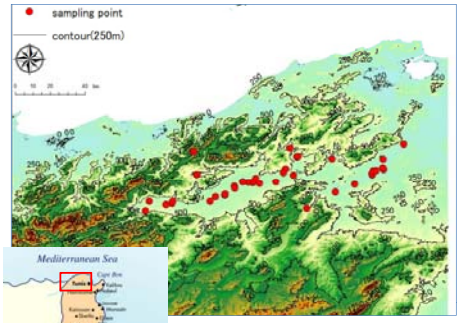
Objective

Kendall et al(2010):

- Large scale spatial isotope studies
  → important insight into groundwater recharge process
- Stable isotope (18O and 2H)
  → follow the water flow patterns
  estimate the process of groundwater recharge
- High resolution isotopic mapping
  → useful data for designing large-scale monitoring programs

To make the isotopic map across the whole of Tunisia

The study area, Medjreda watershed in Tunisia

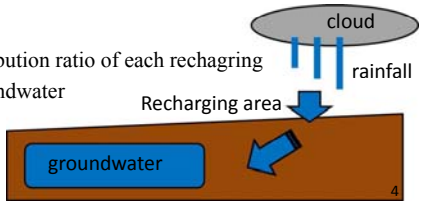


- schedule
  2011/7/7~11
- survey item
  EC, pH,
- analysis
  stable isotope
  inorganic ion
  (Na^+, K^+, Mg^{2+}, Cl^-, Ca^{2+}, NO_3^-, SO_4^{2-}, HCO_3^-)
- Sampling points
  40

Average temperature: 25.6℃(July)
Precipitation: 600mm/year

Stable Isotope (^{18}O, ^{2}H)

- evaporation, deposition, melting
  → different behaviour by isotopic fractionation
  → varing with the temperature and humidity
  → various isotopic ratio
  - Temperature effect
  - Continental effect
  - Altitude effect
  - Amount effect
- Estimate the contribution ratio of each rechagring source to the groundwater



Future works

- Continue to analysis the water samples
- Comparing the result of isotopic ratio with that of inorganic ions
- Widen the survey area to the whole of Tunisia

reference

- Carol Kendall, Tylar B. Coplen(2001): Distribution of oxygen-18 and deuterium in river waters across the United States, *Hydrological process.* 15,1363-1393
- Carol Kendall, Megan B. Young, and Steven R. Silva(2010): Application of Stable Isotopes for Regional to Nationl-Scale Water Quality and Environmental Monitoring Programs, *Isoscapes,Understanding movement, pattern, and process on Earth through isotope mapping*

Application of Life Cycle Assessment to Evaluate Two Wastewater Treatment Plants in ChongQing Province

Wenyu Huang
Graduate School of Life and Environmental Sciences, University of Tsukuba, Ibaraki, Japan
hwy_4@hotmail.com

As the water crisis in the world, especially in china, gets more serious wastewater treatment has become a very important method for water recycling, as the world's natural energy and other resources are consumed it is important to construct sewage treatment plants which are efficient and have less adverse impact on the environment. Hence governments need to pay more attention to wastewater treatment plants and policy.

This presentation discuss the use of the Life Cycle Assesment(LCA) method to evaluate a wastewater treatment plant. The LCA method is an effective means for scientifically determining the efficiency of sewage treatment plants. The life cycle of municipal wastewater treatment plant can be divided into three stages; construction, operation and removal.

This presentation demonstrates the use of the LCA method in the evaluation of two plants in ChongQing province. The daily wastewater treatment capability of each plant is 8000t. The wastewater treatment process of A plant is Anaerobic-Anoxic-Oxic (A2/O) process while the B plant is Conduction Current Biofilter (CCB) process. In the construction stage, B plant has the feature of low cost and small occupation area. In the operation stage, I apply a method which is provided by the Imperial Chemical Industry (ICI)to calculate the environment burden (EB). As ICI determined that the environment burden involves many factors and each factors has it's own weigh value, the EB in two plants is different. In the removal stage, although A plant produce more sludge than B, but B plant should wash the biofilter regularly. In this presentation, Combining with the economic benefit and EB finally make a conclusion that B plant has advantage than A plant.

In the summery, As a whole life cycle of the row water, considered with the economic benefit and cost and the environment burden，B plant has advantage than A. Nevertheless, the relative new wastewater treatment process in B plant is more easier causing problems. Lowering the energy depletion, improving the wastewater treatment process and revising the environmental police would be advantage for both of the two wastewater treatment plants.

Keywords: wastewater treatment process, life cycle assessment, environment burden, economic benefit and cost

Application of Life CycleAssessment to Evaluate Two Wastewater Treatment Plants in ChongQing Province

Wenyu Huang

Graduate School of Life and Environmental Sciences, University of Tsukuba, Ibaraki, Japan

Background

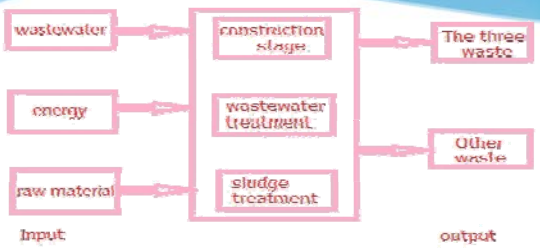
ChongQing city

Population: 31590000

Water Resource: ChangJiang, Jialingjiang

Volume of Domestic Waste Water Discharged (10000 tons):
year 2008: 78086 year 2009：81385

system and boundary of municipal wastewater treatment plants



This presentation discuss the use of the Life Cycle Assesment(LCA) method to evaluate a wastewater treatment plant. The LCA method is an effective means for scientifically determining the efficiency of sewage treatment plants.

Case study: Two plants in ChongQing province(plant A and plant B) Construction stage

Category	Plant A	Plant B
Daily wastewater treatment capability of each plant	8000	8000
Wastewater treatment process	Anaerobic-Anoxic-Oxic (A2/O)	Conduction Current Biofilter (CCB)

Fp of different environmental category of municipal wastewater treatment plants

category		Fp
global warming	CO2	1
	NOX	40
	CH4	21
	CO	3
	NH3	1.88
atmosphere acidic	N	0.7
	S	1.0
heavy metals	Hg	16.67
	Cd	2.0
	Cu	1.0
eutriphication	N	1.0
	P	0.067

Imperial Chemical industries

Environment bordern
EB=M1*Fp1+M2*Fp2+M3*Fp3+•••

Benefit and cost

Categary	Plant A	Plant B
Raw material consumption /t	7480	64320
Energy consumption/G	142000	54000
Solid waste /t	6700	34000
Exhaust emission /t	22500	13900
COD /t	200	200

Analytic comparation

Environment bordern	Plant A > Plant B
Benefit and cost	Plant A < Plant B
Water quality	Plant A > Plant B

Thank you!

The Impact of Forest Management and Forest Concession on the local livelihood of Papua Province, Indonesia

Maria Ludia Simonapendi
Graduate school of Life and Environmental Sciences, University of Tsukuba, Ibaraki, Japan
zizai_87utsukushii@yahoo.com

Papua Province, the western half of the world's second largest island, New Guinea, accounts for almost a quarter of Indonesia's land area. Papua is one region in the east-end which gives the biggest contribution towards the richness of the tropical rain forest resources in Indonesia. With a total forest area of 40,803,132 ha, its contribution reached 32.8% towards the total area of Indonesian forests (Marwa, J. et all 2010).Based on the Decree of the Minister of Forestry, number 891/Kpts-Ⅱ/1999 dated 14 October 1999, the total area of forest covers 95.50% of the total area of Irian Jaya Province (what is now called Papua and West Papua). It comprises Conservation Forest, Protected Forest, and Production Forest. The history of forest resource utilization in Papua is as old as the age of Papuan human civilization. The phase of life commencing from primitive life patterns – hunter gatherer, shifting cultivation, peasant community to the modern stage is also influenced by the role played by forest resource. For the Papuan , forest is a "mother" who gives birth, raises and gives lives; accordingly they depend almost entirely to this forest.

Even since the collapse of natural forests in Sumatera, Java, and Kalimantan regions due to excessive extraction, the forest of Papua have become a target of timber for businessmen in Indonesia. In fact, businesses on forest in Papua offer immense benefits for them; as a result, it opens opportunities for investors to locate their money here. In 2000, Papua became the "forest businesses field" for 54 companies holding forest concession, HPH (Hak Pengusahaan Hutan/Natural Forest Concession Holder). Government of Indonesia established Peraturan Pemerintah (government decree) No. 21/1970, which grants rights to the private sector to manage HPH forest areas. But after several decades, it was indicated that HPH system has failed to achieve sustainable forest management.

This research aims first, to evaluate impact of forest concession on local livelihood of Papua Province, Indonesia. Second, does forest concession give different impact to society lived inside and outside HPH areas and third, will forest concession be able to give an optimum contribution in supporting sustainable forest management in Papua Province. This research itself will be conducting on December this year.

Key words: Forest concession, local people, Papua Province, sustainable forest management, government decree.

THE IMPACT of FORESTRY MANAGEMENT and FORESTRY CONSESSUS to THE LOCAL LIVELIHOOD in PAPUA PROVINCE, INDONESIA

Maria Ludia Simonapendi
Graduate School of Life and Environmental Sciences, University of Tsukuba, Japan

Papua Province

Total Area:
420,540km2

Population:
Total 2,900,900
Density 6.9/km2

Total Area of Forest
40,803,132 ha
(Source: papua.go.id)

FORESTS

Rainforest

Mangrove Forest

Savanna

(Source: Biodiversity Action Plan)

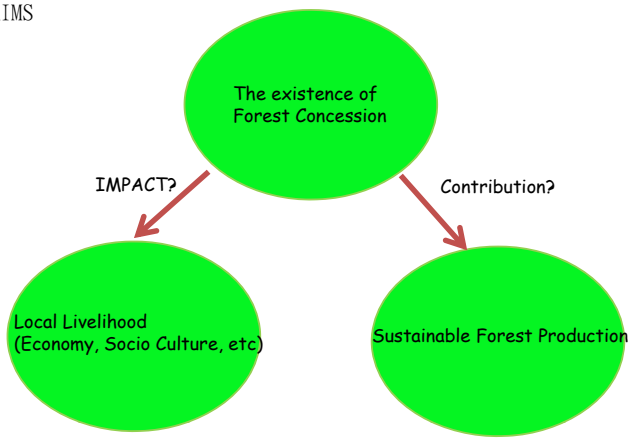
Forest Condition in Papua

Ⅰ. The Regions of Papua Forest Based on its Functions: Conservation Forest, Protected Forest, and Production Forest.

Functions of the Area	Total Area of Papua(Ha)	Province	
		Papua	West Papua
Conservation Forest Area	9,704,300	7,070,346	2,633,954
Protected Forest Area	10,619,090	7,638,676	2,980,414
a. Limited Production Forest	2,054,110	1,856,685	197,425
b. Permanent Production	10,585,210	8,354,283	2,230,927
c. Conversion Production Forest	9,262,130	6,486,673	2,775,457
Total area	42,224,840	31,406,664	10,818,176

Ⅱ. In 2000 Papua became the "forest business field" for 54 companies holding forest concession (HPH)
Ⅲ. Papua forest area covers 21,901,450 ha production forest which has been managed intensively since 1970 by Forest Concession (HPH) holders.

AIMS



THANK YOU FOR YOUR KIND LISTENING

Study on Photocatalytic Treatment of Activated Sludge with TiO2

Jie CHEN

*Graduate School of Life and Environmental Sciences, University of Tsukuba, Ibaraki, Japan

cj-86124@163.com

Development of new technologies for the reduction of sludge discharge is of great importance because the quantity of sewage sludge is increasing rapidly with the spread of sewage treatment plants. Sewage sludge is generally treated by anaerobic digestion. However, the application of anaerobic digestion was often limited due to relatively long retention times and low digestion efficiencies. Various pre-treatment techniques, such as ultrasound, peracetic acid oxidation and thermal treatment, have been studied and suggested to overcome these limitations and to improve the biogas production rate by enhancing the hydrolysis of waste activated sludge (WAS). However, these pretreatment techniques have not yet been applied due to their high treatment costs. This study aims to develop a kind of economic and efficient sludge treatment technique ---photocatalytic treatment with TiO2 to degrade the complex organics in sludge. Activated sludge diluted with water to different concentrations and catalyst TiO2 were the experiment materials irradiated by UV irradiation experimental setup. Then three conditions that can effected the result of experiment will be studied in this research which are effect of TiO2 concentration, effect of light intensity and effect of sludge concentration. Until now, we just finished the initial experiment. In the fixed UV-light exposure, the effect of experiment irradiated with TiO2 to the sludge was much better than that without catalyst in the process of pretreatment.

Key words: Photocatalytic treatment, sludge, TiO2

Study on Photocatalytic Treatment of Activated Sludge with TiO_2

Chen Jie M1

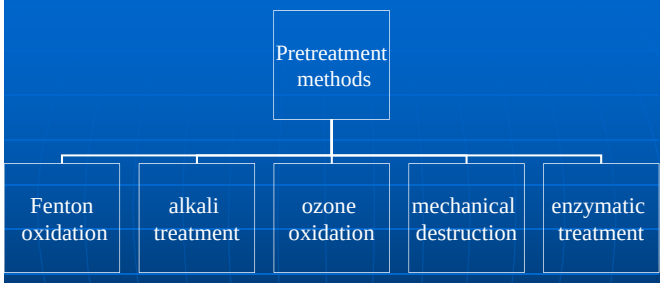
Supervisor：Zhang Zhenya

1

Introduction

- Development of new technologies for the reduction of sludge discharge is of great importance because the quantity of sewage sludge is increasing rapidly with the spread of sewage treatment plants.
- Sewage sludge is generally treated by anaerobic digestion. However, the application of anaerobic digestion was often limited due to relatively long retention time and low digestion efficiency.
- Various pre-treatment techniques have been studied and suggested to overcome these limitations and to improve the biogas production rate by enhancing the hydrolysis of waste activated sludge (WAS)

2



However, the pre-treatment techniques have not yet been applied due to their high treatment costs.

3

Purpose

This study aims to develop a kind of economic and efficient sludge treatment technique --- photocatalytic treatment with TiO_2 and to design a new equipment, which are effective to degrade the complex organics in sludge.

4

Research content

Material and method

◊UV irradiation experimental setup

◊Activated sludge（diluted with water to different concentrations）

◊Catalyst：TiO_2

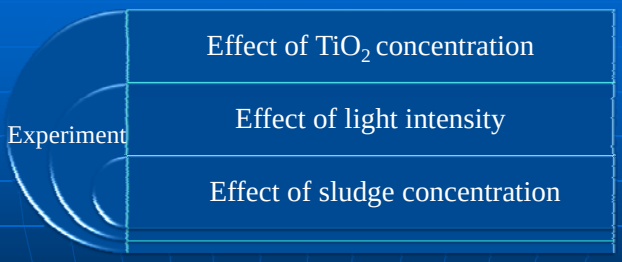
◊COD removal can be used as an indication of the extent of mineralization

Advantages:

- TiO_2 is non-toxic, cheaper and efficient.
- Catalyst is easy to replace and reuse.
- The equipment is simple and practical.

5

Research content



»» To design a reactor to further improve the degradation of the sludge.

6

Nuclear Concentration of Subsurface Water in Small Catchments, Covered by Forest, Grassland and Farmland in Kawamata Town, Fukushima

Ishwar Pun *

*Graduate School of Life and Environmental Sciences, University of Tsukuba, Ibaraki, Japan

punisr@gmail.com

The spatial distribution of radionuclides in the soil depends mainly on their soil adsorption and the rate of movement of soil water. The rate of movement of water in the soil is determined by the amount of precipitation as well as the number, size distribution and shape of pores in the soil.

Cesium-137 (Cs-134, Cs-137) is a radioactive isotope of caesium which is formed as a fission product by nuclear fission. It has a half-life of about 30.17 years. After the Fukushima nuclear disaster, as there was some leakage of fission products in the local environment, it was very important to measure the level of the radioactive materials. As the main long term radioactive pollutant and behaviour of Cesium, here research focused on the measurement of Cs-137 level.

Cesium-137 is the principal source of radiation in the pollution zone around the nuclear power plant; and together with caesium-134, iodine-131, and strontium-90, caesium-137 constitutes the greatest risk to health. Also tritium (^{3}H) might be released into the hydrological cycle from the plant.

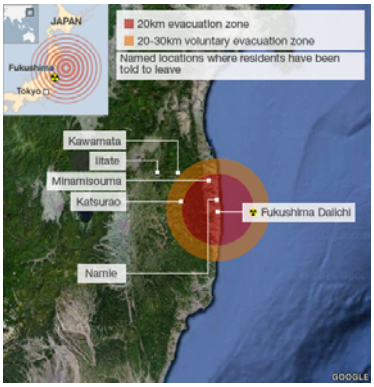
The research analyse the behaviour of radiocaesium and tritium in shallow soil water and movement to groundwater. To carry out the intensive research, soil water is collecting from three different places; Farmland, Grassland and Forest (Young and Old forest) in the depth of 10 cm, 30 cm and 50 cm each. This is an initial phase of research and still monitoring for long term effect seasonal changes (Climatic pattern) in level of Cesium.

Keywords: Cesium Analysis, soil water, nuclear power plant disaster, health risk, Fukushima

Nuclear Concentration of subsurface water in small catchments, covered by Forest, Grassland and Farmland in Kawamata Town, Fukushima

PUN Ishwar
University of Tsukuba

Introduction



Research Objective

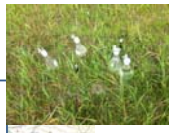
- To investigate behavior of the radionuclides with the water flow

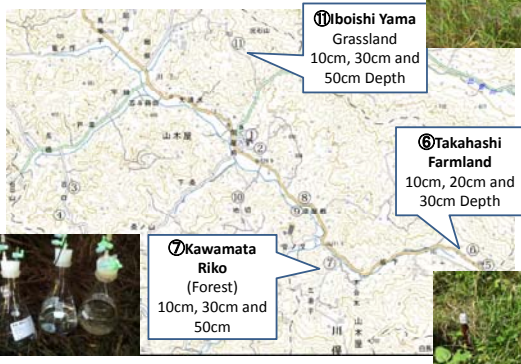
-Farmland

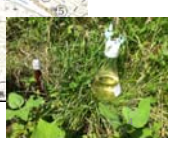
-Grassland

-Forest (Young and Old Forest)

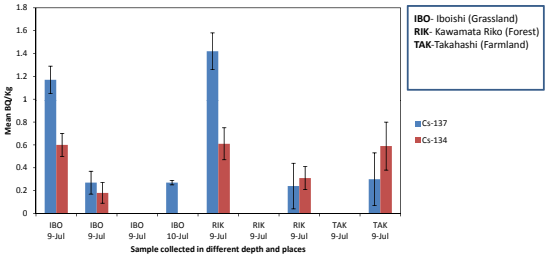
Soil water points







Cesium Level in Soil Water



Conclusion & Future plan

-It is the initial monitoring of radionuclides in the soil water at different depths. From the first result, it is found that water collected at 30 cm depth is comparatively higher concentration.

-Further monitoring will be done to understand the behavior of Cesium in soil-water in future.

Interaction between Shallow and Deep Groundwater in Baiyangdian Lake Watershed, China

Jie ZHANG
Graduate School of Life and Environmental Sciences, University of Tsukuba, Ibaraki, Japan
jeokey@hotmail.com

It is well known that groundwater accounts for most of contributions on water used for domestic and economic purposes; especially in arid and semi-arid areas. To make effective and sustainable management policy, it's necessary to clarify the mechanism of groundwater flow system.

Prior research on groundwater flow has mainly focused on the groundwater at a shallow depth, including the geochemical characteristics, residence time, and its interaction with surface water. However, with the depletion of shallow groundwater and loss of water quality, groundwater is being taken from a deeper depth. It has been confirmed that deep groundwater has a longer flow path and residence time than shallow groundwater, which means that contamination of deep groundwater would be a more serious environmental problem because it would be more difficult to restore. Therefore, we must pay closer attention to deep groundwater if we are going to consume deep groundwater on a large scale.

The research area, Baiyangdian Lake Watershed, with an area of 31,199km^2, is located in the middle of the North China Plain, where a semi-arid climate dominates. The water resources within the basin, most of which are groundwater, support a population of 12 million people and play an important social and economic role. Baiyangdian Lake Watershed is suffering from a rapid decline of its water level, and from groundwater contamination. So, local development is increasingly relying on deep water resources. Consequently research focusing on deep groundwater is more needed than before.

To clarify the mechanism of interaction between shallow and deep groundwater, the first field survey has been completed in June 2011. 80 water samples were collected from rivers, springs, and groundwater at different depths. Their electrical conductivity, pH, water temperature, oxidation-reduction potential, dissolved Oxygen, and water level were measured in site. The major ions, Hydrogen and Oxygen isotope will also be analyzed for revealing the characteristic of groundwater flow regime. Spatial distribution of EC shows that EC value from groundwater behave to be relatively higher than the water samples from rivers and springs. A primary ion analysis indicate that, the water constituent in the samples from Baiyangdian Lake area exhibits $HCO_3 \cdot SO_4$-Na·Mg type, while the water from WangKuai reservoir shows Ca-HCO_3 type.

Keywords: deep groundwater, Baiyangdian, geochemistry, sustainable development

Environmental Diplomatic Leader
環境ディプロマティックリーダーの育成拠点
科学技術戦略推進費／戦略的環境リーダー育成拠点形成事業

2011 Mongolia Internship symposium

Interaction between shallow and deep groundwater in Baiyangdian Lake Watershed, China

Zhang, Jie

Sustainable Environmental Studies(D1)

Graduate School of Life and Environmental Sciences

University of Tsukuba

筑波大学 University of Tsukuba

Background

- contaminations of groundwater in shallow aquifer
- sufficient yield and higher quality than in shallow aquifer

A tendency in groundwater resources consumption:

shallow ⇒ deeper

- A longer flow path and residence time than shallow one, which means the contamination of deep groundwater will become a more serious environmental problem because it's more difficult to restore it

pay more attention to deep groundwater at the beginning of when we are going to consume deep groundwater in large scale

Previous studies
on deep groundwater

- No definite depth but some qualitative methods can distinguish between shallow and deep groundwater
- Deep groundwater has a longer flow path and residence time than shallow one, but get less recharge from upper aquifer.
- Generally speaking, deep groundwater has little connectivity with the shallow aquifer. However, the connectivity will be activated when shallow groundwater is under an exceeded exploration, especially when absence of Aquitard or Aquiclude. This will result in deep groundwater contamination, which will be a more serious environmental problem and is more difficult to restore than contaminated shallow groundwater.

(Klaus-Peter Seiler, et al. 1995; R.K. Dhar, Y.Zheng et al, 2008; Dipankar Saha et al, 2011; Shin-ichi Onodera et al, 2009; Shin-ichi Onodera et al, 2009; Guo Yonghai et al, 1995)

Study area

Location of the Baiyangdian watershed in North China

Baiyangdian Lake Watershed(BYD) (39.4° - 40.4° N, 113.39° -116.11° E) is located in the middle of North China Plain, where a semi-arid climate dominates. Average annual temperature, precipitation and lake evaporation are, respectively, 12℃, 580.78mm and 1581.24mm.

The water resources here support 12 million population and play an important role at society developments within the basin.

(Juana Panl Moiwo et al, 2010 ;MAO Xufeng, et al.2010;DI Long, et al. 2010)

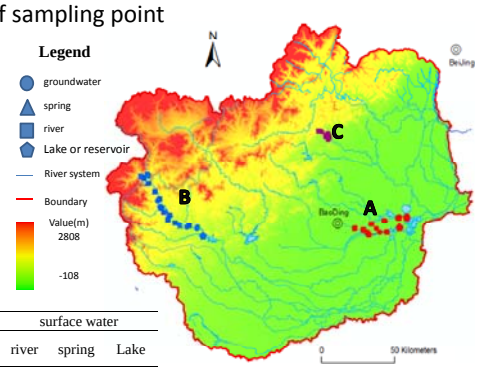
Objective & Methodology

- This research aims to clarify the mechanism of interaction between shallow and deep groundwater, and then based on the results, propose some suggestions to groundwater resource managers.

◎ Field survey: June 10th-June 16th,2011
◎ Measurements on field
Electrical Conductivity, pH, water temperature, Oxidation-Reduction Potential, Dissolved Oxygen, and water table depth
◎ Analysis indoor
Ions by IC & ICP
Stable isotopes by Mass Spectrometer
Statistic analysis

Distribution of sampling point

- Number of investigation point:83
- Sampling available :80



groundwater			surface water		
shallow (<100m)	deep (>100m)	unknown	river	spring	Lake
32	4	10	20	10	4

Study on Adsorptive Removal of High Ammonium Nitrogen from Organic Waste Using a Novel Ceramic Adsorbent

Yingxin ZHAO
Graduate School of Life and Environmental Sciences, University of Tsukuba, Ibaraki, Japan
kaixin225@hotmail.com

In recent years, anaerobic methane fermentation has drawn more and more attention from the standpoint of energy recovery and material recycling. On the one hand, a high ammonium level in organic waste, like livestock waste, inhibits the anaerobic digestion process. Therefore, high concentration ammonium should be removed down to the proper level before digestion. On the other hand, as ammonium uptake by methanogen is difficult, large amount of ammonium is left in the digester liquor when the anaerobic digestion is completed. Not only is the nitrogen resource wasted, but also exceeded nitrogen discharge without treatment results in water pollution and soil degradation.

In order to reduce ammonium inhibition of the digestion process and to recover nitrogen resource, a novel ceramic adsorbent of ammonium was synthesized. Kamuma clay, Akadama clay, zeolite powder, soluble starch and sodium salt were mixed homogeneously and granulated manually, then calcined in the muffle furnace. Batch experiments were conducted to evaluate the performance of the ceramic adsorbent on ammonium adsorption. The optimum adsorbent material and conditions were obtained by investigating calcined temperature, calcined time, initial ammonium concentration, and adsorbent dosage.

The results demonstrated that calcined temperature at 600 ℃ and calcined time at 1.5 hours were the most suitable conditions for the synthesized ceramic adsorbent. The maximum adsorption capacity achieved 63.0 mg g^{-1} when the initial ammonium concentration is 10000 mg L^{-1} at the dosage of 20 g L^{-1}. The adsorption capacity was decreasing with dosages increasing during the dosages range of 5-40 g L^{-1}.

On the account of extensive sources, low cost, simple synthesized method, and large ammonium adsorptive capacity, the adsorptive removal method using the novel ceramic adsorbent could be promising to treat ammonium rich organic waste and effectively recover nitrogen resource from the digester liquor.

Keywords: adsorption capacity, ammonium adsorption, ceramic adsorbent, digester liquor, organic wastes

Graduate School of Life and Environmental Sciences
University of Tsukuba, Japan

Study on adsorptive removal of high ammonium nitrogen from organic wastes using a novel ceramic adsorbent

ZHAO Yingxin

Supervisor: ZHANG Zhenya

Strategic Funds for the Promotion of Science and Technology

Background

From the standpoint of energy recovery and reuse, *anaerobic fermentation* has drawn more and more attention!

waste → energy

Problems

Pretreatment

A → *High ammonia in organic wastes inhibits fermentation processes!*

Two possible mechanisms of ammonia toxicity :
(i) un-ionized ammonia could directly inhibit the activity of cytosolic enzymes;
(ii) NH_4^+ accumulated inside cells might be toxic by its effect on intracellular pH or the concentration of other cations such as K.

Aftertreatment

B → *Ammonia is rich in fermentation liquor, but it is not utilized effectively.*

Traditional methods

- biological treatments
- chemical precipitation
- advanced oxidation processes
- air stripping
- ion exchange
- adsorption
- membrane processes

Disadvantage

- low ammonium loading (C<500 mg L^{-1})
- high cost
- difficult maintenance
- residual by-product

Purpose

Develop a new adsorbent

Adsorb ammonia from: Organic wastes (pretreatment); Digester liquor (after treatment) — solve → A, B

The material adsorbed ammonia: Fertilizer; Desorption and regeneration

Materials and methods

Synthesized process

Kanuma mud + Akadama mud → Sieved → Grain Size ≤ 105 μm

Zeolite powder + Soluble starch + Sodium salt → Mixed → Granulated manually → Calcined in muffle

Modeling water quality dynamics in a tropical inland wetland:case study Abras de Mantequilla, Ecuador

Batdelger Odsuren
Institute of Geoecology, MAS
Baruun Selbe-15, P.O.B-81. Ulaanbaatar, Mongolia
Email address

Wetlands are important ecosystems that have important functions and values. The most important functions of wetlands are water supply, water purification, flood control, reducing erosion, recharging groundwater and maintaining/improving water quality. They also provide socio-economic values, such as provision of habitat for fisheries and forestry resources which are depending on the spatial scale and hydrogeomorphic location in which they are found. The water quality modelling of a wetland is important to quantify the pollution removal functions and services of the wetlands that is an essential part for a proper wetland and river basin management.

In this study, we investigate the nutrient regulation function of the Abras de Mantequilla wetland which is located in the central part of the Guayas River Basin, Ecuador and that is one of the case studies of the EU funded WETWIN project. The Guayas River Basin is the most important river basin in the Coastal Region of Ecuador. In the Abras de Mantequilla, pollution from non-point sources, such as agricultural activities and surface runoff is actually one of the major threats to the wetland water quality.

This study uses a hydrodynamic and water quality model to simulate and define the dominating nutrient removal processes in the Abras de Mantequilla wetland. Two-dimensional depth averaged hydrodynamic and water quality models for the Abras de Mantequilla wetland and the upstream/downstream river reaches were set-up by applying Delft3D-FLOW and Delft3D-WAQ.

The modeling results show that the performance of the water quality model is good for applying in the Abras de Mantequilla water quality simulation. Generally, simulated results are in order of magnitude of the measured values. It can be used to predict the future water quality.

Keywords: Abras de Mantequilla wetland, Water quality, DELWAQ modeling, nutrients removal processes, WETWIN project

Modeling water quality dynamics in a tropical inland wetland: Case study, Abras de Mantequilla, Ecuador

Odsuren Batdelger

02-Sep-2011

1

Outline

- Introduction
- Objectives
- Research questions
- What is new?
- Methodology
- Research results
- Conclusions
- Recommendations

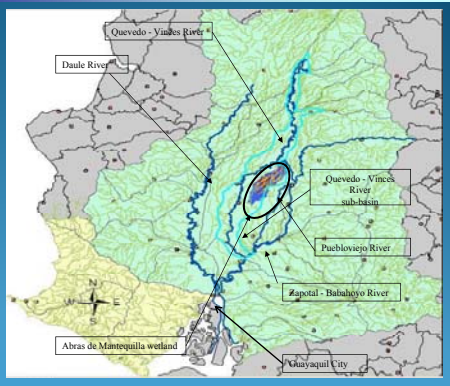
2

Study area

The study area is located in the Guayas River Basin. It is located 106 Km northeast from Guayaquil main port of Ecuador.

The area of the wetland is 22.500 ha

The wetland has been declared as a RAMSAR area in March 2000.



3

Objectives

GENERAL OBJECTIVE:
Build a DELWAQ model to simulate and define dominate nutrient removal processes in the Abras de Mantequilla wetland, based on nutrients cycle.

Specific Objectives:

- To define the dominate nutrient removal processes of the Abras de Mantequilla wetland, based on the environmental policies and available water quality data
- To do the sensitivity analysis of the most important parameters which influence the environmental cycle of the study nutrient
- To simulate the hydrodynamic processes that describe the environmental cycle of the nutrient removal

4

Research questions

- What are the dominating processes regarding nutrient removal in the Abras de Mantequilla wetland?
- How important is the spatial dynamics?
- Which are the most important parameters that are influence the nutrient removal processes?

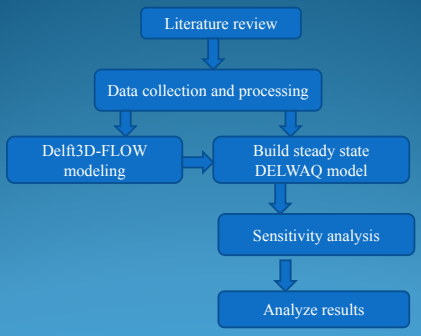
5

What is new?

- There are no studies that do a modelling of the water quality parameters and specifically the nutrients pollution in the Abras de Mantequilla.
- little understanding of the nutrient removal functions in tropical wetlands
- no or little modeling studies using hydrodynamic & spatially distributed tools (most studies use conceptual STELLA type models)
- no or little information on the dominant water quality processes related to nutrient pollution/removal in tropical wetlands

6

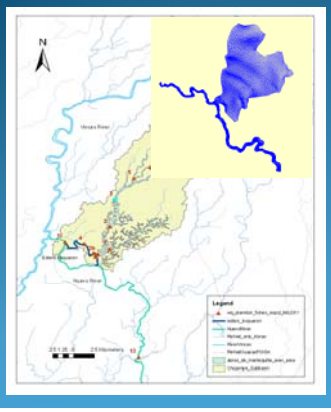
Research Methodology



7

Research Methodology

Data collection and processing

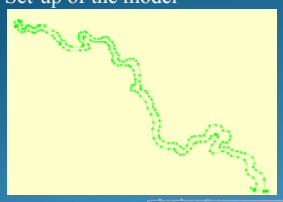


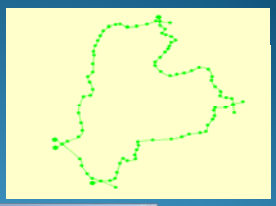
DEM:
Using available topographic maps in the area in 1:10000 scales (obtained from CEDEGE, former water authority in Guayas Basin) and complemented with recent bathymetry campaigns, a DEM was constructed
The original spatial resolution was 5m x 5m; however, in order to save further computational costs in Delft3D, the DEM was resampling to 90x90m.

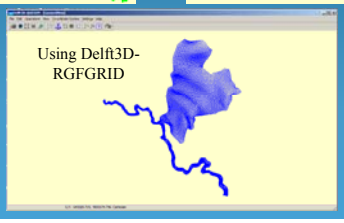
8

Research progress

Set-up of the model

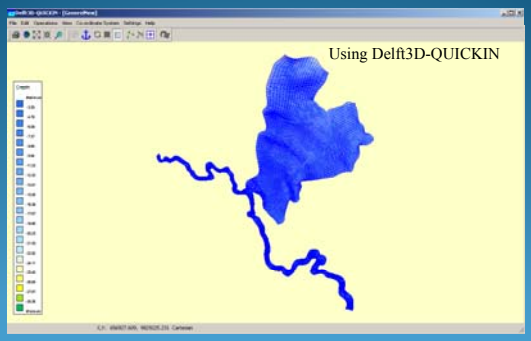






9

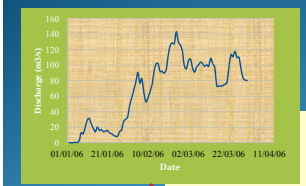
Research progress

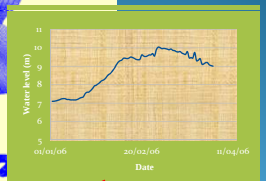


10

Research progress

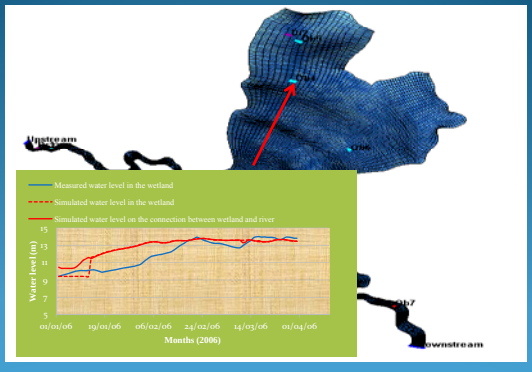
Boundary conditions





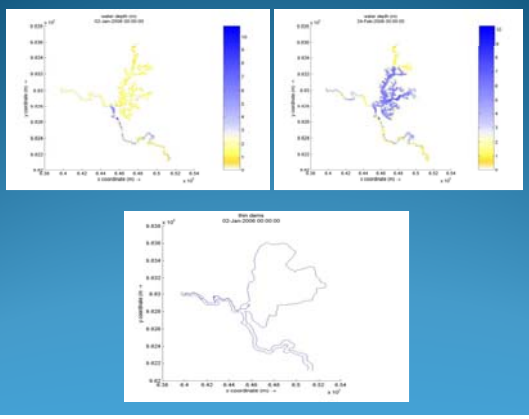
11

Research results



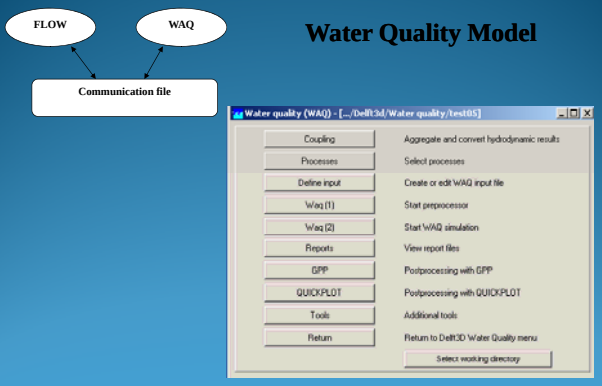
12

Research results



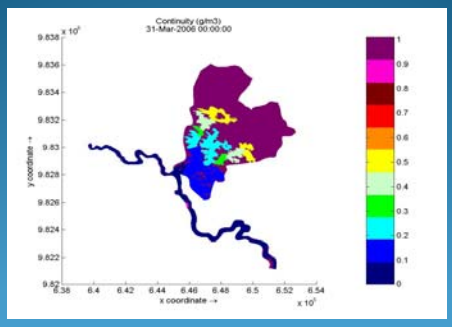
13

Research results



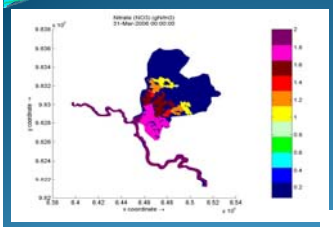
14

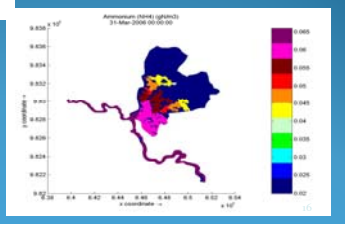
Research results



15

Research results





16

Research results

Table1: DELWAQ Activated Processes for Abras de Mantequilla wetland

Substance Group	Substance	Activated Processes
Eutrophication	Ammonium (NH4)	Nitrification of Ammonium
		Denitrification in sediment
	Nitrate (NO3)	Nitrification of Ammonium
Oxygen-BOD	Dissolved oxygen	Nitrification of Ammonium
		Reaeration of oxygen
		Sediment oxygen demand
General	Temperature	-

Table2 Initial and boundary conditions for state variables

State variable	Name	Initial condition	Boundary conditions	Units
NH4	Ammonium	0.02	0.066	(gN/m3)
NO3	Nitrate	0.08	2.0	(gN/m3)
ModTemp	Water temperature	30	25.3	(oC)
DO	Dissolved Oxygen	8.31	5.28	(g/m3)

17

Research results

Table3: Process parameters for Water Quality Processes

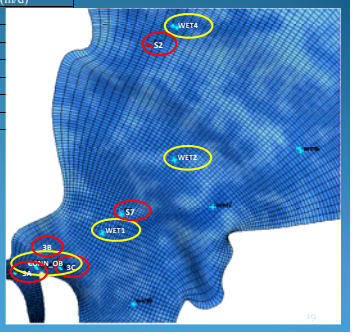
Item	Name	Process parameters	Default value	Adjusted value	Units
1	ZNit	zeroth-order nitrification flux	0		(gN/m3/d)
2	ReNit20	MM- nitrification rate at 20 oC	0.1		(gN/m3/d)
3	TeNit	temperature coefficient for nitrification	1.07		(-)
4	KsAmNit	half saturation constant for ammonium cons.	0.5		(gN/m3)
5	KsOxNit	half saturation constant for DO cons.	1		(g/m3)
6	Temp	ambient water temperature	15	28	(oC)
7	CTNit	critical temperature for nitrification	3		(oC)
8	Rc0NitOx	zero-order nitrification rate at neg. DO	0		(gN/m3/d)
9	Poros	volumetric porosity	1		(-)
10	SWVnNit	switch for old (0), new (1), TEWOR (2) version	0		(-)
11	OOXNIT	optimum oxygen concentration for nitrification	5		(gO2/m3)
12	RcDenSed	first-order denitrification rate in sediment	0.1		(m/d)
13	CFLNIT	oxygen function level for oxygen below COXNIT	0		(-)
14	CTDEN	Critical temperature for denitrification	2		(oC)
15	CurvNit	curvature of DO function for nitrification	0		(-)
16	Salinity	Salinity	15		(g/kg)
17	VWind	Wind speed	3	0.7	(m/s)
18	KLReair	Reaeration transfer coefficient	0		(m/d)
19	ISOD	Zeroth-order sediment oxygen demand	0		(gO2/m2/d)

18

Research results

Table4: Process parameters for simulations

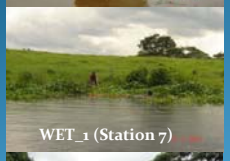
Simulations	Process parameters	
	Sediment oxygen demand FSOD ($gO_2/m^2/d$)	Reaeration coefficients KLRear (m/d)
S1	0	0
S2	0	0.4
S3	1.2	0.4
S4	0.8	0.4
S5	1	0.4
S6	1	0.25
S7	2	0.4

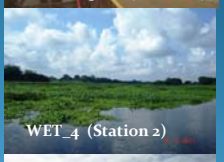


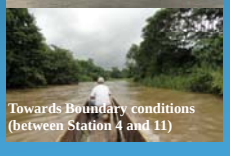
Research results


Connection point (Station3a)


Connection point (Station3a)


WET_1 (Station 7)

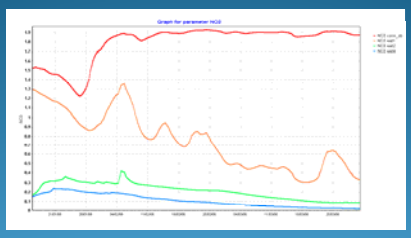

WET_4 (Station 2)


Towards Boundary conditions (between Station 4 and 11)


Boundary conditions (Station 11)

Research results

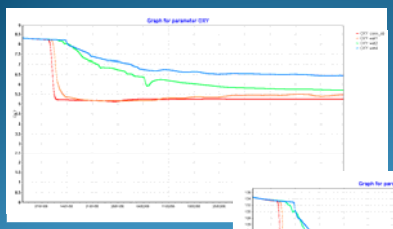
Simulation1:



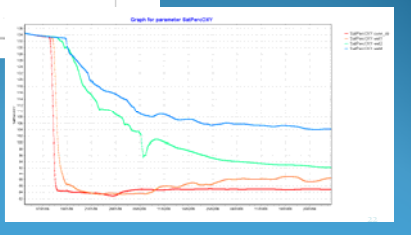
From the result, the nitrate concentrations are between 0.02 to 1.92mg/l which is in order of magnitude of the measured values (0.001 to 1.90mg/l) what means that the calibration of NO3 by denitrification process is realistic.

Research results

Simulation1:

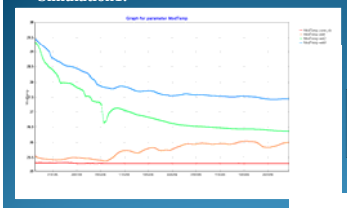


Measured values: between 1.24-5.49mg/l at 7 different stations (February, 2011).



Research results

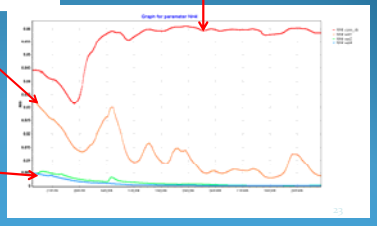
Simulation1:



The concentrations at the connection point, ranged from 0.032 to 0.062 mgNH4/l, being similar to the measured values in February 2011 at Stations 3a and 3b (0.052 and 0.062mgNH4/l).

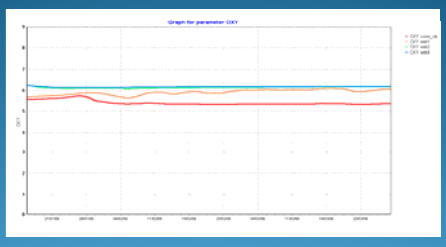
Wet 1 ranges from 0.003 to 0.033 mgNH4/l, which are lower than the measured one in station S7 (0.16 mgNH4/l).

For wet 2 and wet 4, the simulated concentrations were in the range of 0.002 to 0.007mgNH4/l, which are well below the measured ones in stations 7 and 2 (0.16 and 0.22 mgNH4/l).



Research results

Simulation2: Calibration of DO



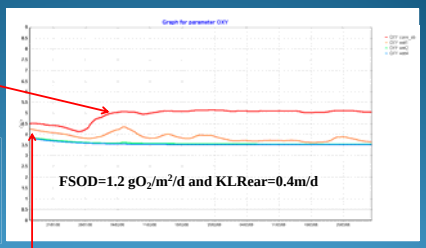
Reaeration coefficient was adjusted from 0 to 0.4m/d for calibration. In generally, normal Reaeration coefficient could be around 0.5m/d in our study area (Postma, pers comm).

Research results

Simulation3: Calibration of DO

around 5mgO_2/l

this is in the range of the average value (5.04mg/l) of the 3 measured points (3a, 3b and 3c).



FSOD=1.2 gO_2/m^2/d and KLRear=0.4m/d

around 3.5 and 4 mgO_2/l

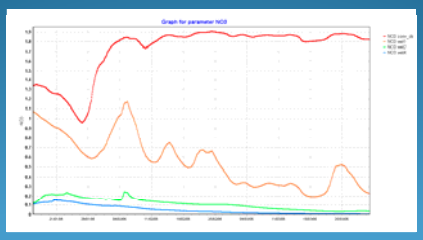
which is in the range of the average of the measured ones (3mgO_2/l).

25

Sensitivity analysis

•Sensitivity analysis for nitrate simulation

Sensitivity analysis for NO3 was done by adjusting first-order denitrification reaction rate (RcDenSed) from default value (0.1) to 0.15m/d.



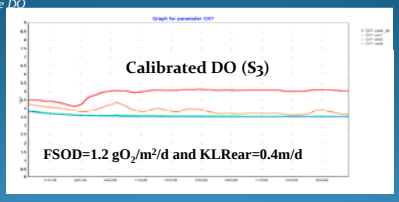
For instance, at wet2 average value of NO3 is decreased from 0.31 to 0.14 mg/l

26

Sensitivity analysis

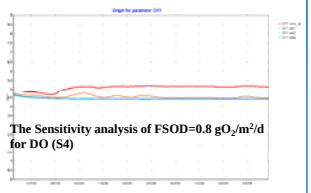
•Sensitivity analysis of the DO

The sensitivity analysis was performed (S4 to S7), by varying the sediment oxygen demand (FSOD) and the Reaeration coefficient (KLRear) for DO.

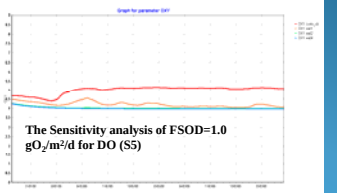


Calibrated DO (S_3)

FSOD=1.2 gO_2/m^2/d and KLRear=0.4m/d



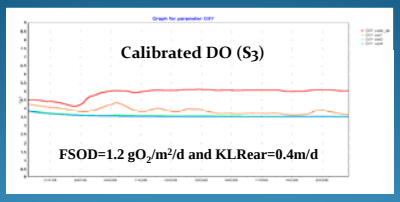
The Sensitivity analysis of FSOD=0.8 gO_2/m^2/d for DO (S4)



The Sensitivity analysis of FSOD=1.0 gO_2/m^2/d for DO (S5)

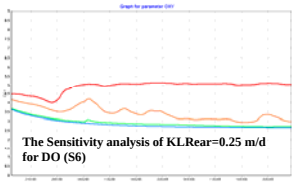
27

Research results

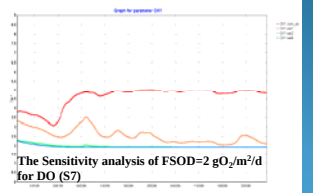


Calibrated DO (S_3)

FSOD=1.2 gO_2/m^2/d and KLRear=0.4m/d



The Sensitivity analysis of KLRear=0.25 m/d for DO (S6)



The Sensitivity analysis of FSOD=2 gO_2/m^2/d for DO (S7)

28

Research results

Discussion of the Water Quality results

Firstly,

- lack of water quality data
- the water quality stations in the study area

Secondly,

- the yearly non point pollution load

Thirdly,

- location of the sampling and analyzing methods
- some measurements are not accurate

Nevertheless, the rough calibration results are realistic. All simulated parameters are in order of magnitude of the measured values.

29

Conclusions

- The main objective of the study was to define the dominant nutrients removal processes in the wetland.
- The calibration done for NO3 by denitrification however it does not consider the effect of Water Hyacinth on the nitrate cycle in this study. The first -order denitrification rate was sensitive to nitrate.
- From the sensitivity results of the DO, sediment oxygen demand had very important effect to the model results.
- In generally, simulated results coincide with observed data.
- A difference between simulated and measured water levels was observed.

30

Recommendations

In order to improve water quality model first, it is necessary to collect more data about nutrients concentration in the Nuevo River. In other words increase the frequency of the measurements. A continuous measuring the water quality parameters in the river it will help to describe the nutrient loads to the wetland also it will be important for the nutrient regulating function that the wetland has for the river water quality.

Second, to collect more data in the wetland in order to able to validate the model result in wetland.

Third, it needs accurate estimation of fertilizers to the wetland.

Fourth, Sediment oxygen demand depends on organic matter in sediment therefore, in order to determine sediment oxygen demand by molecular diffusion in between water and sediment further must model decay of organic carbon in the sediment.

Fifth, the model to incorporate the Water Hyacinth processes.

Sixth, the lack of water quality data to calibrate and validate DELWAQ water quality model poses limitations on the evaluation and validations of the simulation. Therefore, there is a need to improve the water quality monitoring strategies.

Finally, another suggestion is that water institutes/organizations must unite and harmonize their monitoring work in such a way that the dates, frequency and locations, as well as the analyzing methods are in line. Ideally, a continuously monitoring should be performed.

31

32

Intentionally blank

Morpho-dynamic Effects of Dam Construction in the Tuul River of Mongolia

Sukhbaatar CHINZORIG
Institute of Geoecology, MAS
Baruun Selbe-15, P.O.B-81. Ulaanbaatar, Mongolia

A dam will be constructed on the Tuul River, which is one of the biggest rivers in the northeast of Mongolia. This dam, which has multiple purposes, was planned by the Water Agency of Mongolia and Ministry of Nature and Environment in 2008. After the dam is constructed, short and long-term morphological changes will take place in the river downstream and upstream of the dam. This thesis studied the effects of the planned dam on the Tuul River morphology and more in general on the river environment.

The study reach is the part of the river downstream of the planned dam and is 5.8 km long. In this area the river splits in two channels that join after 2 km. Due to dam construction, one of the two channels may become dominant, changing the characteristics of this river reach. The effects will be felt also by the floodplain environment.

The outputs of the study are future morphological short and medium-term changes. The output has been derived from a Delft 3D morphological model. Three scenarios (A, B and C) have been considered: without dam, with dam and sediment bypass, as well as with dam and no sediment bypass. The simulations cover periods of 1, 5 and 10 years.

The output of this thesis is a comparison of sedimentation and erosion trends, river pattern and water levels between scenarios A, B and C. Since the river is gravel-bed, the presence of the dam will increase bed armouring, which result in a reduction of erosion rates if sediment is bypassed. If all sediment is kept inside the reservoir (no by pass) the river downstream will be subject to erosion. Reduction of water flow in spring will result in lowered ground water levels in the period of vegetation growth. This might strongly affect the floodplain environment.

Keywords: River morphology, sedimentation, erosion, river pattern, armoury layer, floodplian

INSTITUTE OF GEOECOLOGY

MORPHODYNAMIC EFFECTS OF DAM CONSTRUCTION ON THE TUUL RIVER (MONGOLIA)

Sukhbaatar Chinzorig
Ulaanbaatar, Mongolia
02-09-2011

1

Table Contents

2

General information

❖ Introduction

3

General outline

❖ Objectives

➢ **Scenario –A. Investigate morphological changes without dam construction.**

➢ **Scenario-B. Investigate morphological changes with dam construction and with bypass of sediment.**

➢ **Scenario-C. Investigate morphological changes with dam and without bypass of sediment.**

➢ **Assess the short or medium-term effects of dam construction on the ground water table.**

➢ **Assess effects on floodplain ecosystem**

4

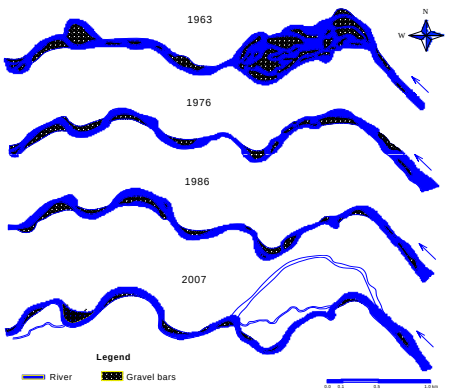
Field work and data collection

❖ Channel and floodplain cross-sections

5

Field work and data collection

❖ Study of historical maps

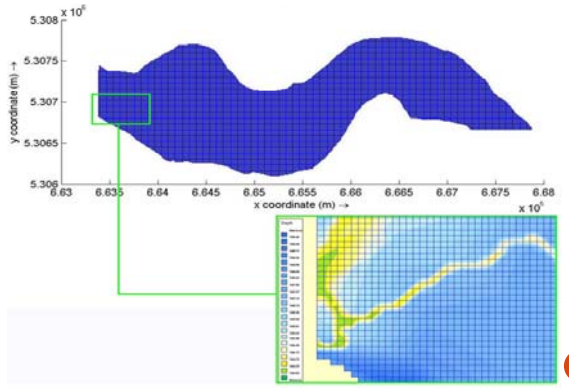


Possibility of cyclic behavior governed by flood events (to be checked the future)

6

Model construction

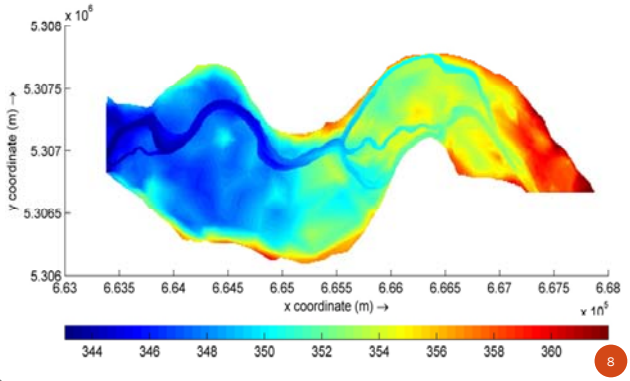
❖ Grid



7

Model construction

❖ Bed topography

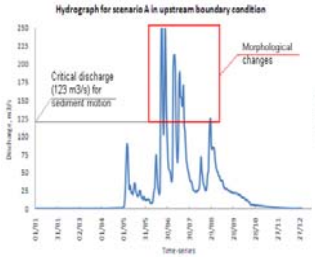


8

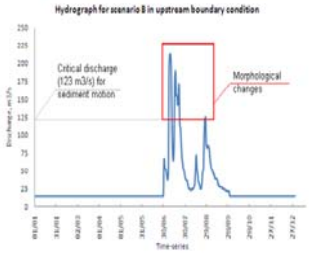
Model construction

❖Upstream hydrodynamic boundary condition

Scenario A (without dam)



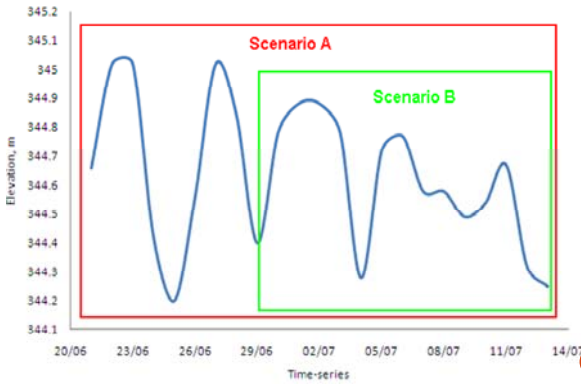
Scenario B (with dam)



9

Model construction

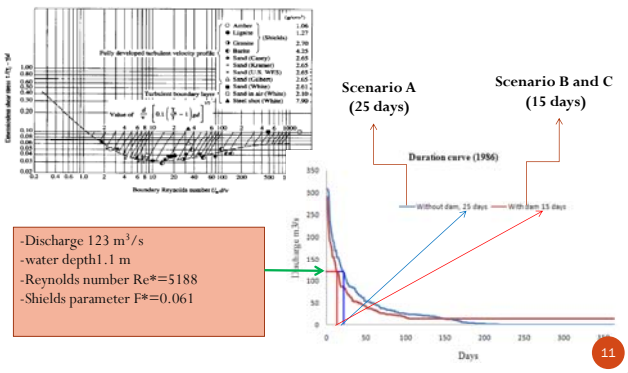
❖Downstream hydrodynamic boundary condition



10

Simulations

❖Definition of morphological year



-Discharge 123 m^3/s
-water depth1.1 m
-Reynolds number Re*=5188
-Shields parameter F*=0.061

11

Simulations

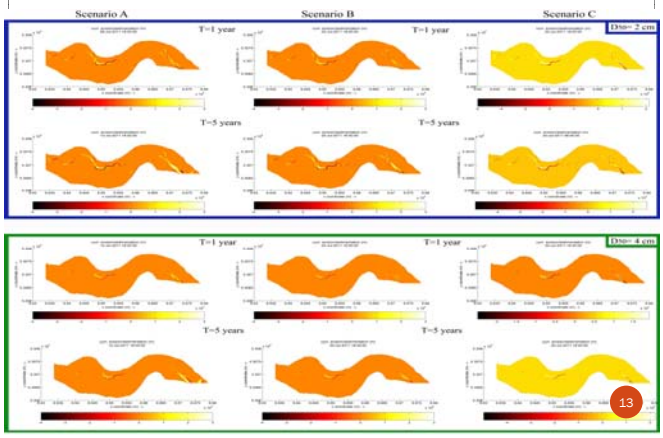
❖Simulation processes repeated for 3 sediment diameters

Name	Description	Duration	Results
Scenario A	Simulating without dam	1and 5	-Morphological changes (reach scale: erosion and deposition, cross-sectional scale: erosion and deposition) -Hydrodynamic changes (water levels)
Scenario B	Simulating with dam and with bypass sediment	1, 5 and 10 years	
Scenario C	Simulating with dam and without bypass sediment	1, 5 and 10 years	

12

Analysis of results

❖**River evolution**

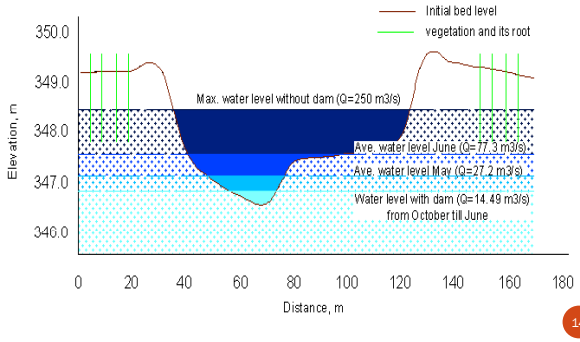


13

Analysis of results

❖ Comparisons between scenario A and scenario B on ground water tables

cross-section 2 (M: 167 N72,97)



14

Conclusion

❖After dam construction, two problems occur in the study area:

1. The ground water table is changed, which affects the floodplains ecosystem. Especially during vegetation growth.
2. The study reach belongs to a river that may be affected by cyclic incision and deposition governed by events. The cyclic behavior will be strongly affected by the dam, with long-term consequences.
3. Apart from cyclic behavior (to be checked) the dam does not affect significantly the river morphodynamics, because of bed armouring.

15

16

Study of quality and chemical composition of precipitation around the Ulaanbaatar city

Gerelt-Od.D, Javzan.Ch

gereltod_dmn@yahoo.com, Choijil_Javzan@yahoo.com

Institute of Geoecology, MAS. Baruun Selbe-15, P.O.B-81. Ulaanbaatar, Mongolia

We have been implemented research study on theme "The influence of air pollution to the quality and chemical composition of precipitation which run around Ulaanbaatar city" in 2009-2010.The main objective of this study was that the air pollution procedures are how to influences to the quality of the precipitation, and we selected 2 point for collecting samples as following:

- First point inside of Ulaanbaatar city near the building of Geoecology Institute,
- Second point outside of Ulaanbaatar city in Sanzai region

We have taken samples in selected points inside of Ulaanbaatar city as 23 samples from snow, 22 samples from rain and Sanzai as 26 samples from snow, 35 samples from rain. The result of chemical analysis of those samples was that the quality of precipitation by /pH=6.1-7.0/ it means the quality of precipitation changed from containing low acid to neutral in Sanzai region but near building of Institute of Geoecology the pH of presipitation was /pH=6.4-7.71/ it means the quality of precipitation changed from containing low acid up to alkalinity. The mineralization of rain water increased in city center as 1.75-2.3 times more, mineralization of snow water 1.9-4.86 times more than the precincts of a town in the whole condition. In addition the principle observed that the mineralization of rain water was relatively high in the beginning period of rain run in springs May in whatever place then decreased in summer season. The dissolved substance in one liter snow water (mineralization) is 18.59-102.45 mg/liter in central part of the city and 14-24.15 mg/liter in Sanzai region. The main ionic balance of snow water changed depending from air pollution then the balance of cation is $Na^{+}+K^{+}>Ca^{2+}>Mg^{2+}$, $HCO_3^{-}>SO_4^{2-}>Cl^{-}$ in Sanzai region and $Na^{+}+K^{+}>Ca^{2+}>Mg^{2+}$ in snow water of central part of the city, sulfate ion predominate from anion, property changed $SO_4^{2-}>HCO_3^{-}>Cl^{-}$. It is concerned established sulfuric gas originate from the fuel (petroleum) combustion. The amount of suspended matter and dusty substance of snow water in central part of the city was 3-4 times more than Sanzai, nitrogen compound (NH_4^{+}=0.2-1.3 mg/liter) moreover nitrate ion has (0.1-6.37 mg/liter) high content. It is concerned established particle mix with nitrate which to react (NOx) dusty substance where originate from fuel combustion. In addition the heavy metal content in snow water was relatively high in the central part of the Ulaanbaatar city. The conclusion of this research study was that the concentration of ammonium and heavy metal of precipitation's water is increasing in winter season in area of Ulaanbaatar city. It is confirmed the air pollution influences to the chemical content of precipitation water and its quality.

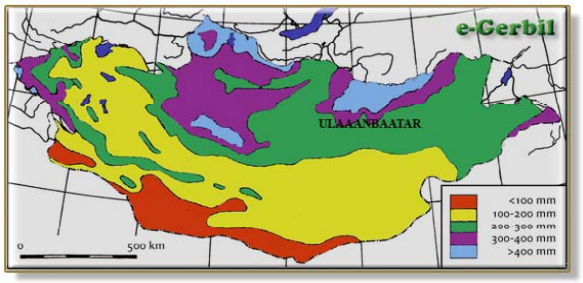
Quality and chemical composition of precipitation around the Ulaanbaatar city

Institute of Geoecology, Mongolian Academy of Sciences,
Division of Water resources and Water utilization

The 2nd International Symposium
International Multidisciplinary Conference on Environment
September 1-2, 2011

Introduction

Mongolia is high, cold, and dry. It has an extreme continental climate with long, cold winters and short summers, during which most precipitation falls. The country averages 257 cloudless days a year, and it is usually at the center of a region of high atmospheric pressure. Precipitation is highest in the north, which averages 20 to 35 centimeters per year, and lowest in the south, which receives 10 to 20 centimeters.



In this investigation have been proceeding:
The quality of the precipitation which is around the Ulaanbaatar and its influence of air pollution last two years (2009-2010).
We selected 2 points for collecting samples as following:
Center of the Ulaanbaatar city Institute of GeoEcology, MAS
25 km close Ulaanbaatar Sanzai

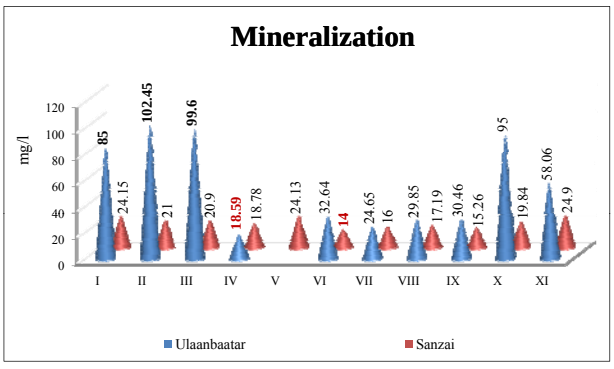
Center of the Ulaanbaatar

Sanzai

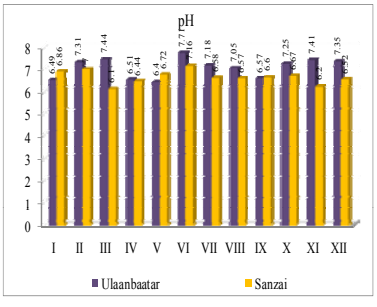
Methods

- **Chemical methods**
- **Spectrophotometer TU-60**
- **DR 2800 Spectrophotometer**

Mineralization



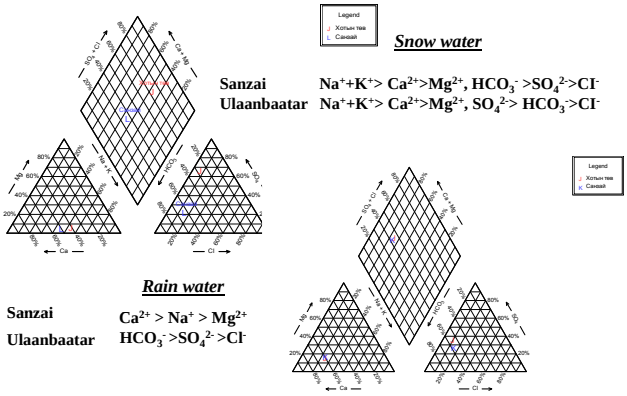
Mineralization of precipitation were started to increase after rain season and reached to maximum value during the winter time, and decreased backward from March.



Sampler

pH value of the rain water in Ulaanbaatar city was little bit higher (6.4-7.71) than near the Sanzai (pH=6.1-7.0)

Piper diagram



Snow water

Sanzai $Na^+ + K^+ > Ca^{2+} > Mg^{2+}$, $HCO_3^- > SO_4^{2-} > Cl^-$

Ulaanbaatar $Na^+ + K^+ > Ca^{2+} > Mg^{2+}$, $SO_4^{2-} > HCO_3^- > Cl^-$

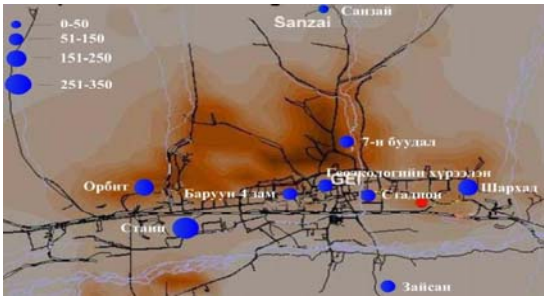
Rain water

Sanzai $Ca^{2+} > Na^+ > Mg^{2+}$

Ulaanbaatar $HCO_3^- > SO_4^{2-} > Cl^-$

7

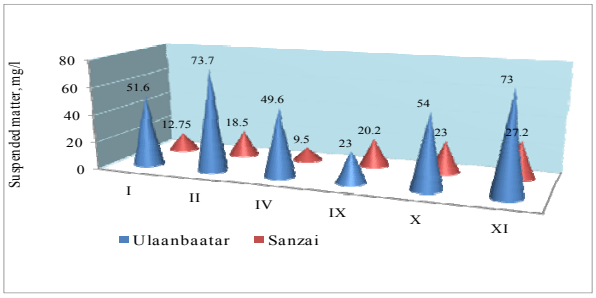
EC



The results of chemical analysis of the snow water samples have different EC, such as Thermal Power Station (279 μs/cm), Orbit (165.2 μs/cm) and Shar khad (210.4 μs/cm)

8

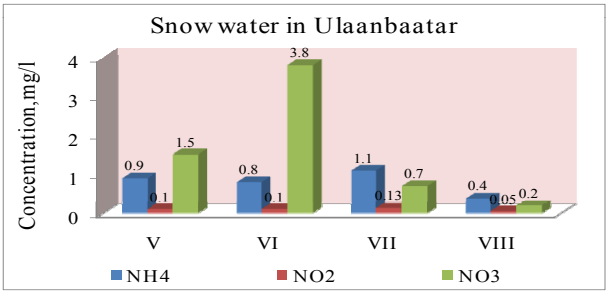
Suspended matter



The amount of suspended matter and dusty substance of snow water in central part of the city were 3-4 times more than Sanzai region

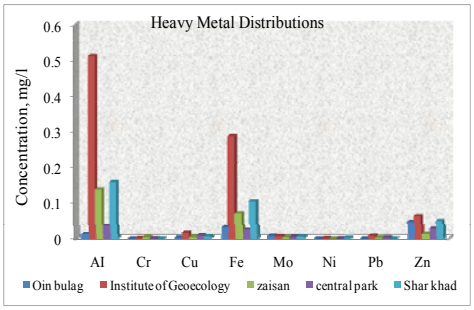
9

Nitrogen ionic contents



The amount of nitrogen compound moreover nitrate ion has high content.

10



The concentrations of some heavy metals in snow were determined by low amount such as Fe 0.2835 mg/l, AI 0.5112 mg/l and Zn 0.06 mg/l.
In addition the heavy metals content in snow water were relatively high in the central part of the city center.
It is confirmed the air pollution influences to the chemical content of precipitation water and its quality.

11

Conclusions

- The rain water mineralization in the central part city as more than 1.75-2.3 times in the outsides of Ulaanbaatar , snow water mineralization was 1.9-4.86 times more than outside city.
- Highest amount mineralization (58.06-102.45mg/l) in snow water was in the winter months especially from November to February.
- The chemical composition of snow and rain water has been changed. Sulfate ionic amount was increased . Possibly its winter time in the air increased sulfur trioxide.
- The amount of suspended matter and dusty substance of snow water in central part of the city were 3-4 times more than Sanzai region.

12

Intentionally blank

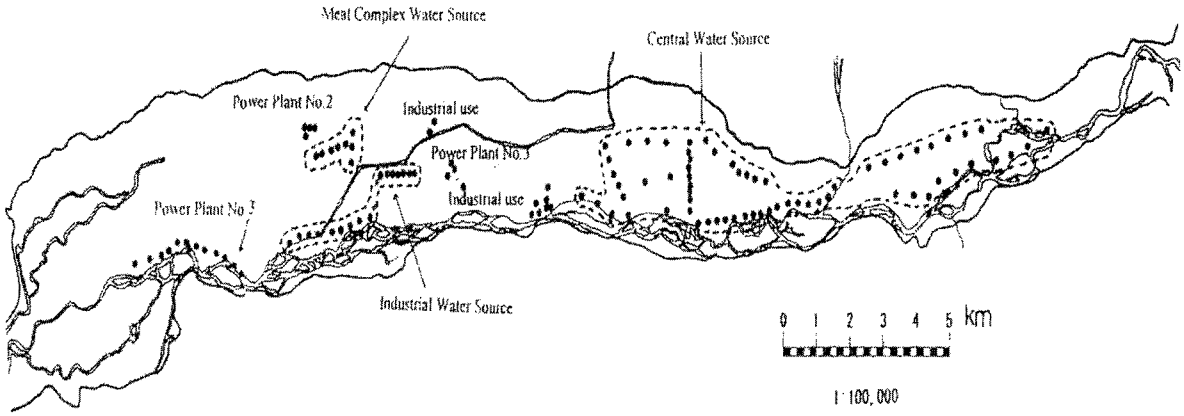
Key word: air pollution, snow water, rain water, precipitation, influence of air pollution

The managed aquifers recharge groundwater resources for water supply ULAANBAATAR city.

Narantsogtyn NASANBAYAR*
*Hydraulics and Hydro construction professor team ,
School of Civil Engineering and Architecture, MUST
nnasan_4@yahoo.com.

The Ulaanbaatar is a capital city of Mongolia and it's the primary hub for commerce and industry and generates nearly 70 percent of national production. More than million people, 20,000 industries and businesses, 400 hectares of irrigated farms, 330,000 livestock, and 3 power plants in Ulaanbaatar depend on water supplied from the Tuul river.

Ulaanbaatar's current and future water supply options depend wholly on the Tuul river. To date the city has been supplied deep wells that draw on groundwater sources from an unconfined aquifer that runs along the bed of the river or on exploiting additional alluvial- proluvial deposits from the Tuul's tributaries. Ulaanbaatar's water supplies are extracted from deep wells, located in 4 sites: the "upper source" just below the confluence of the Terelj and Tuul Rivers in the upper basin, and 3 sources in the city



itself "central", "industrial", and "meat factory" . Ground water is the only source of drinking water supply capital city of Mongolia.

Nowadays are searching and monitoring ground water resources in 4 points.

Every year in February, March and April ground water table drink water sources decrease to minimum 14-15m from surface, in June, July and August reach to highest level 2-3m deep from earth surface. The data's from Ulaanbaatar water supply groundwater monitoring stations shows that ground water table decrease every year. The data shows ground water table level decrease 2.7m from the year 2001 to 2008 .

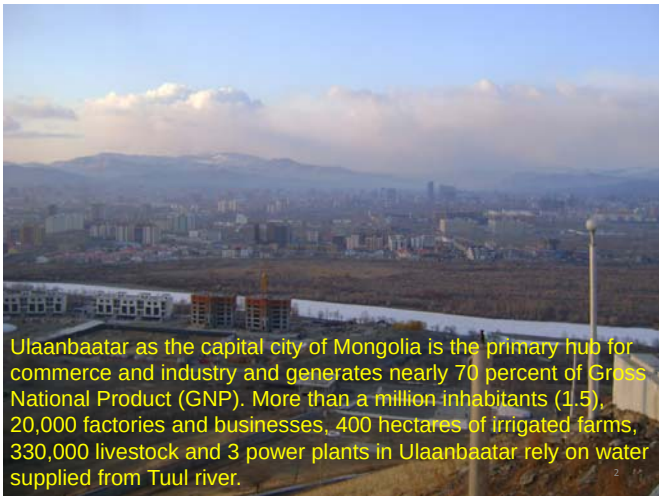
Ground water abstraction is expected to increase in the future because of expected population growth, and industrial development in the city. Due to possible increase in temperature caused by climatic change, evaporation is also expected to increase. All these effects may lead to a lower ground water recharge and a reduction of sustainable ground water resources availability.

Keywords: managed Aquifer recharge, injection well, drainage basin, ground water flux control.

The potential for managed aquifer recharge to increase the groundwater resources for water supply ULAANBAATAR city.

Lecturer of MUST
Environmental Engineering Department
Hydraulics and Hydro construction professor team

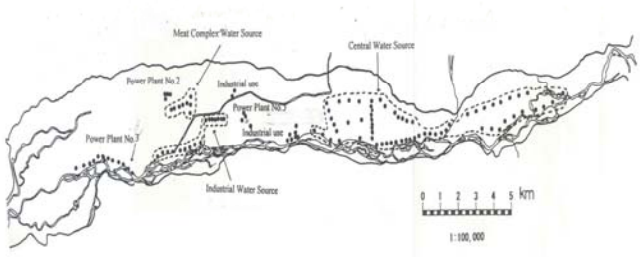
1



Ulaanbaatar as the capital city of Mongolia is the primary hub for commerce and industry and generates nearly 70 percent of Gross National Product (GNP). More than a million inhabitants (1.5), 20,000 factories and businesses, 400 hectares of irrigated farms, 330,000 livestock and 3 power plants in Ulaanbaatar rely on water supplied from Tuul river.

2

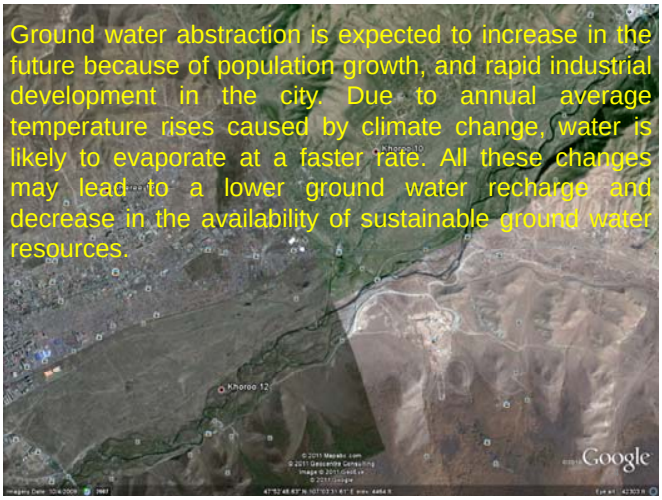
Ulaanbaatar's water supplies are extracted from deep wells, located in 4 sites: the "upper source"- just below the confluence of the Terelj and Tuul Rivers in the upper basin, and 3 other sources - "central", "industrial", and "meat factory"- in the city itself. Ground water is the only supply of drinking water for the inhabitants of Ulaanbaatar.



UB, Location of wells

3

Ground water abstraction is expected to increase in the future because of population growth, and rapid industrial development in the city. Due to annual average temperature rises caused by climate change, water is likely to evaporate at a faster rate. All these changes may lead to a lower ground water recharge and decrease in the availability of sustainable ground water resources.



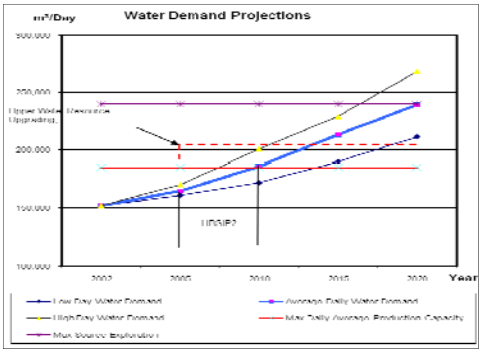
4

Groundwater tables in Ulaanbaatar /JICA 2006/ have been showing a marked decline over the last 50 years. Water is being abstracted faster than the rate of recharge. As the city grows and water demand increases, this problem is intensifying. According to government figures, water use is estimated at 212,000 cubic meters per day and is predicted to reach 286,000 cubic meters in 2010, 438,000 cubic meters in 2020, and 708,000 cubic meters by 2050.

	2002	2005	2010	2015	2020
Low Day Water Demand	152,000	161,000	172,000	190,100	211,500
Average Daily Water Demand	152,000	164,600	186,100	213,200	239,500
High Day Water Demand	152,000	170,300	201,000	229,100	268,500
Max Daily Average Production Capacity	185,000	185,000	185,000	185,000	185,000
Max Source Exploration	240,000	240,000	240,000	240,000	240,000

5

Water supply every days is increasing with the development of city, industries and growth population but ground water source is decreasing by the climate change and last decade year flow of TUUL river during the every spring in May come off or doesn't flow. Therefore, we need decide this problem by building complex of hydro constructions, flow control and build some artificial groundwater recharge systems like drainage near drink water extraction wells.



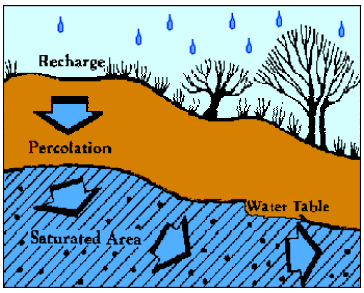
JICA 2006

6

Possibilities increasing water supply.
In response, measures are being set in place to:
-manage water demand,
-improve water use efficiency,
-deal with problems of leakage in the system.
On the supply side the options that are being considered include plans to
-new groundwater supplies,
-develop surface water storage reservoirs,
- increase waste water treatment and re-use,
-water transport system from outside another ground water aquifer like Kherlen 150km, Zuukharaa 140km, Darkhan 230km .

7

Groundwater recharge or deep drainage or deep percolation is a hydrologic process where water moves downward from surface water to groundwater.



Recharge occurs both naturally (through the water cycle) and anthropologically (i.e., "artificial groundwater recharge"), where rainwater and or reclaimed water is routed to the subsurface.

8

The managed Aquifer recharge.

How to make artificial recharge ground water resource for aquifers water sources in Mongolian weather conditions for Ulaanbaatar city. First ideas for Artificial recharging is constructing and operating percolation reservoir or storage with derivation channels from river near drink water exploitation wells which are located in valley river Tuul and collecting data about water table and balance for use and recharge. Also making ground water flow and aquifers control for regulation of sources which useful in dry season like in spring.

9

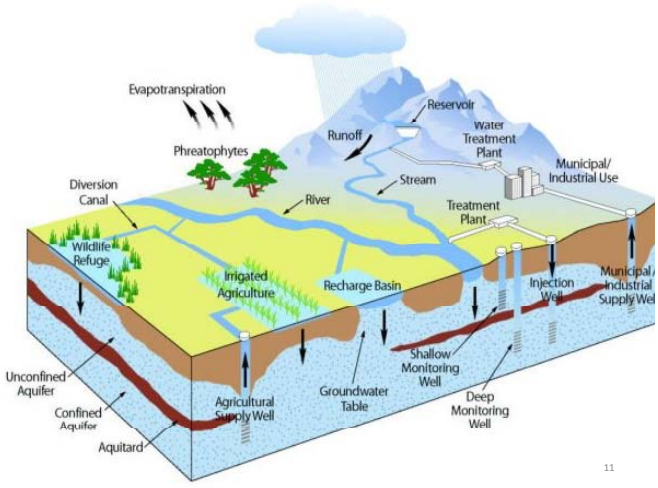
In Mongolia “Management of Aquifer recharge” is known about but we are lacking in experience and practice in this line of work.

Research methods of artificial ground water recharge, structures and the suitable method for the harsh Mongolian continental weather conditions e.g..

•Method for injection wells’ and its structure
•Derivation channel method
•Infiltration basin and its structure

I am doing this research to find the most suitable and efficient method for the management of aquifer recharge for the ground water resources of the city of Ulaanbaatar in order to purify the surface water and to improve the water management.

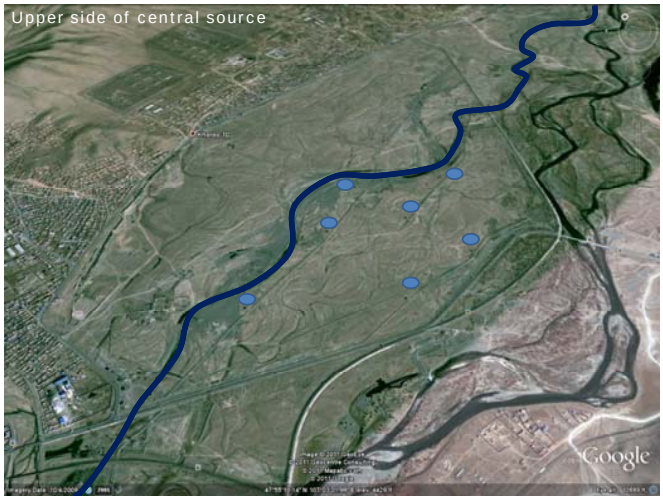
10



11

Objectives:
•Search for unconfined aquifer deposits and the sediments of groundwater sources that runs along the bed of the river Tuul near UB city.
•Research underground run-off and filtration coefficient near drinking water wells.
•Research percolation of drainage basin near drinking water wells.
•Research filtration of injection well near drinking water well.
•Research aquifer infiltration from precipitation and during wet seasons. Use some run-off by derivate of the river Tuul by building artificial recharge basin.
•Research aquifer recharge management possibilities, also increase or decrease of ground water resources by artificial recharging during the winter cold season
•Research aquifer storage possibilities of surface water by infiltration in flooding. season in order to use in low flow period like winter.
•Research methods of monitoring of underground water flux control in Mongolian weather condition.
•Research the balance between consumption and recharge in order to develop strategies to solve water shortages using managed aquifer recharge.

12



Preliminary structure:

•Modelling and testing the methods of artificial managed aquifer recharge in Mongolian conditions.

•Determine the most suitable and efficient method of Injection wells or Infiltration basins in Mongolian extreme weather conditions.

•Determine method of increasing ground water resources in the winter months.

•Research underground water flux control and regulation.

•Provide information for future improvement in solving the water supply related issues in Ulaanbaatar.

The knowledge gap its research methods of artificial ground water recharge, structures and which method suitable in Mongolian harsh weather condition. These are

•Injection wells method his structure

•Derivation channel method

•Filtration basin his filtration bottom structure

16

Contamination level of drinking water source, in Mongolia

Ch.Solongo
Public health institute

Background

- Access to water and sanitation is one of the major challenges for the 21st century
- 5 million, majority of who are children, die from water-related diseases
- Drinking water quality – chemical and bacteriological
- Infectious and non infectious digestive diseases increasing in Mongolia
- Some outbreaks related to drinking water contamination

Drinking water standard MNS900:2005

Content

- Assessment on hygienic level of chemical contamination (N=274)
- Assessment on hygienic level of Bacteriological contamination (N= 7055)
- Risk factors of drinking water source

(Review result by inspection agency and laboratory analysis)

Chemical result: Mineralization level by province and regions

Region	Province	No. of samples	Mean of minerilization, mg/l
Center	11	158	199. 6
Western	5	36	172. 2
Eastern	2	25	394. 9
Gobi	4	55	437. 6
National average	**22**	**274**	**301. 6**

***Norm – 200-500 mg/ l**

Hardness level of by province and regions

Region	Province	No. of samples	Mean of hardness, mg/l
Center	11	158	3.2
Western	5	36	2.9
Eastern	2	25	4.4
Gobi	4	55	3.6
National average	**22**	**274**	**3.7**

60% of drinking water source didn't meet standard

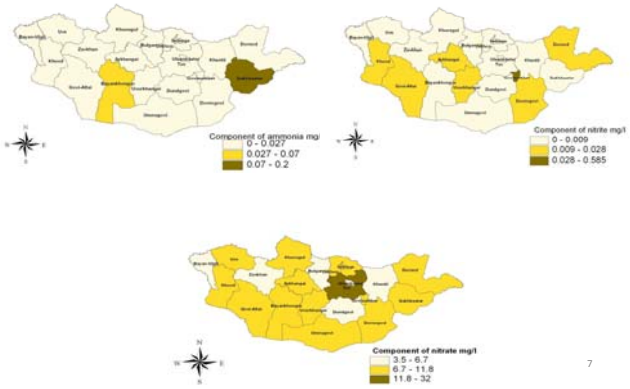
***Norm – 0-3 mg/ l**

Component of magnesium, by province

Region	Province	No. of samples	Mean of magnesium , mg/l
Center	11	158	13.0
Western	5	36	12.6
Eastern	2	25	16.3
Gobi	4	55	16.0
National average	**22**	**274**	**17.6**

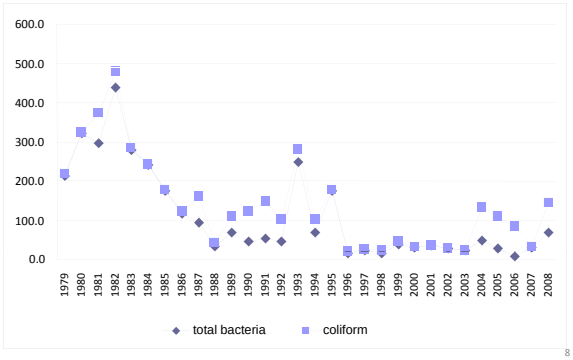
***Norm – 11-30 mg/ l**

Distribution of the nitrogen components

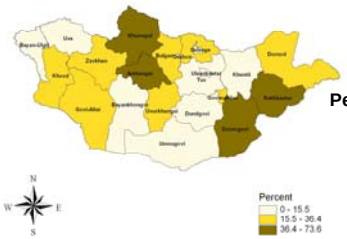


7

Total bacteria and coliform counts, 1979-2008



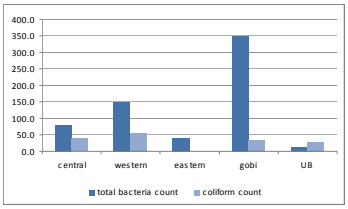
8



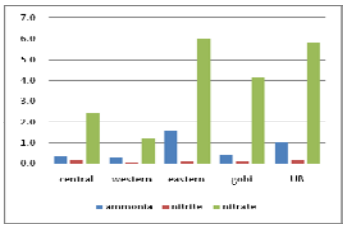
Percentage of centralized drinking water didn't meet standard of bacteriological

Percentage of non centralized drinking water didn't meet standard of bacteriological

9



Total bacteria and coliform counts , by region (1970-2008)



Ammonia, nitrite and nitrate (mg/l), by region (1970-2008)

•Source - Climate Change and Health In Mongolia, 2009

10

Incidence of hepatitis A, 1999-2008

Incidence of dysenteria, 1999-2008

Incidence of typhoid, 1999-2008

Incidence of hand foot mouth, 2008

Incidence of total infectious digestive diseases, 1999-2008

11

Comparison between type of drinking water by bacteriological contamination

Bacteria	Type of drinking water source	No. of samples which detected bacteria	%	RR, CI95%
Thermophilius bacteria	Centralized	20	1.1	Ref
	Non centralized	132	2.5	2.2 (1.4-3.6)
Pathogenic bacteria	Centralized	0	0	Ref
	Non centralized	79	1.5	27.2 (3.7-194)
	total	**231**	**5.1**	

*Denominator
Centralized N=1783
Non centralized N=5272

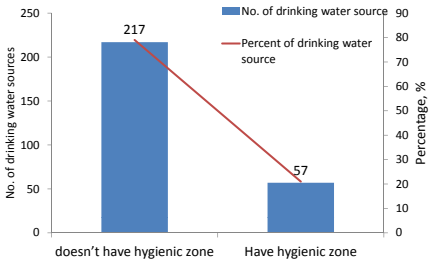
12

Resuls of rapid bacteriological test of drinking water (N=492)

Lab performances	Results, %						
	UB	Khovd	Dornod	Dundgo-vi	Arkhan-gai	SB	Total
Samples taken from water sources							
Coliform bacteria (-)	57.1	73.5	75	55.6	-	100	76.1
Coliform bacteria (+)	42.8	26.5	25	44.4	100	-	23.9
Drinking water in water carriage container							
Coliform bacteria (-)	7.5	61.8	-	-	50	4	25.6
Coliform bacteria (+)	92.5	38.2	100	100	50	96	74.4
Drinking water in water storage container							
Coliform bacteria (-)	1.9	58.8	37.1	-	19.2	15.4	16.3
Coliform bacteria (+)	98.1	41.2	62.9	100	80.8	84.6	83.7

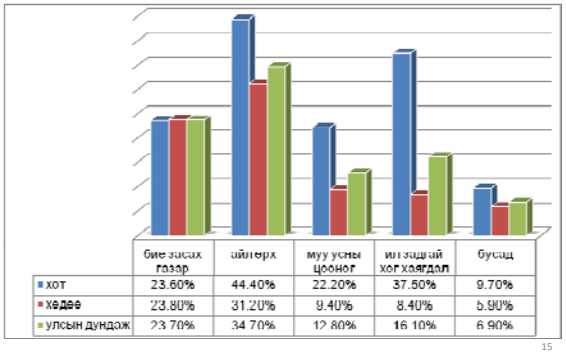
13

Around 80% of drinking water sources without any protected zone



14

Majority of pollutant was pit latrine in drinking water source



15

Sanitary risk factor of WDP

Characteristic		Urban	Rural	Average (%)
Is there any damage		-	4. 3	1. 9
Is there have any capful/burry		22. 9	92. 9	61
Is there properly empty out		100	83. 3	91
Is there have seal		55. 6	42. 5	42. 5
Surrounding by cement		100	51. 9	79. 4
Washing frequency of water tank	Once a week	8. 1	12. 5	10. 4
	Once a season	89. 2	67. 5	77. 9
	Twice a year	2. 7	15	9. 1
	Once a year	-	5	2. 6

16

Sanitary risk factor of Borehole/well

Characteristic		Urban	Rural
Is there have protected by construction	93. 3	90. 5	91. 2
Surrounded by cement（1m）	88. 2	53. 7	62
Is there any damage in borehole	17. 6	16	16. 4
Is there stagnant water close to the borehole	11. 8	16. 7	15. 5
Is there any breakage in surrounding soil	29. 4	11. 6	16. 7
Handling ladle for pouring water	100	72. 7	73. 9

17

Conclusion

- Some province's drinking water quality lower and higher than optimal level due to its risk of water related diseases
- More than 60% of provinces need to softening in drinking water source
- 24.5% of the samples didn't meet standard of bacteriological
- The spatial distribution of bacteriological and infectious water related diseases (Gobi and eastern)
- Non centralized drinking water source 2 times higher than centralized
- Also, Evidence suggested, mostly polluted water point was household level
- Insufficient to protect drinking water sources. Most pollutant source was human and animal faecal.

18


Strategic Funds for the Promotion of
Science and Technology


Geoeco


Environmental Diplomatic Leader