Master's Program in Environmental Sciences
Doctoral Program in Sustainable Environmental Sciences
University of Tsukuba, Japan

Completion Report of

International Internship in Mongolia

October 25 – November 1, 2010

Foreword

Global environmental problems are caused not only by natural phenomena, but also by human activities. Population growth, poverty and poor infrastructures often exacerbate environmental problems. To solve these problems, one needs to be able to both recognize and understand culture, and its environmental, economic, political, and social backgrounds.

Based on this understanding, the Environmental Diplomatic Leader education program (the EDL education program) offers students opportunities for internship. For students who are interested in environmental problems, having the opportunity to visit areas of concern and get fast-hand experience on the ground is the best way to learn what the environmental problem is.

Mongolia, a typical example of semi-arid country, is a showcase of environmental problems for the participatory students. It is because almost all of the participatory students are from wet and hot regions and they have seldom visited dry and cold regions such as Mongolia. In this tour, three topics were chosen as the main targets of the field research; public health, water issues and natural resources management. Moreover, an international symposium was held during internship to offer students opportunities to enhance their presentation skills and improve current research through discussion with Mongolian scientists of the host institute.

This report is a summary of field research conducted in international internship in Mongolia. It consists of four parts; the first section is concerned about overview of natural resource in Mongolia. Then, natural resources management in rural area will be discussed with special reference to forest and grassland. The third section explains current status of public health in Mongolia in statistical way and shows the relationship health issues and environmental degradation. The fourth section deals with wastewater treatment system in Ulaanbaatar city and the problem to be solved. The last section is appendix to keep general information of this tour.

Lastly, we would like to express our gratitude to Institute of Geo-Ecology, Mongolian Academy of Science. Without their general assistance, this tour could not be conducted. Also we really appreciate Institute of Meteorology and Hydrology, Scientific Secretary of Institute of Public Health and Mongolian National Commission of UNESCO. Their active participation made the symposium during this field tour very stimulating to the EDL students. Lastly, warm welcomes of mayor and farmers of Bayachandmani soum were unforgettable. This internship program came true based on their general cooperation and support.

March 17, 2011

The Environmental Diplomatic Leader education program

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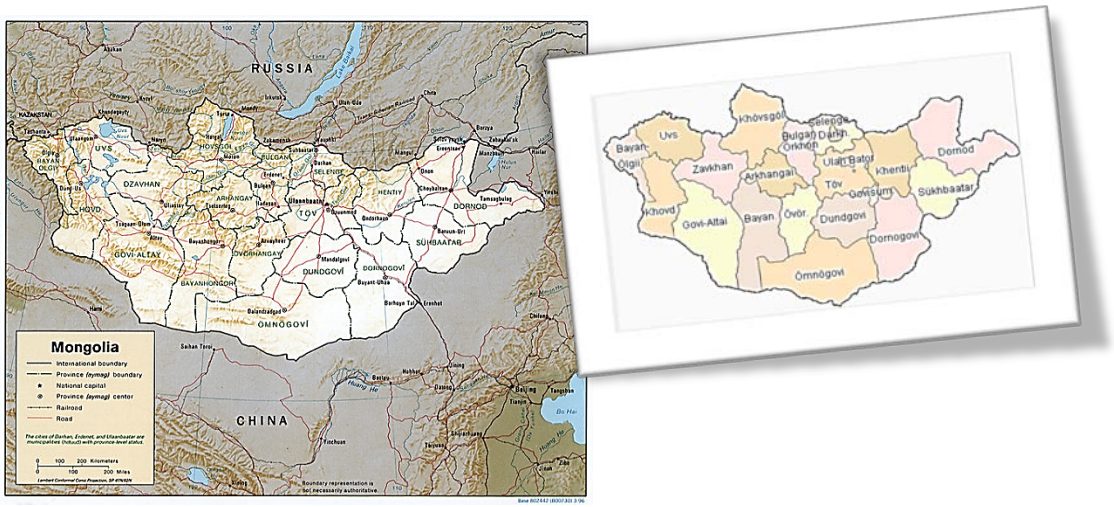
1. General Information of Mongolia

1-1 General information

Mongolia is a landlocked country in East and Central Asia, which bordered by Russia to the north and the People's Republic of China to the south, east and west, between latitudes 41°-52°N and longitudes 87°-120°E; and it has an area of 1,564,115.75 km2 (Figure 1). The country is administratively divided into 21 provinces (*aimags*), namely: Arkhangai, Bayan-Ölgii, Bayankhongor, Bulgan, Darkhan-Uul, Dornod, Dornogovi, Dundgovi, Govi-Altai, Govisümber, Khentii, Khovd, Khövsgöl, Ömnögovi, Orkhon, Övörkhangai, Selenge, Sükhbaatar, Töv, Uvs, and Zavkhan, which are in turn divided into 329 soums (districts). Meanwhile, the capital Ulaanbaatar separately administrated as a *khot* (municipality) with the provincial status.



The 21 *aimags* in Mongolia.

(Source: United States. Central Intelligence Agency.

Create/Published [Washington, D.C: Central Intelligence Agency, 1996]

Figure 1-1. The Mongolia

2 Environment

2-1 Landscape

Mongolian's terrain is a mountainous and rolling plateau, with a high degree of relief. Overall, the landscapes are high mountains in the west-north and plains or depressions in the east-south. The Khüiten Peak in extreme western Mongolia is the highest point (4,374 meters) and the lowest is 518 meters in the eastern Mongolian plain. The country has an average elevation of 1,580 meters. The landscape includes one of Asia's largest freshwater lakes (Lake Khövsgöl), many salt lakes, marshes, sand dunes, rolling grasslands, alpine forests, and permanent montane glaciers. Northern and western Mongolia is seismically active zones, with frequent earthquakes and many hot springs and extinct volcanoes.

Mongolia has three major mountain ranges. The highest is the Altai Mountains, which exist across the western and the southwestern regions of the country. The Khangai Mountains, is the mountainous range in the northwest to southeast and existing in the central and north-central of Mongolia. Both of mountain ranges are older and more eroded mountains, with many forests and alpine pastures. Lastly, the Khentii Mountains, near the Russian border to the northeast of Ulaanbaatar.

Most area of eastern Mongolia is occupied by a plain, and the lowest area is a southwest-to-northeast trending depression that reaches from the Gobi Desert region in the south to the eastern frontier (Figure 2). The rivers drain in three directions: north to the Arctic Ocean, east to the Pacific, and into the depressions of Inner Asia. Rivers are most extensively developed in the north, and the country's major river system is that of the Selenge, which drains into Lake Baikal. Some minor tributaries of Siberia's Yenisei River also rise in the mountains of northwestern Mongolia. Rivers in northeastern Mongolia drain into the Pacific through the Argun and Amur (Heilong Jiang) rivers, while the few streams of southern and western Mongolia do not reach the sea but run into lakes or deserts.

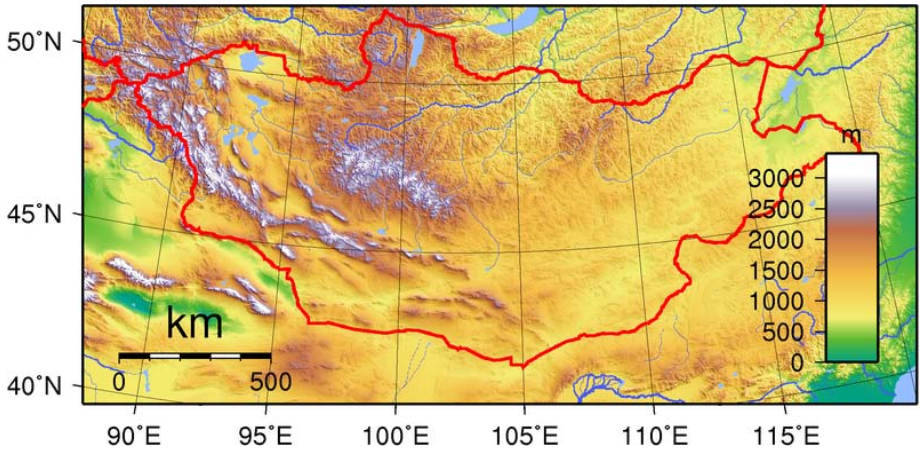


Figure 1-2. Mongolian’s landscape. The southern part of Mongolia is the Gobi Desert, while the northern and western are mountainous

(Topographic map of Mongolia. Created with GMT from publicly released SRTM data)

2-2 Climate

Mongolia is a land of temperature extremes. The Gobi desert in southern Mongolia can reach 40°C in the summer and fall to -40°C in winter. Hovsgol Province in northern Mongolia experiences temperatures that can fall to -50°C. The average annual temperature in Mongolia's capital, Ulaanbaatar, ranges from -16°C in February to a more comfortable 16°C in July. During the short spring transition in Ulaanbaatar, the average temperature increase from 8°C (48°F) in May to 14°C in June (Figure 3). Average temperatures over most of the country are below freezing from

November through March and are about freezing in April and October. January and February averages of −20°C are common, with winter nights of −40 C occurring most years.

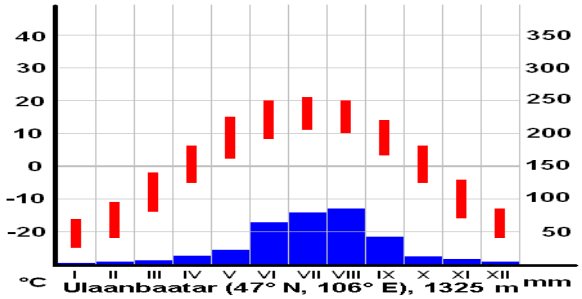


Figure 1-3. Average temperature over Ulaanbaatar

Most of Mongolia is covered by discontinuous permafrost (grading to continuous at high altitudes), which makes construction, road building, and mining difficult. All rivers and freshwater lakes freeze over in the winter. Ulaanbaatar lies at 1,351 meters above sea level in the valley of the Tuul River. Located in the relatively well-watered north, it receives an annual average of 310 millimeters (12.2 in) of precipitation, almost all of which falls in July and in August.

Ulaanbaatar has the lowest average temperature of any national capital in the world. Mongolia is high, cold, and windy. It has an extreme continental climate with long, cold winters and short summers, during which most of its annual 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 (average of 200 to 350 millimeters (7.9 to 13.8 in) per year) and lowest in the south, which receives 100 to 200 millimeters (3.9 to 7.9 in) annually. The extreme south is the Gobi, some regions of which receive no precipitation at all in most years.

2-3 Land use

The land use condition in Mongolia in 30 years was provided by the State Land Use Cadaster Inventory and National Land Information Database. Land use change trend is dividing into two periods from 1975-1990 and 1990-2005, which had been presented by quite different social and economic constraints and stimulations to diverse type of land usage (Table 1).

Table 1. Land use change in the period 1975- 2005 (Areas in thousand hectares)

Year / Land use types	1975	1990	2005	Change in period 1975-1990	Change in period 1975-2005
Pasture	120990.4	119304.6	111229.7	-1,685.8	-9760.7
Arable land	748.5	1281.6	697	+533.1	-51.5
Fallow, abandoned agricultural land	196.9	84.4	478.4	-112.5	+281.5
Town and Settlements	464.6	501.0	466	+36.4	+1.4
Mining area	46.8	58.9	97	+12.1	+50.2
Road	61.1	203.8	278.2	+142.7	+217.1
Natural Parks	132.5	5282.7	20864.8	+5,150.2	+20732.3
Utility	-	4.5	50.1	+4.5	+50.1
Military	2543.3	2593.2	218.1	+49.9	-2325.2
Forest land	15171.5	14403.1	14748.1	-768.4	-423.4
Water bodies	1619.2	1630.5	667.8	11.3	-951.4
Total	156411.8	156411.8	156411.8		

(Source: Department of Land Management & Geo-ecology, National University of Mongolia)

General land use changes in two periods are: agricultural sector development and destruction, rapid urbanization (rural areas population's migration to urban areas) and transformation of nomadic livestock husbandry to semi-sediment husbandry which is go behind overgrazing and desertification, global warming and human impact which have been presented by reduction of forest and surface water areas.

3 Economy (Industrial sector)

Industry currently accounts for 21.4% of GDP, approximately equal to the weight of the agriculture sector (20.4%). These industries include construction materials, mining (coal, copper, molybdenum, fluorspar, tin, tungsten, and gold), oil, food and beverages, processing of animal products, and cashmere and natural fiber manufacturing. The industrial production growth rate is estimated to be 4.1% in 2002. Mining is continuing to rise as a major industry of Mongolia as evidenced by number of Chinese, Russian and Canadian firms opening and starting mining business in Mongolia. Domestic food production, especially packaged food production has been increasingly coming up with speed with investments from foreign companies.

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(Yudi Setiawan)

2. Natural resource management in rural area in term of grassland and forest

Mongolia, the seventeenth largest country in the world, is a mountainous country situated in the heart of Central Asia and shares borders with Russia and China. Mongolia comprises 1564.1 thousand km2 of land and average altitude at 1580 m above sea level (UNDP Mongolia, 2011). In term of administrative management, Mongolia is divided into 22 main units, namely 21 aimags (provinces) and the capital city Ulaanbaatar. Aimags are divided into soums that are further divided into bags. Based on geographical features, Mongolia can be classified as table below (figure 2.1).

Zones	Area (M km^2)	Percentage
Montane	0.344	22
Boreal Forest	0.063	4
Forest Steppe	0.125	8
Steppe	0.406	26
Desert Steppe	0.329	21
Desert	0.297	19
Total	1.564	100

(Source: ADB, Country Environmental Analysis – Mongolia, 2005)

Figure 2-1: the classification of natural zones of Mongolia

Land degradation is a serious environmental problem in Mongolia that threatens to the life of rural people and destroys the country's productive capacity. It is also the cause of desertification, water shortages and natural disasters. In Mongolia, the overgrazing of livestock and dwindling of forests has become a serious problem.

2-1 Grassland

Grasslands take the main parts of nature resources of Mongolia and cover about 1.26 million km2. Grasses and legumes are well adapted to grazing. Grasslands have existed

Photo 2-1: grassland in Mongolia

and supported feed for grazing animals for thousands of years. Natural pastures with high-yielding are harvested as hay for supplemental feed in winter time. In recent times, due to economic development and social conditions, grasslands in Mongolia are being threatened by overgrazing of large herd size, and the development of mining activities are leading to soil erosion and land degradation.

Basically, pastureland belongs to state ownership and to be used as a “common use resource”, and livestock services are provided by the government. The 1994 Law on Land and some regulations established a legal basis for land use rights as ownership, possession in small land parcels. Aimag and Soum officials have primary responsibility for implementing the land law such as interpretation and application of the land law in allocating pastoral resources. Especially, winter camp sites and winter pastures to users have been selected at random and unregulated in terms of group size, length of possession. From 2009, a new draft law on pastureland has been issued and discussed throughout among representatives of organizations, agencies, and herders from many soums and aimags to get opinions and proposals on contents and principles. This legal documents will serves all factors relating to herder’s daily life and create legal environment for developing farms with possessed land and pasture.

2-2 Forest

Different to grassland, forestland in Mongolia take small part in natural resources, but it play an important role in preventing soil erosion, in regulating the water regime in the mountain areas, and in providing habitats for wildlife and preserving biodiversity. According to statistics in 2000, the total area of forest in the country was 18.3 million ha, including 12.9 million ha of closed forest, which covers 8.1 percent of its territory. The forests of Mongolia are under state ownership and are divided to three types as strictly protected forests (8.4 million ha), protected forests (7.9 million ha), and utilization forests (1.2 million ha). In recent years, the area of forest has been decreasing because of transferring areas to the category of strictly protected and protected forests, weakness of forest management such as unregulated use, overuse, and inadequate protection. In addition, fire, overgrazing, mining activity, improper commercial logging, and illegal collection of wood for construction and for use as fuel, etc are causes of deforestation and forest degradation.

Photo 2-2: forest in Mongolia

The movement of legislation started in 1925 and the Forest Law was enacted in the 1930s. In 2001, government adopted a new forest policy statement, namely the new National Forest Policy of Mongolia. This document specifies five main goals: 1) prevention of deforestation and desertification, 2) modernization of wood-processing technology and satisfying domestic demand for forest products, 3) conservation of ecological balance, 4) fostering institutional restructuring, technology transfer, and 5) research extension. This forest policy also produces guidelines of forest activities that suitable for the sustainable development and ecological sustainability.

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(Nguyen Van Tra)

3. The livestock in Mongolia; past and current situation

Because of geographical location, diversity of ecosystems ranging from forest-steppe in the north, to the Gobi desert in the south pastoralism has been the dominant land use in Mongolia for millennia.

In the 20th century administrative boundaries of the region were established which restricted seasonal free movements of livestock. The trend to smaller administrative units was advanced during the early Soviet period in the first half of the 20th century. The *sum* and *bag* administrators maintained control over the movement of livestock and many other livestock management decisions (Fernández-Giménez 2006) (Table 8-1). Before the formation of the collectives (called *negdels)* in the late 1950s, movement of the Mongolian herders incorporated traditional pastoral management concepts associated with using forage and water resources within a broader landscape context and using community-based movement decisions (Chuluun and Ojima 2002).

During the *negdel* period between 1960 and 1990, livestock were owned in common and controlled by collectives. Pastoralists moved collective animals, along with a smaller number of personally-owned animals. The provincial and national government established a strategy for short-term, long-distance moves (*otor*) to safeguard against drought and

Photo 3-1: Farming companies in Tuv province, 2010.10.29.

rangeland overuse, as a strategy to fatten the stock in summer and fall, and to avoid drought-affected areas and d*zud* (severe winter conditions of various kinds) conditions (Bedunah *et al*.2004).

Since democratization in 1990, Mongolia shifted to a free-market economy, which has led to changes in the livestock sector. With the privatization of livestock in the early 1990s collective farms were dissolved, animals were distributed to the Mongolian population, the number of pastoral households increased dramatically. This creation led to poor grazing practices during the earlier period of transition in the 1990s and the resultant degradation of rangeland resources. Higher concentration of livestock is located near settled areas and year-round use of riparian zones, and has led to deterioration of the rangelands (Chuluun *et al*. 2005). All this resulted in a declining livestock herd size and increased poverty, in general, at least until about 1993 when livestock numbers began to increase. Livestock privatization eventually provided incentives for increasing livestock numbers. It increased from 25.8 million in 1990 to 33.6 million in 1999. The combined drought and *zuds* during the period from 1999 through 2002 resulted in severe livestock losses; livestock numbers were reduced up to 24 million in 2002. However, livestock numbers increased back and according to the results of the 2009 livestock census there were 44.0 million livestock, including 277.1 thousand camels, 2.2 million horses , 2.5 million of cattle , 19.2 million sheep and 19.6 million goats. . The predominant management strategy is pastoral nomadism; it accounts for about 30% of the GDP in Mongolia (Rural development, 2002).

Nowadays the most common form of livestock ownership is the livestock company. Of the 255 collectives in Mongolia which were privatized, 80 exist in the form of joint stock companies.

During our internship in Mongolia we visited one of the successful farmers (dairy and cattle-breeding farm) in the Bayanchandmana soum Tuv province. We were introduced their activity. This farm is located about 20 km. from the nearest village. The owner has lease with local government for long term use the land. They (his family and his assistants) live there round year, and he organized everything to provide farm and get good income. He has enough equipment and machinery. This dairy farm is not only for producing milk but also breeding Charolais cows. They had 5 Charolais calf (young cows) from France. He mentioned they have good opportunity to develop sustainable business. But natural disasters as dzud or water shortage as well as drying up of sources are not inevitable for them also.

Photo 3-2 The visit to dairy and cattle-breeding farm in the Bayanchandmana soum Tuv province 2010.10.29.

Table 3-1. Changes in land-use patterns, land-use regulation and land tenure from pre-*negdel* to post-*negdel* period.

Attributes	Pre-*negdel* period (Until late 1950s)	*Negdel* period (1960 - 1990)	Post-*negdel* period (Since 1990)
Land-use patterns	Nomadic movements with ecological conditions	Less frequent and more distant movements, but often with conservation of cultural landscapes	*Otor* enforced; Many shelters and wells built further reduced distance and frequency of moves; Less *otor*; Year-round use of riparian and reserve pastures; Animals concentrated near towns and roads
Regulatory institutions	Traditional pastoral networks (little formal regulation)	Negdel	None (few newly emerged *hot ail* and new cooperatives)
Land-use regulation	No enforced formal regulation of movement	Neighborhood groups migrate together using animal cart Negdel enforces seasonal moves and *otor*	Machinery provided by *negdel* for transportation and hay making; Species specialization by kind, age and sex No formal regulation or enforcement; Little coordination of seasonal movements by *hot ail*; Diverse species composition
Land tenure and legal framework	Customary rights within administrative units *Negdel* allocate pasture, often along customary lines	All property stateowned; Disputes resolved by brigades and *negdel* Customary rights weak	Livestock, shelters and wells are privatized; Disputes are resolved by local governments (*bag & sum*)

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(Nazgul Turdumatova)

4. Public Health in Mongolia

4-1 General information on public health on Mongolia

Mongolia, a country of 2.8 million populations had a well structured and staffed health care system under the socialist era. But since 1990’s the healthcare system has been facing a transition, moving from a socialist to a market oriented economy which accompanied by increased rural to urban migration. From that time, the mortality pattern also has shown a rapid epidemiological transition, having increase of cardiovascular diseases, cancer and injuries and poisonings, while deaths from communicable and respiratory diseases have declined.

As of the end of 2007, 15 specialized hospitals, 3 regional diagnostic and treatment centers, 18 aimag general hospitals, 9 district general hospitals, 4 rural general hospitals, 35 intersoum hospitals, 288 soum hospitals, 229 family group practices and 857 private clinics delivered health care services for the population of Mongolia (NCHD, 2007). The leading causes of morbidity per 10,000 populations were respiratory (883.82), digestive (793.42), genito-urinary (714.45) and circulatory (577.79) diseases and injuries and poisoning (409.12). The rates of the diseases of genito-urinary, circulatory and digestive systems have steadily increased over the past 5 years (NCHD, 2007). Moreover, sexually transmitted infections (STI), viral hepatitis, rubella and tuberculosis were the top infections of all communicable diseases. Besides, Mongolia is a one of the countries of the WHO Western Pacific Region with the highest tuberculosis (TB) incidence. In recent years, TB incidence has remained high, and according to official health statistics, incident TB cases comprised 10.6% of all reported communicable diseases in 2007.

According to another survey conducted by the Ministry of Health of Mongolia revealed that 9 in

every 10 people (90.6% of the surveyed population) had at least one risk factor for developing non-communicable diseases (NCD). One in every 5 people (20.7) had three and more risk factors or was at high risk of developing NCDs. In particular, one in every 2 males aged 45 years and above was at high risk of developing NCDs. The overall prevalence of current smokers was 28%, of which 24.2% and 3.4% were current daily and non-daily smokers, respectively. When asked about alcohol consumption in the past 12 months, about 60.8 (±0.02) percent of the population (65.1% of males and 56.2% of females) reported drinking occasionally, 5 percent (8.8% of males and 1.0% of females) consumed in alcohol in moderate amounts, and 0.7 (±0.04) percent (1.1% of males and 0.2% of females) drank frequently. In addition, about 23 percent of the surveyed population reported low levels of physical activity.

One of the reason why the public health condition is getting better in Mongolia is introduction of a compulsory health insurance system based on the principle of solidarity. It helps them to improve significantly the major health indicators. For example, in the last ten years, the mortality rate of newborn babies and children under 5 years has decreased.

4-2 Health problem in Ulaanbaatar city

But in the capital city, Ulaanbaatar; the overall health condition of the people is getting worse due to rapid environmental degradation. When we traveled inside of Ulaanbaatar, we saw smoke come from power stations and boiler-shop. It is said that power stations in Ulaanbaatar burn five million tons of coal and boiler-shops use 400 tons of coal every year, spraying over 200 kinds of toxins in the city's air. Besides, all forms of household heating which are mainly fueled by coal, wood and in some cases rubbish contribute to the air pollution problem. Moreover, increasing number of cars on the city's roads, discharges carbon dioxide, carbon monoxide, sulphur dioxide and nitrogen oxides into the air. When cars do move, dust is released into the air, especially in the *ger* areas where most of the roads remain unpaved.

Photo 4-1: Ulaanbataar's Power Plant, between downtown and the airport.

When we visited the Waste Water Treatment Plant of Ulaanbaatar city during the internship, the stuff of the plant told us that people who lived in that area suffered from some health problem of teeth and hair. We asked them about the cause of the diseases when we visited the Institute of Public

Health, the stuffs in the institute responded that they did not have clear idea about what had caused the disease due to insufficient study. But they showed an opinion that it may have something to do with environmental problems which are going on in Ulaanbaatar at a rapid speed.

The Ministry of Health of Mongolia is the central governmental administrative body in charge of health policy formulation, planning, regulation and supervision. They are trying to build a favorable living condition for people by upgrading the quality of health care to international standards. In recent years, The Ministry have implemented programs focusing on formulating health policies and actions, expanding international cooperation, regulating drug and medical supply policies and actions, improving health management, evaluating the implementation and impact of health intervention, and providing information for clients and decision-makers. Besides, the National Program on NCD Control and Prevention for 2006-2015 has been approved by the Government of Mongolia which aimed at reducing risk factors and contributing to the reduction of the non-communicable disease morbidity and mortality.

Photo 4-2: Two posters hanged at two feet above eye level in the Health Department. The one of the left lists the gross things that smoking causes to your body; the one on the right lists the organs affected by heavy drinking.

4-3 Conclusion

We can conclude that, the Mongolian health system has evolved into a system with a mix of revenue sources, private sector service delivery and a plurality of actors. It has succeeded in reducing the infant mortality rate, the under-five mortality rate, the maternal mortality rate and infections from vaccine-preventable diseases. However, the leading cause of mortality is now non-communicable diseases and health services have not yet adjusted sufficiently to the new burden of disease. Moreover, getting habituated in modern urban life style and increasing environmental pollution causes new kind of diseases. So, there is now a growing demand that government as well as private organizations should make effort to reduce those kinds of diseases. And it needs further research and study. Through the internship, we have learned that developing countries are facing more or less same kind of environmental problems in their transition to a more urbanized state, though the possible solution measures might be varies in different countries, mostly depend on socio-economic, cultural, geographic condition of that country.

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(Hossain MD Shahadat and Li Meihua)

5. Wastewater treatment in Ulaanbaatar city

5-1 Introduction

On October 28th, 2010 we visited the wastewater treatment plant of Ulaanbaatar city in Mongolia. First, we were welcomed by the director of the plant who gave an introductive speech about the station.

Photo 5-1 Technical staff explaining the functioning of the Wastewater Treatment Plant

The wastewater treatment plant of Ulaanbaatar city was established in 1960. It is specialized in both domestic and industrial wastewater treatment principally coming from about 2300 connected households (60%). The total treatment capacity is varying from 150,000 m^3/day to 160,000 m^3/day. The head of the station explained that the treatment equipment available in the plant were continuously renovated during the last 10 years thanks to Danish, Korean and Spanish cooperation and technical support. In fact a tertiary treatment has been introduced since 2009 replacing chlorination method to UV treatment for bacterial removal. The treated water is actually released without any use; however, a future plan of its reuse in agriculture is under review. The produced sludge after treatment in stocked and sometimes used to generate heat and electricity.

5-2 Technical functioning of the wastewater treatment plant

The treatment process can be divided in the following way;

Pre-treatment and primary treatment

The wastewater is supplied to the station by 2 pipelines with 1200 mm as diameter for each. The primary treatment consists of removing materials that can be easily collected from the raw wastewater before they damage or clog the pumps and skimmers of primary treatment clarifiers (trash, tree limbs, leaves, etc.). It is generally composed by bar screens, grit removal chamber using sand filters and fat removal mechanism.

Photo 5-2 Primary treatment

Secondary treatment

Secondary treatment is designed to substantially degrade the biological content of the sewage which is derived from human waste, food waste, soaps and detergent. The majority of municipal plants treat the settled sewage liquor using aerobic biological processes. To be effective, the biota requires both oxygen and food to live. The bacteria and protozoa consume biodegradable soluble organic contaminants (e.g. sugars, fats, organic short-chain carbon molecules, etc.) and bind much of the less soluble fractions into floc.

Photo 5-3 Secondary treatment: aerators for biological treatment

The final step in the secondary treatment stage is to settle out the biological floc or filter material through a secondary clarifier and and filter press to separate sewage water containing low levels of organic material and sludge.

Photo 5-4 Filter press system to produce sludge

Tertiary treatment

The tertiary treatment was introduced since 2009 in WWTP of Ulaanbaatar city to replace chlorination method by UV treatment for bacterial removal. The UV treatment consists of using channels and UV lamps for water disinfecting.

5-3 Problem of sewage sludge and treated water reuse

Most wastewater treatment processes produce a sludge which has to be disposed. Conventional

secondary sewage treatment plants typically generate a primary sludge in the primary sedimentation stage of treatment and a secondary, biological, sludge in final sedimentation after the biological process. Generally, raw sewage sludge consists to approximately 95 percent of wastewater.

The total produced sewage sludge in Ulaanbaatar WWTP seems to be considerable compared to the station capacity. This raw sludge seems to have a high potential of toxicity since it is generated from both domestic and industrial wastewaters. Several studies mentioned the pathogens and heavy metals as first pollutants. Reuse of such product in agriculture may cause serious environmental problems for soil, water and ecosystem in general. At the present stage, the sludge in Ulaanbaatar WWTP is only stocked and rarely used to produce heat and electricity. Therefore, it is necessary to think about other ways of its recycling or reuse such spreading in silviculture, waste-to-energy incineration, additive in cement industry or in coal-fired power stations.

The WWTP of Ulaanbaatar is capable to produce 160,000 m^3/day; a considerable quantity, unfortunately discharged in the hydrologic network without any benefit. In fact, its reuse in irrigation of agricultural field or its recycling and use in some industrial processes can be an opportunity since Mongolia has a semi-arid climate where water shortage is the rule.

5-4 Conclusion

Based on our field observations, it seems that the WWTP of Ulaanbaatar city is underexploited. Furthermore, separation of domestic and industrial treatment processes is essential in order to avoid mixed origin sludge which limits its reuse as fertilizers in agricultural field. Further alternatives of treated water and sewage sludge reuse should be found. The WWTP of Ulaanbaatar can be the core of an integrated eco-friendly project guaranteeing an improvement of produced water and sludge quality and their insertion sustainably into agricultural, energetic and industrial sectors.

(Anis Chekirbane)

6. Appendices

6-1 Time Schedule of Mongolian international internship

Date	Time	Location	Activities
25 Oct	08.50	Tsukuba - Tokyo Narita	
	13.20–18.30	Narita – Ulaanbaatar	
		Ulaanbaatar	One night stayed in Ulaanbaatar (In HotelFlower). Take a rest and preparation for the next activities in the next day
26 Oct	9.00–17.00	Ulaanbaatar	International Symposium « Bridging Environmental Leaders –Dialogue between Disciplines- » Opening session (Chair : Damba Odontsetseg) Opening Remarks (L. Janchivdorj UNESCO Chair holder) Objectives of the symposium (Maki Tsujimura, UT) Keynote Address : Implementation of IHP in Mongolia (Bandii Garid, Mongolian National Commission UNESCO) Session 1 : Environmental Problems in Mongolia (Chair : Wakasugi Naomi) Hydrology systems, specificity and their tendency of changes in Mongolia (Gambo Davaa, IMH) Flooding in Ulaanbaatar city and reducing risk assessment issues (Dambarajaa Oyunbaatar, IMH) Studies of arsenic in Mongolia (Idesh Bolormaa, Public Health) Utilization of water resources in Mongolia (Luten Janchivdorj, IGE) Discussion Session 2 : Environment Diplomatic Leader Program (Chair : Badamgarav Erdenechimeg, IGE) Environment Diplomatic Leader (EDL program) : A new integrated capacity to solve global environmental issues (Maki Tsujimura, UT) Environment and Human health – Role of Public

Date	Time	Location	Activities
			Health – (Naomi Wakasugi, UT) Integrating scientific technologies with local knowlegde and practice for sustainable development of pastoral societies (Xiaogang Sun, UT) The case for government in groundwater management : Institutional responses to the problem of land subsidence in Asian megacities (Takahiro Endo, UT) Discussion (Chair : Maki Tsujimura) Stayed in Ulaanbaatar (In Hotel Flower)
27 Oct	09.00 – 12.30	Ulaanbaatar	POSTER SESSION (Meet the Young Scientists) (Participant: Nazgul Turdumatova, Nguyan Van Tra, Meihua Li, Shahadat Hossain MD, Anis Chekirbane, Yudi Setiawan, Sukbaatar Chinzorig, D. Gereltod)
	12.30 – 14.00		Clean up the room, Lunch
	14:00 – 15.30		To visit Zaisan memorial
	15.30 – 18.00		To visit Zanabazar Museum of Fine Art
28 Oct	09.00 – 17.30	Ulaanbaatar (UB)	To visit waste water treatment of Ulaanbatar city To visit Institute of Public Health To visit Institute of Geo-Ecology, Mongolia
29 Oct	09.00 – 10.30	UB – Bayanchandmani	To trip to Bayanchandmani soum, Tuv province
	10.30 – 16.00	Bayanchandmani	To discuss with the head of Bayanchandmani soum To make acquaintance with farmland activity To visit pasture land near the farmland Lunch, and hotel registration To visit traditional house of Mongolian (GER)
30 Oct	08.00 – 11.00	Bayanchandmani	To visit a spring as a water resources in pasturland
	11.00 – 13.00	Bayanchandmani – UB	Leave for Ulaanbaatar, take a lunch
	– 16.00		To visit Budda monument Stayed in Ulaanbaatar
31	08.30 – 11.00	Ulaanbaatar	To Visit the Chinggis Khan Monument (touristic

Date	Time	Location	Activities
Oct			area)
	11.00 – 16.00		Field survey in Ulaanbaatar city
1	09.00 – 14.00	Ulaanbaatar -	
Nov		Tokyo, Narita	
	17.00		Arrival at Tsukuba

6-2 List of Participants (Alphabetical order)

Students

CHEKIRBANE Anis (Tunisia)
HOSSAIN MD Shahadat (Bangladesh)
LI Meihua (China)
NGUYEN Van Tra (Vietnam)
SETIAWAN Yudi (Indonesia)
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Editied by M.Tsujimura, N.Wakasugi, X.Sun and T.Endo
Published by Master's Program in Environmental Sciences,
Graduate School of Life and Environmental Sciences, University of Tsukuba