Final Report of the Domestic Internship in Nagasaki, Isahaya, and Minamata July 7th-10th, 2013

Edited and compiled by participants of the 2013 Domestic Internship

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

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Environmental Diplomatic Leader Education Program,
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Foreword

Various kinds of environmental problems are caused not only by natural phenomena, but also by human activities. Rapid population growth, poverty, poor infrastructure and sanitation, and the deterioration of ecological systems often accelerate environmental problems. To solve these problems, one needs a deep recognition and understanding of culture, and its environmental, economic, political, and social backgrounds.

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

This year, Nagasaki, Isahaya and Minamata were selected as visiting places because their problems have both local and national, what is more, international aspects. Nagasaki is one of the atom-bombed city. We could gain firsthand knowledge of atomic holocaust at Atomic Bomb Museum and remains. At Isahaya-bay, we deepened our understanding of the conflict between bio-diversity conservation and a reclamation project, and the conflict between cities, prefectures and national governments. At Minamata, we deepened our understanding of not only human health issues, but also negative aspects of rapid economic development.

This report is a summary of field research conducted during the international internship in Nagasaki/ Isahaya/ Minamata. This report shows how students understanding progressed throughout the tour. In addition, an appendix contains general information about this internship.

Lastly, we would like to express our gratitude to the EDL office staff. Without their general assistance, this tour could not have been undertaken. We are grateful to all the people who helped and supported us during this tour.

I believe that students understood various aspects of the environmental problems present in Mongolia and that this internship experience will be helpful in their future research and career development.

December 24th, 2013

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1. Nagasaki Atomic Bomb Museum

1.1 The history of the Nagasaki Atomic Bombing

Fig. 1.1 The wall clock stopped at 11:02 (At Nagasaki Bomb Museum). Photo: KOYAMA Nika, July 07 2013

We arrived at the first destination of our internship, the Nagasaki Atomic Bomb Museum. Walking through the entrance the heavy monotone background music gives one shivers and sets the appropriate tone for the museum. The explanation in the museum confirmed what we already knew, on August 9th, 1945 the second atomic bomb after Hiroshima was released upon Nagasaki city at 11:02 am. To signify this specific time there is the display of a wall clock that is stopped at 11:02 [Fig.1.1] [16]. Originally, the bombing was supposed to take place at Kokura, the primary target, but due to bad weather conditions the target was changed to the secondary one - Nagasaki. According to the explanation at the museum, the B-29 bomber “bock scar” had to circle above Nagasaki due to bad weather conditions and when it was about to reach its fuel limit an opening in the clouds formed which made the bombing possible [14]. As a result, most of Nagasaki was decimated, and most of its population was killed either by the blast itself, or by the subsequent heat wave and fires that followed. Of the few survivors, many suffered serious injuries in most cases severe burns, as well as severe psychological stress.

Fig. 1.2 Damage to Nagasaki Medical College [1]. Photo: KHONSAVANH Vilaysack, July 07 2013

Fig. 1.3 Steel frames of the Mitsubishi arms factory in Mori-machi Plant remained [1]. Photo: KHONSAVANH Vilaysack, July 07 2013

1.2 Effects on buildings and structures

At the Nagasaki Atomic Bomb Museum, we were able to view exhibits such as photographs and actual items from Nagasaki as they were found after the bombing. Some of the exhibits display the destructive power of the Atomic Bomb on materials that are very sturdy. Pieces of concrete, rooftops and even glass bottles melted from the heat wave of the explosion, with the glass melting point being between 1425 and 1600 degrees Celsius.

The damage that the bomb caused to Nagasaki can be divided into that caused by instantaneous destruction from the blast, the subsequent damage from the blast heat wave and the fires it caused [1]. Any structure within a radius of 2 kilometers from the blast was

Fig. 1.4 Map showing the characteristics and radius of the impact [1].
Photo: KHONSAVANH Vilaysack, July 07 2013

completely destroyed [Fig.1.4] [1]. Interestingly enough at an area 200 meters to the southeast of the hypocenter some trees were left standing as they were exposed to the blast from above. Within 500 meters and one kilometer from the hypocenter all the buildings were decimated, including the Nagasaki Medical College [Fig.1.2], the Nagasaki Medical College Hospital, the Nagasaki Electric Railway Co. building, the Urakami Railroad station and a primary school and two middle schools. Between one and two kilometers from the blast all wooden houses were scorched and the only thing left standing [1; 16], even today, is the steel frame of the Mitsubishi Steel Mfg. Co., Ltd., Nagasaki factory [Fig.1.3] [1]. This was part of the bombing plan, as the destruction of Mitsubishi's factories by the Americans would weaken Japanese military operations. Between three and five kilometers away, buildings suffered severe damages to their upper floors, while all window glass was shattered by the heat wave.

1.3 Consequences of the blast

Contrary to our belief that most of the injuries were from the explosion and the consecutive shockwave, in reality most of the secondary damage was caused by fire, which was a result of the explosion. The displays show the severity of heat to which the affected area was exposed. We saw glass bottles that were fused due to heat, metal objects that were misshaped to the point of being unidentifiable, and of course, the toll on human lives. Actual pictures depict the horror of scorched bodies, and even though the damage was immense, some people who sustained great injuries and burns survived and were left to face the aftermath. [Fig.1.5] According the information panel, afflicted people suffered terrible radiation-induced disorders like nausea, diarrhea, fever, epilation, subcutaneous hemorrhage and stomatitis. These disorders were particularly severe among victims in close proximity to the hypocenter and their condition rapidly deteriorated leading to many deaths after one week.

Fig. 1.5 Pictures of scorched bodies (At Nagasaki Bomb Museum). Photo: KHONSAVANH Vilaysack, July 07 2013

One picture is especially attention worthy. It depicts a woman standing amongst the rubble right after destruction with complete loss in her eyes. One can only wonder what went through the minds of the survivors that day when no one could comprehend the reality nor know the reasons behind it.

1.4 Target: Nagasaki city

Before the bombing, during the 16th century and after the Meiji Restoration, Nagasaki was a base for trading with the western world, as well as a center for the spread of Christianity. During its industrialization, the city expanded, serving as a center for mining armaments. One of the mining sites was Gunkanjima, which we visited during the course of this internship. Nagasaki was selected as a viable target for bombing for two reasons; it's above mentioned mining and industrial facilities; due to the fact that it had suffered minimal damage from air strikes during the war and the effects of bombing on an unaffected area were of high research value to the Americans. [16]

Fig. 1.6 Picture of the actual "fat man" (At Nagasaki Bomb Museum).
Photo: KHONSAVANH Vilaysack, July 07 2013

The bomb itself was plutonium based, and was 3.25 meters in length and 1.52 meters in diameter, while its weight was 4.5 metric tons. Interestingly due to its shape it acquired the nickname ‘’fat man’’. During its detonation, the energy released is presumed to have been 50% in the blast, 35 % in heat, and 15 % in radiation. During the internship we had the opportunity to inspect a mock-up of the bomb, which is displayed in the Nagasaki Atomic Bomb Museum. We had not imagined the bomb to be of such proportions, even after all this time looking at the mock model it seems intimidating. Further investigation showed that the actual “fat man” was not the dark brown color as shown in the mock-up model, but in reality it was yellow, at color which does not erase the “frightening” feeling. [Fig.1.6].

1.5 Effects of the bombing on the city of Nagasaki

In its misfortune, Nagasaki was fortunate enough not to receive the maximum yield of the atomic bomb. This was due to the fact that the bomb did not land in the center of the city and also, because the city was surrounded by mountains which had a dampening effect on the bombs devastating power. Regardless, 36% of the buildings in Nagasaki were leveled within a radius of 1km from the hypocenter, while buildings up to 4 kilometers from the blast were partially destroyed.

The effects of the bombing on the population were equally devastating. Short-term effects were the death of 73,884 people and the injury of 74,909 others, either from the blast itself or the following heat wave. Long-term effects were caused by radiation contamination, and while exact numbers are not known, estimates indicate at least 140,000 people died of radiation sickness between 1945 and 1950 [15; 16].

In the museum, there is a comprehensive mode, which details the blast, its waves and radius as shown in figure 1.7. Through looking at the model we could imagine the full scale of the blast and the affected area.

Fig. 1.7 The model of Nagasaki and its surrounding mountains
(At Nagasaki Bomb Museum). Photo: KHONSAVANH Vilaysack, July 07 2013

The museum made us think of the horrors of man-made weapons. In the 21st century, it seems absurd that countries still continue to stockpile nuclear weapons that have the potential of wiping out life on our planet, and if ever deployed the possible damage is beyond human comprehension.

1.6 Effects on Humans

Among the photographs exhibited at the Nagasaki Atomic Bombing Museum, include those of the bombing. These grotesque images display the effects of the bombing from simple burns to complete incineration. There appears to be three kinds of damage inflicted upon humans by the atomic bomb [1]. The first kind is burns caused by the infrared radiation released by the explosion. Approximately 20 to 30 % of the burns are a result of this. Another 20% of the deaths were due to the thermal wave that propagated from the hypocenter and outwards, in other words a wall of high pressure and extremely high temperature air that traveled at about the speed of sound. The rest of the deaths were due to poisoning from the ionizing radiation, also released by the blast. People receiving dosages of 4 grey (SI unit of radiation dosage) or higher perished [15]. The survivors of the bombing had to live with injuries caused by the above, or with severe psychological stress, in most cases both

Fig. 1.8 Senji Yamaguchi at 14, after the bombing [2]. Photo: KHONSAVANH Vilaysack, July 07 2013

Fig. 1.9 Photograph of Senji Yamaguchi in later life displayed at Nagasaki Atomic Bomb museum [2]. Photo: KHONSAVANH Vilaysack, July 07 2013

The above photographs show one of the victims of the Nagasaki Bombing, displayed in the museum. The person's name is Senji Yamaguchi, and he was 14 years old during the incident [Fig.1.8] [2] – at the time he and some fellow students were digging a hole for shelter from air strikes at the Mitsubishi arms factory [2]. The bombing caused him severe burns in his upper body, which healed into extensive keloid scarring [Fig.1.9] [2]. In 1955, he got involved in the anti-nuclear arms movement and led the Confederation of A-Bomb and H-Bomb Sufferers Organization of Japan between 1981 and 2010 [13]. He gave a speech at the 1982 United Nations second special session on disarmament pleading ''No more Hiroshimas, No more Nagasakis, No more Hibakusha (Japanese word for atomic bomb victim)''. He passed away on the July 6th 2013 at the age of 82 [2; 13].

1.7 Impressions of the Nagasaki Atomic Bombing Museum

During the course of this domestic internship it became apparent how devastating the effects of nuclear weapon use were in both the cities of Hiroshima and Nagasaki. The bombs effectively scarred both locations physically due to the destruction caused by the bombs, but also psychologically, as the grotesque images of this destructive power remain vivid not only in Japanese society and later generations, but also in world history; People will forever know the extreme monstrosities that humans are capable of in times of war. The Nagasaki Atomic Bomb museum through its remarkable

exhibition is a constant reminder of the shortcomings of humans, who continue to solve their differences through primitive means such as violence, warfare, and potential nuclear weapon utilization.

Today, 68 years after the Nagasaki Bombing, evidence of attack is all but gone, other than the museum and a few structures kept for historic purposes. The scars of the bombing are still present worldwide and, spanned decades of cold war nuclear war terror, where east faced west through an absurd nuclear arms race. This also led to the global adoption of nuclear power by many super-powers for, economic or other reasons, but actual benefits remain doubtful,. In particular, potential hazards were highlighted, after the Chernobyl and Fukushima incidents, as well as numerous others during the cold war that did not receive equal publicity. EDL members were privileged to visit the areas that were first struck by the nuclear plight, but acknowledge their misfortune by being yet another generation that is still affected by the misuse of nuclear technology by a value system that though archaic, is still perpetuated willingly by the majority of governments of our planet.

2. Coal Mining Industry in Japan

Roughly one hour after leaving Nagasaki port, our vessel has finally arrived at the "Gunkanjima" island and were finally able to step our foot on it. Just over a century ago this used to be a mere heap of rock and coal, which was transformed into the once most densely populated place on the planet and is now an abandoned, decaying ghost town. By looking at the history of coal mining one can see how the changes in Japan's energy consumption were influenced by world's trends.

Fig. 1.10 Gunkanjima in operation. Source: Gunkanjima – Concierge.
Photo: Temulun, July 07 2013

2.1 Formation of the Coal Mining Industry in Nagasaki

In the mid-19th century, the demand for coal had drastically grown due to the introduction of steam engine ships. This had also provided an advantage for Nagasaki to expend, as it was a perfect stopover port for foreign trade vessels after the Meiji Restoration. This led to yet another expansion of coal production in the surrounding area. [6; 7]One of the coal mining islands, Takashima, used to export their coal to salt makers in Japan, which was big industry back in 18^{th} and 19^{th} centuries. Salt making relied on fuel to boil the seawater, and the industry switched to coal for efficiency reasons as wood sources became depleted. The island administrators had acknowledged the potential of coal trade in the area thus the industry was born.

However, the coal mining industry in Japan at that time used primitive coal extraction methods. In order to increase the coal yield the mine owners had to use foreign aid. With the help of Thomas B. Glover, a Scottish merchant based in Nagasaki, mining equipment was imported to the island. With the help of British mining engineers vertical shaft mines were drilled on the island, which aligned the industry with modern standards. In 1881 the Takashima coal mine was purchased by Mitsubishi, after the corporation had assessed the mine's potential, it's estimated reserves and potential output, and the advantage of owning ships that could transport the cargo from the island [8]. All this brought economic prosperity to the region and brought about the idea of further developing coalmines on neighboring islands. This, in turn, led to development of the Hashima coal mine.

2.2 Hashima – The Coal Mining Island

In 1890, Mistubishi purchased Hashima and began their operation on the island [Fig.1.10]. By 1895, the first shaft on the island was successfully installed. The residue from shafts was used to reclaim the land in order to create facilities and living quarters for the workers on the island. Following land reclamation the enormous sea wall was built to shield the island from the harsh sea environment [5]. This gave the island the infamous appearance of a battleship and it was dubbed "Gunkanjima". In 1916, the first reinforced concrete living quarters were built, which was the first in Japan. The mine's output was around 150,000 tons of coal annually which led to the expansion of the workforce which, in turn, led to the construction of more and more apartment blocks to alleviate the lack of housing for workers and their families [3]. It is worth mentioning that even during World War II construction did not cease on the island. The building continued until there was no more room left on the island. As a result, there are 30 concrete buildings on a space of just over 60000 m^2. The apartments had all necessities; almost a 100 % diffusion ratio of appliances such as

TVs and refrigerators, which was unusual in Japan at that time, a competitive salary and other benefit; however, private space was rather small. The bathing, toilet, and cooking facilities were communal. It is also said that the island had a school, hospital, shops, a shrine, and barber, recreation facilities such as Karaoke, a movie theater and even a brothel. [3; 5; 11] Residents of the island had to rely on the mainland for provisions and food, even water was supplied until 1957, otherwise the island was self-sufficient. Hashima is also known as an island devoid of greenery, however the residents made a communal effort to grow their own produce on the rooftops of apartment blocks, which was the only area available for such activities. [3; 5; 11]

2.3 Most Populated Place on Earth

All this effort, the amount of workers and the tremendous demand for coal led to a peak in coal production of 410,000 tons in 1941. Demand due to war required more manual labor and for Japanese young people who were sent to war their replacements needed to be found. As other cases in Japan during that time, Koreans, Chinese and people of other Asian nationalities were brought in by force for manual labor and Hashima was no exception [11]. The number of these workers is unknown, however, it is said that over 1,000 of them [3; 11], though the information varies depending on the source, died on the island due to harsh working conditions and ill treatment [3]. On the other hand, there are records of people being satisfied with their life on the island having all the necessities and more [11]. The apartments were also divided according to employee rank or if they were Mitsubishi employees. This indicates that equality did not occur on the island.

After the war ended, coal mining gained the new purpose of supplying coal to aid Japan’s recovery. During this time, the population of the island soared to 5,259 in 1959, making it the most densely populated place on the planet at the time. [5]

After petroleum began replacing coal in the 1960s coal mines began closure down

Fig. 1.11 Gunkanjima as seen from the boat. Photo: ALLIKSEEVA Jelena, July 07 2013

across the country. Again, Hashima was not an exception. Mistubishi started to relocate its workers, officially announcing the closure of the mine in January 1974. The process of vacating the island happened at a surprising speed with the last resident leaving for Nagasaki on 20 April 1974 [3]. Since that time the island has been off limits.

2.4 Impressions

All the internship members had seen countless of pictures of the island but to be able to see it with our own eyes was a whole different sensation. It was a challenge to get to the island for several reasons, one of them being the weather conditions. When our group arrived, the tour guides told us that we were lucky and that the trip to the island had not been possible during the previous few days. The island was much smaller than anticipated and oddly did not look much like a battleship as expected, most likely due to it being abandoned [Fig.1.11]. Now, the island lives up to its reputation of a ghost town with its dark windows, cracks in the walls and fallen rubble. Apart from the neglect it has also sustained extensive damage from severe weather conditions over the years. The island was opened to tourists around 5 years ago however most of the island is inaccessible to visitors due to its decaying condition as a result of decades of neglect.

Fig. 1.12 The accessible path is shown in pink. Source: pamphlet acquired at Gunkanjima Concierge [4]. Photo: ALEKSEJEVA Jelena, July 07 2013

After Mitsubishi's donation of the island, the Nagasaki government had plans to open the place for tourism however, the island became off limits due to structural issues. Now that is has become commercialized, one can only walk on a small fraction of the island, which is shown in pink in figure 1.12, It is not possible to get close to any building as proximity poses danger. [3; 5; 11] Before it was open to tourists, the tour

guide indicated that, people could actually visit, provided that they had means to get to the island, though it was illegal. According to numerous reports on the internet, it seems that illegal trespassing on the island is punishable by incarceration for 30 days and, in case of foreigners, deportation. [10; 13] However, such statements were not verified due to the lack of official information and need further investigation. Still, we can find countless records and pictures of the prohibited areas on the internet by people, who, at the risk of punishment, gave in to their curiosity and went to the island. The tour to the island made us realize that the overwhelming majority of pictures of Gunkanjima on the internet are in fact the result of illegal trespassing. This also signifies the island's popularity amongst foreigners as an abandoned place. The grim popularity of Gunkanjima rivals that of the Pripyat, Chernobyl. The island's popularity was raised once again by the recent blockbuster James Bond movie "Skyfall" which used Gunkanjima as a set for the main villain. In fact, the tour agency has used the image of James Bond for their introduction and explanation of the island prior to departure, jokingly apologizing for James Bond not being able to make it in person for our tour. Speaking of the island is used in video games as settings; a ground for a zombie outbreak in the X-Box game "Left for Dead" amongst others. It was also featured in some educational programs, one of them being History Channel's "Life After People", which can be accessed via YouTube.

Fig. 1.13 View of Gunkanjima from the boat.
Photo: ALEKSEJEVA Jelena, July 07 2013

Thinking back on our visit, it was regrettable that were not able to go inside a single building to look at the history buried under the rubble island and we were envious of others who had the chance to explore it. Instead, we had a tour around the island from a boat. During this time, we could hear Kobata the tour guide's explanation about the places we could see from the boat. Kobata has lived and worked on the island for one year [4], and explained about every building, its purpose and details [Fig.1.13]. Regrettably, our limited knowledge of the Japanese language and the strong wind did not allow us to fully understand what Kobata said. Nevertheless, whatever the small

bits of information we could comprehend proved to be of great value for one does not get a chance to get such information directly from a person who has experience living on Gunkanjima.

Japan was once the largest coal importer in the world, with annual imports of about 200 million tons of steaming and coking coal in 2011. Coal is mainly used for electricity and power generation as well as steel production in Japan. As a country of high-energy consumption, energy resources are very important. This fact makes one think how Japan manages natural resources because they are scarce. Therefore, when we stepped on Gunkanjima Island, once a main coalmine with a dense population at the time brimming with life, but now completely abandoned, only one word comes to mind - sustainability. When oil began replacing coal in the 1970s, the coal mining industry ceased its operation in many places and Gunkanjima was one of them. As a result workers had to leave the island, regardless of their own wishes, and give up the lives they had there for they had nothing to sustain their life if they remained. In fact, staying was not an option. So who is to blame? This case taught us that sustainable development is very important. At that point in time, if decision makers had opted for other options, perhaps Gunkanjima would have had a different fate. This is also closely related to the economic situation at that time, so when considering sustainable development, the reality is never simple. We face this kind of problem everywhere and every day. So at least, we students recognized this as a problem, due to the internship and lectures, and we can exchange ideas and aspire to find a solution.

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Part 2. Isahaya Land Reclamation Project

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1. Background of Isahaya Land Reclamation Project

1.1 Introduction

The EDL program at the University of Tsukuba arranged a domestic internship to Kyushu, South Japan, where practical knowledge was gained about a complex land reclamation project in Isahaya Bay. Although reclamation activities have been carried out for a long time around the Ariake Sea, the project mentioned in this report was first proposed in 1952 by the Nagasaki Prefectural Government. However, the project plan was prepared in 1983 and announced in 1985. The actual project work started in November 1989 and a 7 km dike was constructed (Fig.2.1 and 2.2). The tidal dam gates of the dike were closed in April 1997 [1] to prevent seawater mixing with freshwater from the dam and promote agriculture in the reclaimed land [1].

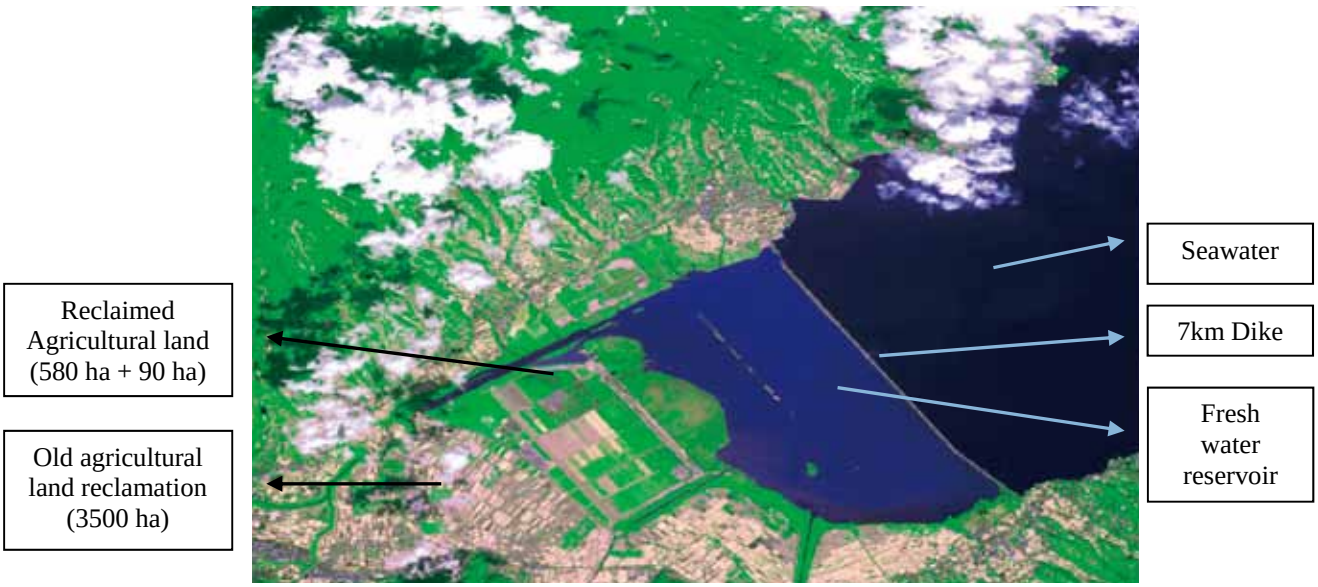

Fig. 2.1 Isahaya Land Reclamation Project (Data Accessed: 2nd August, 2013)
Source: Atlas of our changing environment, Landsat 23 October 2003

Fig. 2.2 (a) The 7km long Dike separating dam water from seawater, (b) North water gate
Photos: ASSEFAW Michael, July 08 2013

Land reclamation has a long history in Japan, mainly along the Ariake Sea, Ise Bay, Atsumi Bay, Tokyo Bay and Kojima Bay coasts. After the Pacific War, in order to increase grain production, a new round of reclamation was begun to provide high quality farmland and make efficient use of insufficient lands. Up to1989, the acreage of this reclaimed land was 52,023 ha [2].

Isahaya and Moriyama (now it is the Moriyama District of Isahaya City) used to be a hilly area surrounded by the Ariake Sea, Tochibana Bay and Oomura Bay. At that time, there was no paddy field to plant rice in order to support people's daily life. To open up more paddy fields, people living there began to build dykes and intercepted the seawater. This reclamation started 500 to 600 years ago [3]. Isahaya Plain has become the biggest granary of the province.

Isahaya City and its vicinity often have typhoons, and due to the surrounding hills, the city suffered from torrential rains caused by upward flow. Flooding and high tides also brought damage to people living there. Huge flooding occurred in July 1957 and caused the loss of 445 million JPY and the death of 494 people. No.13th Typhoon in August 1985 caused the loss of 225 million JPY [4]. The Isahaya land reclamation project (Fig.2.3) began under such circumstances and includes two main purposes [5]:

- The first purpose is to strengthen the disaster prevention system. The dyke can block the waves caused by high tides and typhoons, and thanks to water in the adjustment pool, the farmland is not affected by the damage caused by high salt concentration in the soil. The adjustment pool can also store the rainwater gathered during torrential rains so that the plain would not be flooded. There are actually three dykes protecting the new reclamation land: the original dyke, an internal dyke and a sea dyke. The tide repeats twice in a day and the difference between high tide and low tide can be 6 m, so the sea dyke is 7 m high and extends for 120 m to protect the plain from seawater. The internal dyke is 3.5 to 4 m high and between these two dykes, there is an adjustment pool to hold rainwater during torrential rains. There are two drain gates, at the north and south (Fig.2.2.b), which are opened only during low tide to let the rain water flow away.

- The second purpose is to provide high quality farmland. Farmland has expanded via reclamation year by year since olden times and the new reclamation project will provide 672 ha for agriculture. The government wants to popularize environment-friendly agriculture that will exist symbiotically with the water environment.

Since 1988, 41 farmers moved onto the new reclamation land for agricultural activities. The farmers were eco-accredited to promote eco-friendly agriculture and minimized use of fertilizers. At that time, there were six conditions for leasing land in the newly reclaimed area. The applicant must:

1. Be 20-50 years old
2. Be accredited by a municipality
3. Be accredited by the Ministry of Agriculture, Forestry and Fisheries (MAFF)
4. Sign a lease contract for farmland
5. Make an agreement for payment of water bills
6. Conduct sales of farm products to suppliers [6]

The reclamation project basically achieved its two purposes, but also caused serious problems which will be discussed in the following sections.

1.2 Historical outlook

Since the first news of a red tide was published in February 1998, the reclamation project (cost of 253 billion JPY) has become a serious public concern [7]. The argument about opening or closing the breakwater is ongoing.

In June 2008, the Saga District Court rendered a judgment on the Isahaya Bay reclamation breakwater opening survey case to open the breakwater. Later in December 2010, the Fukuoka High Court rendered a judgment on the same case indicating the gates would be opened for a period of five years. In June 2011, the Nagasaki District Court dismissed a lawsuit calling for an early opening of the Isahaya Bay reclamation breakwater [8].

All of the above are findings of the courts and these deliberations, activities undertaken by private associations continued. Even inside the MAFF, politicians hold different opinions. Now the argument has become a national one.

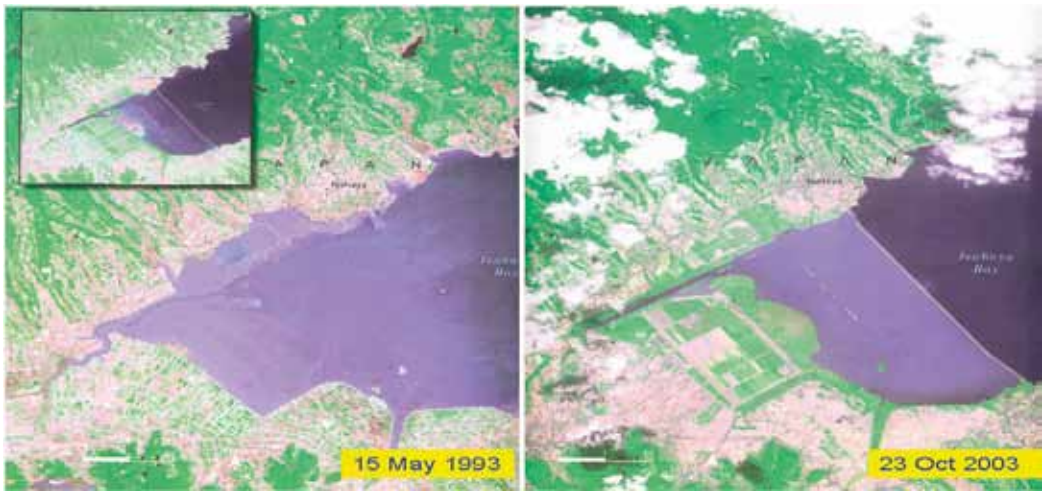

Fig. 2.3 Satellite images of Isahaya land reclamation
Source: Northwest Center for Sustainable Development (NCSR) (Data accessed: 2nd August, 2013)

1.3 Opening the Water Gates of Tidal Bank

There are four plans for opening the water gates; whichever one is utilized it will cause economic losses. First: opening the breakwater completely, will cause a public finance loss of 10.77 billion JPY; second: an interim opening will cause the same loss; third and fourth: opening the water gates to a limited height of about 70 cm will also cause a 2.48 billion yen loss and a 0.82 billion yen loss if opened up to a height of 20 cm. In addition, the desalination budget will be another 3.49 billion, which the local government will have to assume [8].

1.4 Result of Opening the Water Gates

It will be very difficult to close the water gate once it is open. The consequences of opening the breakwater need to be considered as well as the problems local people will face after opening of the water gates.

After completion of the reclamation project, lots of species are in imminent danger. Some migrant bird habitats have also been destroyed because of this project. If the water gates are opened, it is unknown whether conditions will revert to their former state prior to the project. However, some people believe opening of the breakwater will cause more serious problems. The ecosystem established around the adjustment pool will be destroyed. Birds living around the adjustment pool will lose their habitats. The species include egret, hooded crane, mallard, warbler, osprey, etc. and fish include crab and catfish living in the adjustment pool may lose their living environment. During the short opening in 2002, lots of fish and shellfish died because of adaptation problems to a change in their living environment.

The sea dyke prevented flooding in previous years. However when the breakwater is opened, the influence of high tide and typhoons will be felt again. During big flooding which occurred in July 1982, the financial loss incurred was over 107 million JPY and the flood stayed for more than 4 days. The flooding in 1999 that occurred after the completion of sea dyke, reduced losses to below 3 million and water flowed away the same day. If the breakwater opens, the water level in the adjustment pool cannot be controlled during high tides. The water needs more than 8 hours to flow away and to compress the time to 1 hour, more than 480 pumps are necessary [9].

Another problem is sludge. When the breakwater opens, a large amount of sludge around the drain gate will swarm into the Ariake Sea because of tides and the 60 million ton flow rate. The sludge concentration on the coast of the Ariake Sea will reach 100 to 300 mg/L and inshore will be more than 5 mg/L [10].

Salt content in soil should also be considered. After completion of the breakwater, the soil salinity has been gradually reduced and it can be used for cultivation. If the breakwater opens, the water level of the adjustment pool will increase and so will the groundwater. The farmland will become too salty for cultivation.

The last problem is people living in the area. On July 9th 2008, a big assembly was organized to oppose the judgment for opening of the breakwater. More than 2,300 people participated in the assembly including the mayor of Isahaya. Even now, lots of eye-catching slogans have been put up along the roads to protest the opening of the breakwater [11]. On the other hand, if the judgment is kept regarding the breakwater closure, fishermen will also hold a parade. Until now, there's no middle way.

2. Treasure from Isahaya Bay

The Ariake Sea has been loved by people as a 'Treasure Sea" for a long time for some specific fish and seashells. The sea is valuable for people not only as source of production but also for its associated culture.

During our internship, we had the opportunity to interview fishermen. The fishermen said, "Once, this place was a wonderful sea". Their life depended on fishery products. One of the famous products is Tairagi, shellfish that is gathered by hand (Fig.2.4.a). Fig.2.4.b shows the heavy uniform the divers used. Around Isahaya Bay, the peak haul of Tairagi is 150 kg/person a day, and total amount of Tairagi production was worth about 2.2 billion JPY. There were 420 fishermen during peak times. Tairagi was one of the biggest sources of income for the fishermen [1].

Mudskipper is known as a specific fish of the tidal flats in Ariake Sea. These fish can only live in the tidal flats, so the Ariake Sea was one of their largest habitats. They

were captured by a traditional method called “Mutsukake”. A board called “Gata ski” is useful to move around over the tidal flats [12].

Fig. 2.4 a) Shellfish, b) Costume of divers Photos: MIKI Yurisa, July 08 2013

2.1 The Sea as a Business

Other people who are not fisherman have businesses related to fishing, such as tourism and retail stores. The region around Ariake Sea was famous for its beautiful sea, fresh and specific fishes and hot spa, thus, a number of tourist businesses were functioning in the area. Tairagi and Mudskippers were also nice tools for attracting customers. Particularly, traditional Japanese-Style-Hotels were popular with tourists.

2.2 The Sea as a Culture

Businesses involved with fishing, had a tradition of participation in festivals in the region. The traditional festival of Isahaya is known as “Takezaki Oni Matsuri” where a number of young people used to participate (Fig.2.5). However, due to the decline in fisheries, most young people have left and hence; participants in the festival are decreasing [13]. They can’t carry out the main event of the festival called “Onizeme”. This effect has serious cultural repercussions for a rural town like Isahaya.

Fig. 2.5 Takezaki Oni Matsuri

Reference: Takezaki Oni Matsuri, Source: http://www.mapple.net/photos/I04100001501.html
(竹崎観世音寺修正会鬼祭，
マップル観光ガイド)
(Data accessed: 6th August, 2013)

For people who live around the Ariake Sea, the sea is their culture. They have lived with the sea and tidal flats for a long time (Fig.2.6) [14]. If the fishery products disappear, it affects not only the fisherman but also the people who live in the surrounding area. We need to consider the sea not only as a production area but also a cultural environment.

Fig. 2.6 a) Ariake Sea, b) Remaining few tidal flats Photo: MIKI Yurisa, July 08 2013

3. Effects of the Isahaya Land Reclamation Project

3.1 Positive Effects

3.1.1 Promotion of local Agriculture Development

The main purpose and merit of reclamation is to develop environmentally sound and high quality farmland. Until 2012, reclaimed farmland comprised 684 ha, including 289 ha for vegetables, 225 ha for feed crops, 134 ha for crops, 127 ha for green manure, 12ha for horticulture. The total farmland is 788 ha and is already exceeds the reclaimed land area (Fig.2.7).

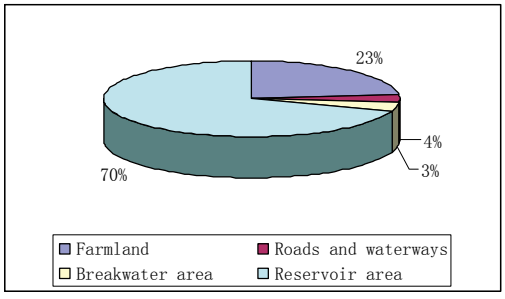

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Fig. 2.7 The function and percentage of reclamation area
Source: http://www.cityfujisawa.ne.jp/~559-mori/isahaya/ (Data accessed: 5th August, 2013)

The main reason for this phenomenon is that, reclamation of Isahaya bay ensures stable fresh water for irrigation farming. In the whole reclamation project, a water

reservoir of 2,600 ha was built in addition to the 684 ha of reclaimed farmland. The stable irrigation water is not only from the reservoir area, the local government and reclamation researchers also decided to utilize the water resource of the Honmyo River, the river around the reclaimed land and to establish a new pond near the reclaimed land. After finishing this project, the agricultural business of Isahaya bay was developed further. [15].

Finally, in order to prevent the fragmentation of the reclaimed farmland, the lands were managed properly as a public asset. This incorporates the local farmland lease system, where the system gives financial support to maintain the reclaimed area and guarantees the local farmers' benefits. Compared with other businesses, labor hours for agriculture are around 1,800 to 2,000 hours per year (around 83 days per year) and the benefit of one economic entity is around 7 to 8 million JPY.

3.1.2 Enhanced disaster prevention functions

In Isahaya bay, the main complication is the sea tides. The frequency of the ebb and flow of tide is twice a day; the averages for high and low tides are +2.5 m and -2.8 m. Sometimes the high tides reach 6 m. This situation threatens the security of life and property of local people, especially residents who live along or around the river.

According to Fig.2.8, the building of the sea dyke prevented tidal waves and flooding. The height of the sea dyke is 7 m. The sea dyke also has two protection dykes, an internal dyke (+3.5 m) and the old dyke (+5.5 m). So if high tide occurs a sea dyke protects the reclaimed land, if low tide happens, the reservoir area can accumulate the water or rain water.

The second positive point is to improve poor drainage. Fig.2.8 indicates that the sea dyke has its own drain gate, which can balance the water level and the drain gate can decrease the accumulation of mud, and contribute to a smoother water flow [16].

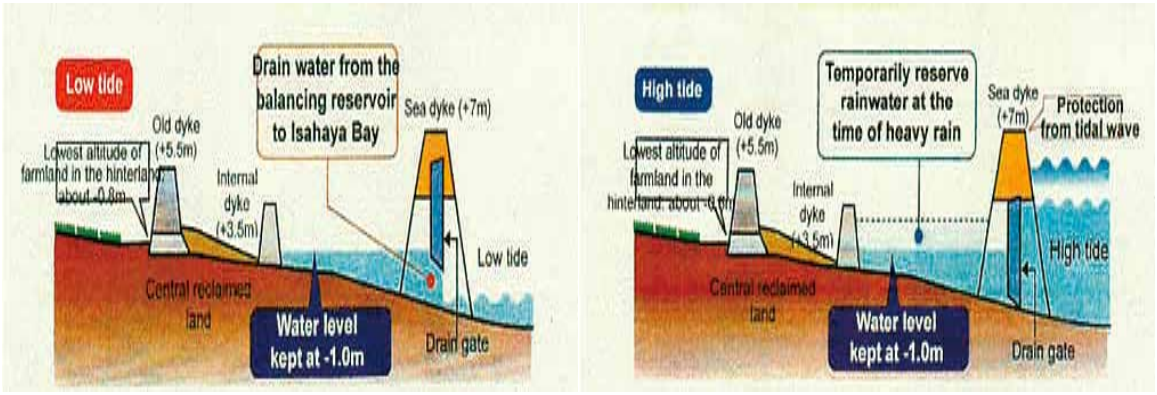

Fig. 2.8 The function of the sea dyke in the reclamation project
Source: Isahaya Bay reclamation breakwater control office (Data accessed: 5th August, 2013)

3.2 Negative Effects

3.2.1 Huge influence on fish catches from the Ariake Sea

There were different kinds of organisms living in the Isahaya bay area before the reclamation project; varieties fish, shellfish, seaweed, migratory bird, etc. After the start of Isahaya Bay reclamation project, the ecological environment of the bay was seriously affected. For example, reclamation work sharply decreased the number fish in the bay. This is because closing of the gates weakened the tide flow, which disabled water circulation inside and outside the bay. This has further reduced the self-purification ability of the seawater. Reclamation work hindered the mixture of the upper and lower water, which lead to the stratification of upper and lower layers. The upper layer is high temperature and low salinity water whereas the lower layer is low temperature and high salinity seawater.

The overall decrease of seawater circulation influenced the natural habitat and living environment of fish. New and fresh water can bring necessary nutrition like oxygen, nitrogen, and phosphorous for fish survival. But after reclamation work, the flow of tides decreased, fish and water plants could not get enough oxygen and nutrition. At the same time the upper layer of sea water seriously lacked oxygen and the lower layer formed a large amount of oxygen depleted water that caused mass mortality of the fish in the Ariake Sea. Especially, *Boleophthalmu spectinirostris* and *Atrina pectinata* have been on the verge of extinction in Isahaya Bay (Fig.2.9).

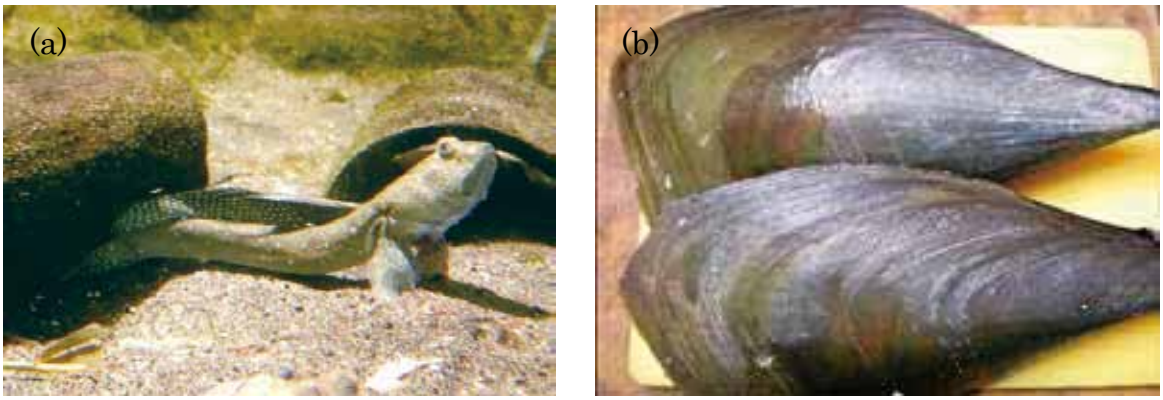

Fig. 2.9 Marine organisms in Isahaya bay
a) Boleophthalmus pectinirostri b) Atrina pectinata

Source:
http://upload.wikimedia.org/wikipedia/commons/thumb/b/b8/Mutsugoroh0809.jpg/266px-Mutsugoroh0809.jpg and http://pds.exblog.jp/pds/1/200905/30/24/d0115124_781291.jpg
(諫早湾の生物 and Wikipedia) (Data accessed: 5th August, 2013)

3.2.2 Water quality in Isahaya bay and water flow into the Ariake Sea

Due to mass mortality of fish, their decomposition influenced the water quality in Isahaya Bay. The decay and decomposition of fish depleted oxygen and released bad smelling gas. Even though the fishermen could pick or salvage the dead fish body in the upper layer of water, the dead fish in the lower layer of water were hard to deal with.

According to figure 2.10, water color inside the sea dyke and outside the sea dyke is very different. The water color inside the sea dyke is muddy and the water color outside the sea dyke is blue. This color contrast means that the water's self-purification ability of Isahaya Bay in the inner dyke is decreasing. As a solution the local government opened some pipelines to let some polluted water from the bay to flow out (Fig.2.10.c). However, the water improvement effect is deteriorating.

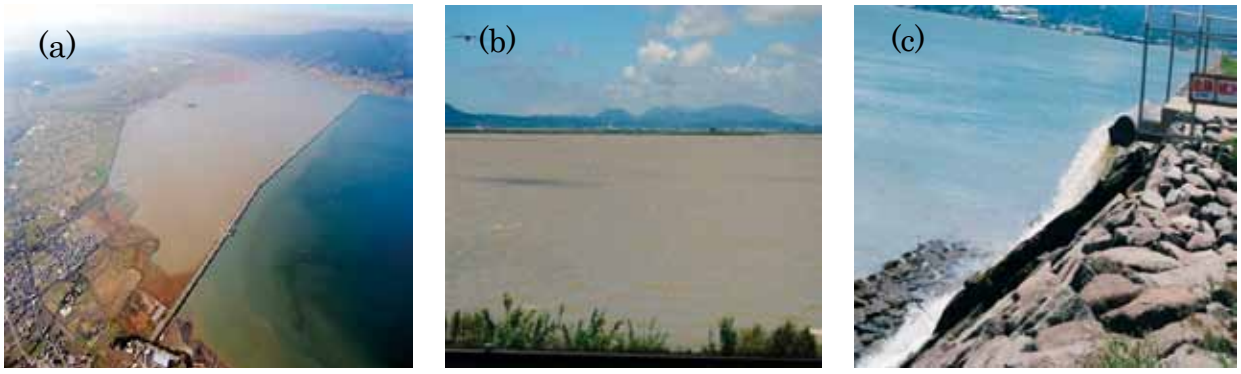

Fig. 2.10 a) The water color contrast in Isahaya bay, b) Muddy water inside the pond
c) Pumping water from pond to sea

Source: a) http://mainichi.jp/graph/select/2010isakan/2010isakan/image/018.jpg (Mainichi newspaper website)
Photos b) and c) by ASSEFAW Michael, July 08 2013 Data accessed: 7th August, 2013

The first instance is the occurrence of a red tide. In the Ariake Sea, the water contains abundant nitrogen and phosphorous [1]. This nutrition is necessary for sea sedge growth. The stratification of upper and lower water layers made this nutrition accumulate in the upper water layer and as a result a red tide occurred. The plankton consumed nutrition and propagated rapidly expanding its damaging range to the whole Ariake Sea. The nutrition carried by tide is the food for sea sedge, however red tide affects this. In 2000, due to red tides over a large area sustained for a long period that year's seaweed production was reduced to almost zero [17].

The other instance is reduction of floating mud. This element is created when a red tide occurs. Before reclamation work, there was some floating mud in the Ariake Sea. The floating mud helped to balance the growth of red tide, but it can also absorb the nutrition to make sea sedges grow stronger. After the reclamation work, the effect of tide flow weakened and most of the floating mud sunk. The water transparency changed and plankton had more contact with sunlight, which led to the red tide break

out. The marine environment, especially shellfish living conditions changed rapidly. The mud sank and affected the seabed mud composition and shellfish could not adapt to this change and died.

4. Opinion of Farmers and Fishermen on the Isahaya Land Reclamation Project

There is a sharp conflict of opinion between farmers and fishermen in Isahaya regarding the land reclamation project. This has a direct connection to the livelihood for both groups. The farmers support the closing of the water gates while the fishermen oppose it. We were able to interview farmers and fishermen during the internship and their opinions are given below.

4.1 Farmers' viewpoint

There are two groups of farmers in the Isahaya reclaimed land area. These include farmers who have been farming for a longer period of time and who settled in the area before the beginning of the reclamation project and farmers who leased land in the reclaimed area after the launch of the project. Both groups support the closing of the water gates of the dike as agriculture is their main livelihood (Fig.2.11). The farmers say opening of the gates will endanger their livelihoods and lead to loss of jobs. They stress the damage from salty water will be severe. They also claim their agricultural activities will be adversely affected by typhoons and flood disasters. As shown in figure 2.11, the farmers undertake agricultural activities that also include green house.

The Isahaya area is characterized by mountainous landforms to the North and South. The mountains are the sources of the many streams in the area and these streams join to form a river known as the Honmyou River. The streams and Honmyou River drain to the Isahaya Bay and bring a huge amount of mud every year. The farmers claim

Fig. 2.11 Agriculture in Isahaya reclaimed land
Photos: ASSEFAW Michael, July 08 2013

that, the major problem before the land reclamation project was the soil carried by the rivers. This soil remains on the flat land and floods the area that, according to them, caused difficulties for agriculture and settlement. The opening of the gates will destroy the blockage walls that exist on their land that are made from soil and mud. The mud blocks are erected at a height of 3.5 m.

The farmers claim the closed dyke enhanced drainage and agriculture both in the reclaimed land as well as the hinterlands. Furthermore they believe that the project prevents inundation and salt damage and hence it is promoting environmentally friendly agriculture with reduced fertilizers. Hence, they vehemently oppose the opening of the gates for the following reasons:

- Protection of agricultural production
- Disaster prevention
- Secure water supply for agriculture
- Improving drainage in the hinterland
- Contribution to farming in the hinterland

4.2 Fishermens' viewpoint

There are two groups of fishermen in the four prefectures around the Ariake Sea that are affected by the Isahaya land reclamation project. These include those who support the closing of the gates and a few others who support the project if they are compensated. However, the majority of fishermen are against the project and claims that closing of the gates has endangered their livelihoods. They claim their fishing activities have been affected due to the gate closure and in turn lead to job losses. They mentioned that the gross annual income from shellfish was around 2.2 billion JPY per year before the project. At this moment income is believed to be non-existent or zero.

The fishermen claim that closing the gate disturbed the natural settings of the Ariake Sea leading to a reduction in fish numbers and drastic declines in shellfish catch and larvae harvests. They remark that the reclamation project caused disruption of the natural coastal process and upset the natural balance of the Ariake Sea and resulted in a loss of marine life diversity. They further argue that young people abandoned the area due to the decline of fishing and hence created a social gap. Contrary to the farmers' argument of disaster prevention, the fishermen denote that construction of the dyke caused a new set of disasters in the sea by imposing changes in sea water movement. Hence, the fishermen oppose closing of the gates for the following reasons:

- To revert to the previous sea water quality
- To reinvigorate the fishing industry

- To restore the usual movement of the Ariake Sea and the surrounding ecosystem

Furthermore, the fishermen explained that the mouth of the Honmyo River near the coastal area is an important place for fish reproduction and growth. It is believed to be home to rare species of fish and other animals.

According to the order given by Fukuoka High Court in December 2010, the Isahaya Bay floodgates will be opened in December 2013 for an experimental period of up to five years. During the experimental period, the gates will be opened and seawater will join the lake. The trial will focus on the assessment of impacts of opening the gates on the farms and fishing industry. It will be used to analyze the link between the reclamation project and decline in fish numbers.

4.3 Land Reclamation experience of other countries

Land reclamation has a long history in many countries as a process of creating new land from water bodies (ocean, sea, river or lake). The need for new land to fulfill human needs has been growing. With the growth of population, enhancement of industry and rapid economic growth and higher rates of urbanization, a number of countries started to reclaim land. However in most cases environmental issues have been neglected.

According to the Foundation for Seas and Oceans [18], 20% of humans live in less than 25 km away from coasts and 39% live within 100 km of a coastline. Hence, several problems have occurred due to land reclamation that directly affects people living in coastal areas particularly those whose livelihoods depend on fishing. Various conflicts have arisen centered on the conservation of tidal flats and economic development by reclamation. The Netherlands has a very long experience of reclaiming tidal flats (up to 7,000 km^2 in total) due to its limited land resources. Land reclamation of tidal marshes along the Wadden Sea coast of Germany was also an issue of concern in the 1990s [19].

When the issue of land reclamation is raised, South Korea is one country with various experiences. For instance, Lake Shi-Hwa is an artificial freshwater reservoir found to the west of Seoul, South Korea. It was formed by reclaimed freshwater and hence a dike of 12.4 km was constructed in 1995. However, its water was polluted due to disposal of untreated water into the lake. It was reported that this damaged fishing activities and coastal wetlands. Manik Hwang [20] mentioned that water quality in the lake was so serious that all polluted water had to be dumped into the ocean by breaking the dike for irrigation and farmland. The problem is believed to have caused the disintegration of several coastal communities.

Furthermore, the case of Lake Shi-Hwa raised concern regarding another land reclamation scheme known as the Saemangeum project near Seoul. The project started in 1991 with the aim of reclaiming 40,000 ha to create a farmland area of 28,300 ha and a freshwater lake of 11,800 ha [18]. A 33.9 km long dike replaced 100km of coastline in 2010 to make the world's longest seawall ever built. The Saemangeum estuarine area was an important habitat for migrating birds and home to many other species. It was a feeding ground for about 400,000 migrating birds on a round trip between Australia and Asia, Alaska and Russia [21]. The reclamation led to a loss of avian biodiversity and to the loss of a wide range of environmental services provided by inter-tidal wetlands [21]. The project is believed to have caused the disappearance of tens of thousands of fishermen and their families due to the destruction of the tidal flat ecosystems [18]. Thus, a number of protests have been taking place including local fishermen, religious leaders, local people and environmental groups. They expressed their opposition through hunger strikes, stay-up-all-night campaigns, submission of petitions, down town bicycle demonstrations and critiques by professors [18]. Such disputes also led to law suits in 2003 and later.

After completion of the dike in 2010, the seawall is still being reinforced and work has only been undertaken on several small stretches of inner seawalls [21]. The project is looking to devote 70 % of the reclaimed area to industry while 30 % is meant for agriculture. The current government has also planned to bring forward its completion to 2020 instead of 2030 while local communities and environmental groups continue to lobby for opening of the gates and the restoration of tidal flats [21].

In other cases, the political tension between Singapore and Malaysia is also a typical case of land reclamation conflict. Malaysia opposed a land reclamation project in Singapore and Indonesia has also banned sand export to Singapore. These circumstances indicate that land reclamation is a serious issue as it affects livelihoods, the economy and the environment. In many cases, it has been politicized and manipulated during elections and other political events.

5. Discussion

5.1 ASSEFAW, Michael

The land reclamation project of Isahaya Bay is a very complex socio-economic and environmental issue. Generally speaking, the impacts of man on the environment are getting worse with current luxurious and rapid lifestyle expectations in developed countries. Once the natural environment is changed it is extremely difficult to return to its original state. In the case of Isahaya Bay, the tidal flats have been reclaimed and

changed to farmland. In its natural setting, tidal flats serve as a sanctuary where fish and shellfish lay their eggs and develop. It is a source of rich food and becomes a good wintering site for migrating birds. From the fisherman's point of view, the sea is their life and any impact on the sea also directly affects their life. On the other hand, farmers are carrying out their livelihood activities on the reclaimed land. Furthermore, the problem remains complex as it involves not only farmers and fishermen but also other stakeholders, which include government bodies, non-governmental organizations and residents in neighboring areas. There is a heavy conflict of interest among these groups.

Keeping this in mind, I think it is impossible to satisfy both groups particularly, the farmers and fishermen. Whether we like it or not, any kind of decision will favor one group while disfavoring the other. This is a situation where an environmental issue demonstrates a real challenge. There is no doubt that agricultural development is necessary to fulfill an increasing food demand, but it should never be at the expense of the environment. The Isahaya land reclamation project is a big lesson on the importance of environmental impact assessments and comprehensive study before promoting projects on any scale.

As the Fukuoka High Court has ordered the opening of the gates for the next five years, the way forward should be to carefully analyze the impacts by involving researchers from multiple disciplines. A comprehensive and detailed study should be promoted on the complex ecological functioning of the bay. With the opening of the gates, it's obvious that the farmers will need support but it should be in a way that doesn't result in a negative impact on the sea. The combined achievement of fishing, farming and environmental conservation is hard to achieve in the Isahaya bay land reclamation area.

5.2 MIKI, Yurisa

I learnt about the problems of the National Isahaya Bay Reclamation project, especially about local culture. I studied about the benefits from the sea, not only for fishermen but also for other people, such as tourist businesses and retail stores.

At first, I felt anger towards the farmers' because traditional and valuable cultures have been lost by the reclamation project. For example, fishermen lost their jobs; tourist businesses could not attract customers because of a decrease in fish and seashells. The reduction in young people contributes to the dullness of cultural activity. In addition to the destructive impacts on fisheries, the fishermen said that the reclamation project also negatively affected the young population.

However, I was surprised at the lives of the farmers. The farmers cultivated crops in vast fields for some years. This production for farmers is their livelihood activity. The reclamation projects began all over Japan after the 1950s. They took a long time, so a

new culture had time to develop. The reclaimed lands support local people products and most people even fishermen must receive benefit from these farms. This is a fact.

Someone asked us a question, “Which is better, opening or closing the gate?” Most people will be distressed, but I won’t be. Both are not adequate answers to this problem. I think the most important cause consists in the social system of local and central government. Ideally, government has to gather both opinions and stand on a neutral position. Particularly the social system of local government strongly relates to lives of people who live there. They should think about benefit for both sides and decide after a comprehensive review. The main cause of this reclamation problem is that government supports only one opinion without wide consultation. They consider only the scientific facts from a survey of the ecosystem. Cultural facts are difficult to measure, however the opinions of fishermen clearly include facts.

This problem is not a conflict between fishermen and farmers. Projects forced through by government need to consider every opinion from the local population. The worst effect of any project should be investigated beforehand.

5.3 LU, Mengqian

To my great surprise, Isahaya City is beautiful and peaceful. The sky is so blue and the large shadows from the clouds float on the sea. I could not imagine how this land used to be. I thought the atmosphere here would be gray and depressed but I was wrong. I began to understand why fishermen want to retake their sea and why farmers want to protect their farmland.

I wondered whether just opening the breakwater and considering nothing else is the best way to solve the problem. I believe not. As we have discussed above, just opening the breakwater will cause a chain of new problems similar to those caused at the beginning when it was decided to build the dyke without long-term considerations. People often gloss over final decisions and suggest they are right in hindsight and others are absolutely wrong. I think nothing is absolute. We should cautiously judge which side is more important and how to deal with the overall consequences.

Whichever position is eventually chosen, I believe it’s a hard decision. Even though I support the opening of the breakwater, I totally understand the feeling of people who have to leave the farmland where they have lived, worked and loved.

After we finished our trip, Mr.Tokitsu a member of the NGO, came to say good-bye and expressed the view that he hoped we could meet again after the breakwater has been opened. If the breakwater is finally opened, I really hope they will be well prepared, especially for flooding and high tides and I also hope there’s a way to keep the farmers on their land

5.4 DING, Jielu

At the end of this year, the gate of Isahaya Bay will be opened. I agree with this idea. Although reclamation promotes local agricultural business and guarantees disaster prevention for some local people, I think the negative consequences of reclamation work are much greater than the positive.

First, I prefer to focus on the relationship of the local businesses of fishery and agriculture. We know, the Ariake Sea is a natural fishery ground and has rich resources. The reclamation project caused seawater pollution problems and caused a large number of aquatic products to disappear. According to the statistical data published by local government and some research reports, the whole cost of building Isahaya Bay including the construction fee was nearly 250 billion JPY, the consideration money which local government pay to fisherman or fishery organizations was 27.92 billion JPY, as well as annual maintenance and environmental administration cost. If we compare the benefit of agricultural business with the cost of building Isahaya Bay, the cost of abandoning fishery business is much higher than the benefit of developing agricultural business. So considering its economic aspect, I don't agree with the Isahaya Bay reclamation project as a suitable project for local development.

Second, I would like to comment on flow disaster and safety of water quality. Building a sea dyke can protect local people from flow disasters to some extent. However, the height of the sea dyke is 7 m, and if the tidal wave is over 7m, it is difficult to deal with this problem. According to interviews with some concerned people, when tidal waves occurred before the reclamation work, the influence of the tidal wave was limited to people who live near the Ariake Sea because of the many streams and rivers flowing into the Ariake Sea. These streams and rivers can share responsibility for tidal flow. However, the reclamation project blocks the joining of Ariake Sea and the rivers. I believe it will be an issue of concern in disaster prevention. Another concern is the reservoir. During the fieldwork, we saw the color contrast between the water in the reservoir and outside the reservoir. The water in the reservoir is not good, if this situation worsens, the water cannot be used for agriculture and other purposes. This means the effectiveness of Isahaya Bay will decrease.

In conclusion, I think, in order to improve the condition of Ishaya Bay, opening the gate is a good idea, though, after opening the gate, the existing problems cannot be solved immediately because time is necessary for the recovery of local ecological conditions.

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Part 3.

Looking back at Minamata Disease: Viewpoints of Engineering, Economy and Environment

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1. Internship in Minamata City

1.1. Before visiting Minamata City

I would like to explain about Minamata disease through consideration of the EDL special lecture and the domestic internship. The lecture was brilliant and easy to understand. It reinforced ideas about “different views from different sides” and “the difference between information and knowledge”. At the beginning of the class, the lecturer explained three words, which are Direct view (近景), Birds eye view (遠景) and Magnified view（拡大図. Until the end of the class, I did not understand exactly why he emphasized these three words. He highlighted the fact that if standpoints are different, ideas can be different. In the case of Minamata, there are many stakeholders such as patients, fishermen, Chisso, Kumamoto University, Tokyo Institute of Technology, the mayor of Minamata, Government of Kumamoto prefecture and the National Government. Stakeholders insist on their opinion or their standpoint. Also, I realized that I just knew or heard about “Minamata disease”. I learned about this tragedy many times in elementary school, junior high school and high school. I thought knowledge is just information. It is not knowledge. I just knew the term ‘Minamata disease’ as a phrase in a textbook. I did not know the facts. I felt ashamed as a Japanese person that I did not have any knowledge about Minamata disease.

After class, I started to read “Minamata Disease, written by Harada Masazumi”. Fortunately, I borrowed this book from my school program. This program organized for students to visit Minamata and my group had to explain about Minamata. My part of this explanation is “Why Minamata disease occurred? (Water pollution due to technical production processes in the factory) ”. The reason why I chose this topic is because I majored in industrial chemistry. This is related to the process of producing methyl mercury. As I have a science background I felt a responsibility to share my knowledge with other internship participants. Some classmates looked like they didn’t understand the chemical processes involved when the lecturer explained catalytic reactions.

When I read this book, I was filled with anger at the behavior of Chisso. I cannot believe how cruel they were to Minamata patients and residents.. They knew their effluents were poisonous to human beings and deceived the public through use of scientists and misinformation. They should feel strong guilt, as what occurred is unforgivable.

In conclusion, we should obtain information and improve knowledge so as not to make the same mistakes as those in Minamata. I am really sad when I heard recent news from Minamata, that in a soccer game, junior high school students said to students from Minamata city “Do not touch me I don’t want to be infected with Minamata disease.” Until people in Japan have true knowledge, and understanding the problems associated with Minamata disease will never be over.

1.2. After visiting Minamata

Even before the occurrence of Minamata disease, I found there was a long history of poverty and discrimination towards Japanese in this area. Before I visited Minamata my big question was why did it take such a long time to solve Minamata disease and I received the answer from our internship.

First impressions of Minamata city, suggest there are really beautiful places and the landscape looks like my family hometown, Iwagi-jima (岩城島), Ehime prefecture. We can see the ocean surrounding the islands. I did not expect tragedy to have happened in this beautiful city. We first visited the Minamata Disease Museum, which is located in downtown Minamata city. Mr. Ogata Masami is a guide in the Minamata Disease Municipal Museum. He was certified as a Minamata disease patient in 2007.

Minamata has had a strong hierarchy since the Edo era and the social class system still exists in the countryside today based on previous generational practices. In Minamata city, the upper class lives downtown. On the other hand, lower classes live around coastal areas or places far from downtown such as in the mountains. Most of the lower class were from the Amakusa islands and moved to Minamata more than 100 years ago during the Edo or Meiji era. They have been discriminated against and shown little respect by the local inhabitants of Minamata city, because the Amakusa region was famous as a poor region. We learned they believed Chisso hid information from the Japanese government since Edo times even though this was prohibited. In my family hometown, my grand-parents told me that no respect was shown to fishermen. This was because, their ancestors moved from different regions in Japan. My family hometown and Minamata city is linked in this social system. Unfortunately, the onset and most of the later patients were from this residence area. People in Minamata thought the reason why they suffered was due to socio-economic reasons. They suspected patients could have eaten rotten fish because they did not have enough food. Actually, they ate lots of fish. Patients from the lower classes were more severely discriminated against than before. They were socially ostracized from the

community. Neighbors seldom visited them. When somebody did visit, they covered their mouth in front of the patients. They were afraid of being infected. Behavior associated with Minamata disease hurt patients and slowed its cure. I could not believe this sort of behavior　happened in Japan just 50 years ago.

Minamata disease also occurred in Niigata. “Living on the River Agano” was filmed in 1992. This movie focused on the life of people who lived around Agano River, in which Syowa Denko released methyl-mercury into the drainage. People have been eating fish from the Agano River since ancient times and ingested toxic chemical substances from the effluent. The developed industry destroyed their life and lifestyle however the company had a strong influence in this city. Nobody could fight against it. This is the same situation as Minamata. The city　depends on just one company. There is one clear difference between the diseases in Minamata and Niigata. People who live near Agano River weren’t originally discriminated against. They did not have a complicated class system like that in Minamata. This is one of the reasons why lawsuits in Niigata occurred earlier than Minamata even the disease onset happened after Minamata.　Showa Denko（昭和電工）has already withdrawn from Niigata. This means the regions that suffered don’t rely on Showa Denko and the town can survive without company influence.　The resistance shown towards Showa Denko is the biggest difference between the two outbreak scenarios.

1.3. Conclusion

I knew poverty and severe discrimination existed in Japan and but did not know we sacrificed many lower social group people and the environment instead of developing our country. I was born in 1988, Showa Era 63 years (昭和 63 年). Five months after my birth, Showa was over. People generally said that Japan in the Showa Era caught up to western countries up and passed them. We changed from poor to rich and we cut and abandoned old practices even though some people still lived according to the olden style. However, I did not have any experience of when Japan was challenged and still poor. We should know that our life was based on a heavy price. Those who accept wealth have the responsibility to contribute our experience to developing countries to avoid tragedy.

After my graduation, I will work in a chemical company from next April and I should keep in mind what happened in Minamata and around Japan.

2. Big mistakes led to Minamata Disease

After World War II, while the world in general and Japan in particular experienced many difficulties in the development of society and economy, the Chisso Company still continued developing and was considered an economic success in Japan [6]. However, there were many problems such as low awareness of environmental protection and safe production. In detail, this company discharged wastewater into the sea without any treatment for a period of 60 years; even the administrators of Chisso Company knew that its wastewater effluent was the cause of a strange disease. In their chemical production processes they did not pay enough attention to construction and chemical reactions. Especially, Chisso never carried out appropriate damage surveys or took any countermeasures to monitor and control environmental pollution.

Before Minamata disease occurred and the causative substances were found, the issue of fishery damage surfaced, Chisso escaped their responsibility and compensation negotiations reached no conclusion and the issue faded. The Chisso Company did not accept any responsibility, as there was no scientific data to support the claimants. Finally, in 1954 Chisso admitted to limited compensation for past and future damages to fishing [6]. Moreover, Chisso played an important role in the economic development of Japan. It paid about 60 % tax revenue and contributed approximately 80 % to the economy in Japan; Chisso's production of acetaldehyde was the largest in Japan, and a large amount of mercury was used for the production process. We can say Chisso's presence in the community was a very important contribution to the local economy as well as local employment and overall Japanese development. Therefore, the government could not prevent its production. When wastewater from the Chisso Company was considered the cause of Minamata disease the company constructed a waste treatment system and purification facilities although this system was completely ineffective and carried out such a deception.

Many people worried about the possible negative impacts of stopping acetaldehyde production on Minamata's local economy and Japan's high economic growth. Even though, they knew clearly that the Chisso factory seriously harmed the environment and human health. It is believed that engineers played very important roles in the management of almost all aspects of technologies. They could plan and innovate new production methods for chemicals such as Acetic Acid. However, engineers themselves did not assess the quality control for production processes as methyl mercury harmed the environment. When environmental pollution occurred due to wastewater from Chisso Company effluent, the engineers kept silent, avoided responsibility and rejected coordination with researchers and others to investigate the causes of Minamata disease. In 1956, the first case of Minamata disease was found. At that time expectations were that Chisso would take responsibility and immediately monitor and control environmental quality during production processes, particularly in regard to water drainage treatment as well as pay attention to safety processes for employees' safety and health. Between 1956 and 1963, many research groups focused

on finding the cause of Minamata disease and finally it was officially recognized. However, all attempts by researchers were ignored and Chisso company production continued to harm the environment and human health. We can see clearly that the role of engineers in Chisso Company was hidden due to complicated reasons. The engineers should have paid more attention to their responsibilities in regard to monitoring and control of environment quality, safety production processes and employee health and safety. When Minamata disease occurred, the engineers from Chisso Company needed to take responsibility and the initiative to coordinate with officers and researchers to find out the causes as soon as possible. They could have initiated an industry wide reformation, developed innovative new engineering standards to prevent accidents happening again and launched new safety production standards to oversee an environmental friendly and sustainable business. Perhaps, Minamata disease would not have occurred and a similar serious situation could not occur even until today if the above measures were implemented.

One of the most difficult points in overcoming the effects of Minamata disease were flaws in the legal system, so people did not have a base from which to control negotiation. Until December 1970, the Water Pollution Control Law was applied, followed by the nationwide uniform regulation of the discharge of toxic substances such as mercury and in 1973, the government enacted the Provisional Regulatory Standards for the Level of Mercury in Fish and Shellfish, requiring total mercury to be less than 0.4 ppm, and methyl mercury to be less than 0.3 ppm.

3. The efforts to make more safe life after Minamata Disease

During our field trip, we had a good opportunity to visit some very important places such as Minamata Municipal Museum, Kumamoto government, Minamata City office, R.B.S Tsukinoura Center, Soshisha, National Institutes for Minamata Disease where staff helped us to understand what sufferers of Minamata Disease experienced as well as the significant efforts to rehabilitate the environment after Minamata Disease was recognized as the first serious health problem related to environmental pollution as a result of human activities.

3.1 Kumamoto prefectural office

On July 9th 2013, we visited Kumamoto prefectural office. We had a lecture on Minamata disease from Mr. Yoshito Tanaka, who is Director of the Minamata Disease Division, Kumamoto prefecture, Japan.

Fig. 3.1 Mr. Yoshito TANAKA introduced Minamata Disease problems
Photo: TOMIMATSU Kohsuke, July 09 2013

In the lecture, Mr. Tanaka shared the history of Minamata disease as well as the efforts and difficult issues that government faced at that time to prevent Minamata Disease. From 1956 to 1963, Kumamoto prefecture took steps to discover the causes of Minamata disease on May 1st 1956 followed by establishing official recognition of Minamata disease on May 28th 1956, together with the creation of the Minamata City-Rare- Disease Task Force. On July 27th 1956, in order to implement the decision of the Rare-Disease Task Force, most patients were isolated and kept in the Minamata City Hospital. On August 3rd 1956, researchers from Kumamoto University were asked to investigate the main causes of Minamata disease. As a result, Kumamoto researchers reported that the main cause of this disease came from heavy metal, especially manganese and wastewater released by Chisso Company into Minamata Bay. Based on this report, the prefectural Government announced to residents to avoid consumption of seafood products from Minamata Bay and applied the Sanitary Food law, however this law was rejected by the Ministry of Health, Labor, and Welfare in Sept 11th 1957. On August 21st 1958 the prefecture instructed the Fisheries Cooperative Associations to stop all fishing within Minamata Bay. However, at that time, local residents surrounding Minamata bay were very poor, they still consumed seafood and Minamata Disease continued to spread and the causes of this disease were still secret. After remarkable efforts and a long time, on February 20th 1963, the main cause of Minamata disease were found by a Kumamoto University investigation team, who reported that methylmercury from the wastewater of Chisso company was main causative substance. However, neither government nor the Chisso Company confirmed this fact, and until 1989 the central and local government took necessary steps to solve this disease. Through this lecture we understood why solving Minamata disease is so difficult and took a long time. Firstly, when considering medical aspects, Minamata disease occurred with various symptoms such as sensory disorder, ataxia, vestibular disorder, afferent constriction of the visual field, dysarthria and these symptoms were very hard to validate. Secondly, in regards to community

structure, it was believed that Chisso Company at that time played a very important role in Minamata City, which was called a "Chisso company town". As a matter of fact, almost all residents and even government depended on the Chisso factory to provide jobs and other products . Finally, at that time Japan lacked environmental laws, therefore it was very difficult to punish Chisso Company.

3.2 Minamata city officer

On July 9th 2013, we visited Minamata city office where city officials gave us an overview of Minamata Eco-Town and they explained why it was established and the concepts behind it. Minamata Eco-Town was founded in 2001 as a significant effort to revitalize the community in Minamata City. Minamata Eco-Town covers around 16,300 ha of Minamata City. Minamata Eco-Town set up two kinds of facilities including bottle reuse and recycle facilities and a waste plastic compound resin recycling facility to meet the main concepts of an Eco-Town. It is one of 26 Eco-Towns throughout Japan that is supported by the Japanese government with a total budget of around one billion Yen. The main concepts of Minamata Eco-Town as follows [7]:

1. "Multi-stakeholders involvement" in which administrations, industries and citizens unite with the aim of creating a sound recycling society and harmony with environment.
2. "Community based approach" to achieve 4R (refuse, reduce, reuse and recycling) by utilizing first-hand materials and technologies.
3. "Model for middle scale cities" which differs from conventional styles such as those in complex larger cities.

In order to achieve the above concepts, many solutions have been implemented such as controlling waste generation by using a reuse system of one-way bottles as shown in figure 3.2 According to this system, waste from households and restaurants will be collected and sorted. After this the bottle is washed before inspection. Later these bottles will be packaged and shipped to manufacturers for reuse.

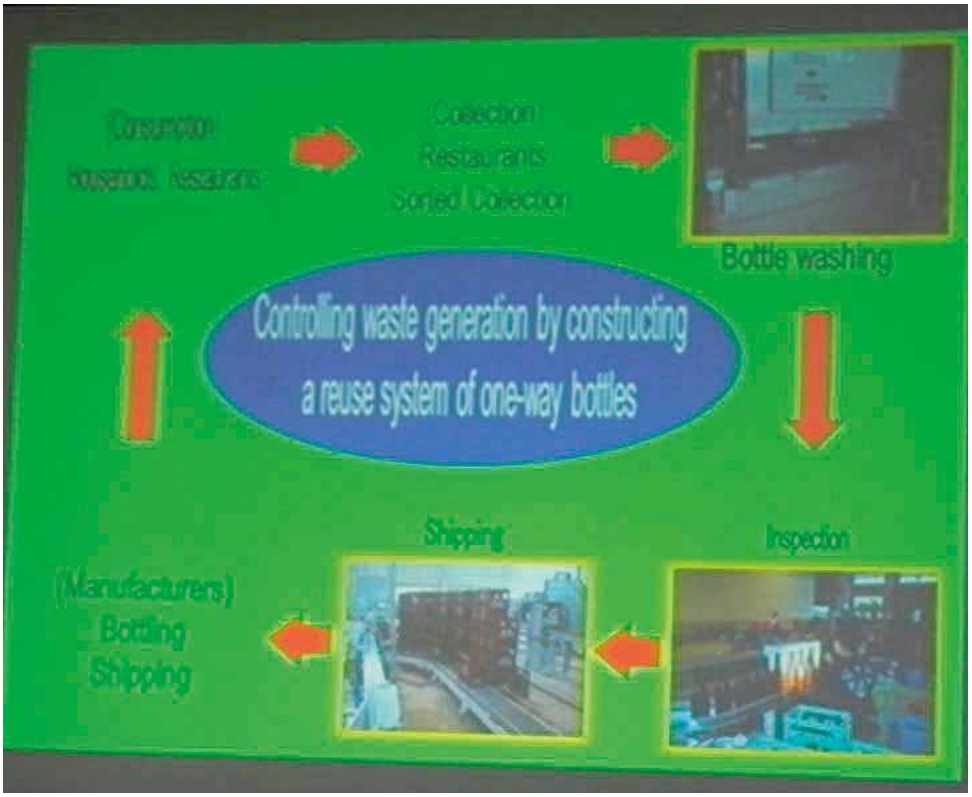

Fig. 3.2 Waste generation control system in Minamata Eco-Town [8]. Photo: TRAN An, July 09 2013

All companies in the Eco-Town are required to follow the above three concepts. Currently there are 7 companies situated in Minamata Eco-Town; one of them is the R.B.S Tsukinura Center that applies innovative technologies to reuse human solid waste from residences surrounding Minamata city.

3.3 R.B.S Tsukinura Center

During this field trip, we visited R.B.S Tsukinoura Center, which is a stakeholder of Minamata Eco-Model City. The R.B.S center is located close to the sea; it was built and operated by the Private Finance Initiative (PFI). Human waste from three collection areas, including 16,800 households from Minamata City, Tsunagi town and 40,000 households from Ashikita town are collected and treated to provide bio-fertilizer production. The R.B.S Center is the first human waste treatment plant in Japan; it was designed and built by JNC Environment Company in September 2001. During the lecture, we received general information of the R.B.S Center as follows:

- ✓ Acceptance time: 6 hours/ day, 6 days/week. This is the schedule for collecting human waste from households in collected areas.
- ✓ Employees: 7 persons, this is the total staff to operate the R.B.S Center.
- ✓ Sewage acceptance: 95 m^3/day

- ✓ Processing time: 24 hours/day
- ✓ Processing systems: Microbe processing (Reactor Bio System)
- ✓ Discharge to a sewer: 105 m^3/day
- ✓ Sludge fertilizer production: 975 kg/day

Fig. 3.3 Bio- fertilizer production from the R.B.S Center. Photo: BUI Van, July 09 2013

One of the advanced technologies applied in this system is the RBS (Reactor Bio System) that uses a kind of special soil bacteria to purify human waste. This system has many advantages such as controlling the odor from artificial waste easily, high capacity for waste purification, using sludge. Direct processing of the high BOD sewage can be carried out without dilution. The fertilizers (Fig.3.3) from R.B.S Center are very useful for agriculture production thanks to their high nitrogen content and friendly with environment. This production now is used widely through Japan and has high potential for export.

3.4 Minamata Disease Center Soshisha and field trip

During this trip, we went to the Minamata Disease Center also known as the *Soshisha* museum. The purposes of this Center is to help Minamata Disease victims with related issues in the their daily life as well as to conduct research work on Minamata Disease. During the outbreak period of Minamata disease around 1956 to 1963, this center was home of many patients and a lot of researchers came to find out causes of this disease. Today, this center is a well-known place not only for local residents but for people throughout Japan and overseas to pray for patients who died from Minamata Disease and reminds us that Minamata Disease is not cured yet. The *Soshisha* Center is very important place, which records the daily life of Minamata residents during the disease period, so we can understand their daily life. As shown in figure 3.4, fish was the main food of many Minamata residents because fishing was their main job rather than farming due to lack of agricultural land.

Fig. 3.4 Many local residents depend on Fish as main food

Photo: NGUYEN Tam, July 10 2013

Fig. 3.5 Wastewater contained Methyl mercury discharged into Minamata Bay

Photo: NGUYEN Tam, July 10 2013

This is an easy way to absorb mercury and get Minamata disease. Because the methyl mercury in wastewater from Chisso Company discharged directly into Minamata Bay without treatment it entered into the food chain via various processes (Fig.3.5).

During this trip, we also visited the first patient of Minamata disease and looked at the outside of the Chisso Company with a guide, Ms. Nagano to understand the current situation after more than 60 years. She said “even today, many patients and their family are very shy when we take photos because this can remind them about what they have experienced in the past". She also shared with us that "Chisso Company still plays a very important role in Minamata City, many local residents work in this company and they never talk about Minamata disease".

3.5. Minamata Municipal Museum

Significant attempts were made to help sufferers and their families overcome Minamata disease. Minamata Municipal Museum (Fig.3.6) was established to collect and preserve valuable material about Minamata Disease and to ensure that Minamata Disease never happens again in the future [9]. Through pictures, storytellers, presentations and annual exhibitions, we know more about the hard situations faced by patients and their families.

Fig. 3.6 Minamata Municipal Museum
Source: http://www.minamata195651.jp/guide_en.html (Minamata Disease Municipal Musium homepage) (Data accessed: 8th August, 2013)

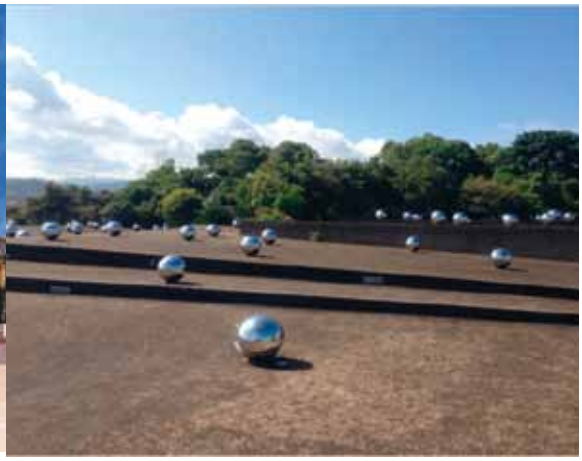

Fig. 3.7 Minamata Memorial is the main symbol of Minamata Disease. Photo: BUI Van, July 10 2013

As the main part of Minamata Municipal Museum, the Minamata Memorial, Fig. 3.7, was completed in October 1996 and is an outstanding symbol to remind people of Minamata disease. The objectives of the Minamata Memorial are 1) offer prayer and requiem for those sacrificed to Minamata disease 2) as a pledge, based on the experience of Minamata disease, to never allow its repetition; and 3) pass on the lessons of Minamata disease to future generations [3].

3.6. National Institutes for Minamata Disease (NIMD)

Before Minamata disease occurred there was limited knowledge about health problems related to Mercury and this resulted in Minamata disease continuing over a long period. Therefore, establishing the National Institute for Minamata disease to do research on Minamata disease is vital. In October 1978, the National Institute for Minamata disease was founded to study all aspects of the disease and improve comprehensive treatment methodologies for sufferers and related people. The Institutes also collaborate with other health centers throughout the world and World Health Organization (WHO) to do research on the health effects of organic mercury.

During this trip, we had a good opportunity to learn more about the characteristics of mercury; the flow path of mercury in nature and how it affects human health. We also conducted a mercury test using hair analysis at NIMD. In total, 9 students from Vietnam, Laos, Mongolia, Latvia, China, and Japan were selected to conduct an experiment of mercury concentration in hair. The method is very simple way to find out the mercury level in the hair of each person. However, this method just provides basic information of mercury content in our body, for more accurate information on mercury concentration other testing methods such a breath testing, urine testing and so on should be used. The hair analysis process took around 15 minutes for each

person; we spent more than 3 hours testing mercury with the support of professors from NIMD. The result is shown in figure 3.8 below; fortunately everybody had a safe exposure level in comparison with WHO standards for Mercury as shown in figure 3.9. Generally,

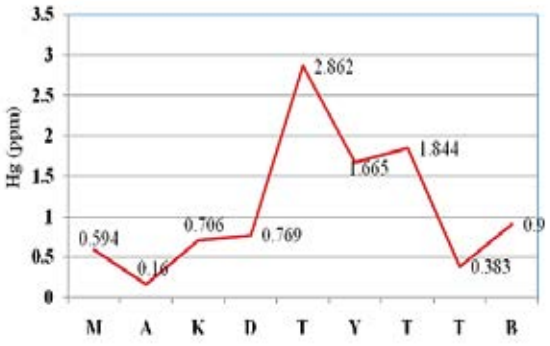

Fig. 3.8 The Mercury results of Hair analysis
Source: National Institute for Minamata Disease

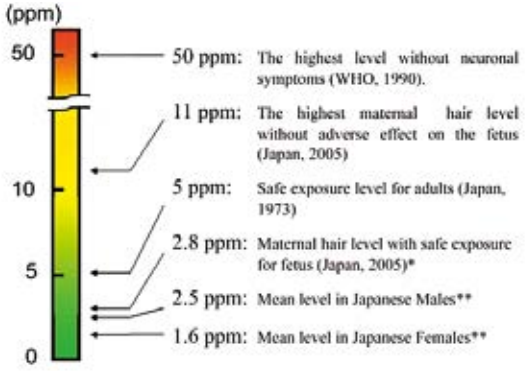

Fig. 3.9 Reference for hair mercury levels
Source: National Institute for Minamata Disease

Mercury is very an important chemical, used widely in medicine, gold mining, and electrical industries. It is divided into main three forms, including: metallic mercury, inorganic mercury and organic mercury. These forms can be converted from one to another; however the most toxic mercury is methyl mercury. The real mechanism under which mercury enters the food chain is unknown. However, it is believed that certain bacteria play a crucial role at the first point of the food chain. At this point, bacteria that contain methyl mercury are consumed by a successor in the food chain such as plankton, small fish and big fish. In case of Minamata disease, Methyl mercury was discharged from the Chisso Company into Minamata Bay for a long period without any treatment and it accumulated in aquatic organisms throughout their gills or intestines directly, or via the food chain. When humans eat polluted fish, the methyl mercury easily enters into the human body as shown in figure 3.10 and this process is called bioaccumulation.

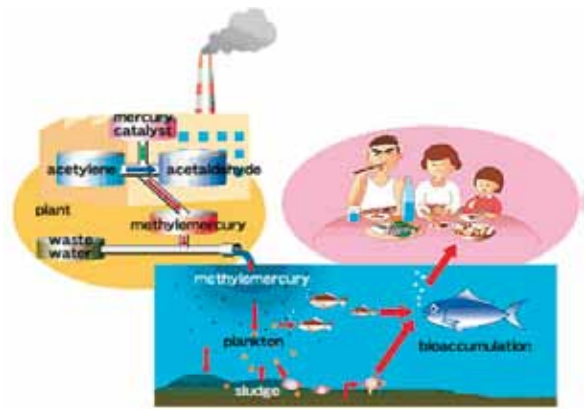

Fig. 3.10 Pathway of methyl mercury,
Source: NIMD, 2010

Depending on many factors such as the amount of fish, time spent consuming the fish and others, each person has different symptoms. Methyl mercury easily entered and accumulated into the human body via the food chain. As a result, after eating fish, many people living around Minamata Bay had various symptoms and it is very difficult to know exactly what happened to these people.

3.7 Conclusion and Discussion

What happened in Minamata City reminds us that pollution prevention is much more important than pollution treatment. The Minamata internship activities in Kumamoto prefecture, and visits to Minamata City offices, National Institutes for Minamata Disease, Minamata Municipal Museum allowed us to understand a part of what Minamata disease sufferers faced as well as the significant attempts to rehabilitate the environment and improve human health since these serious environmental and health problems occurred more than 60 years ago. At present, we live a modern life with advanced technology and innovation as well as well high awareness of environment protection; we cannot control environmental disasters due to many complicated factors. The Fukushima nuclear power plant disaster in March 2011 is a point in fact.. This case shows one more example where to keep human lives safe is difficult and we should make more efforts towards this this work and never stop.

4. Lessons from Minamata Disease (MD)

4.1. The relationship between government, company and local people

From the case of MD, we can see that the relationship between government, company and local people is very “weak” and where the environmental management was not good in Minamata Bay. We can say the above because it took many years from the appearance of Minamata disease before the main reason of this disease being determined.

If good environmental management and periodic monitoring had been implemented the reasons for MD would have been recognized sooner and resulting in a decrease in he number of patients. The arguments among stakeholders lengthened the time to find out information related to MD. This had a big impact on people, environment and society.

Fig. 3.11 Board of Minamata Memorial
Photo: ASSEFAW Michael, July 10 2013

Fig. 3.12 Monument of MD Cat
Photo: NGUYEN Tam, July 10 2013

From the field trip organized by Tsukuba University, we can understand more about Minamata and MD. We visited many places where we got information about Minamata such as from the board of Minamata Memorial (Fig.3.11).

In October 1996 with the 40th anniversary of the official discovery of MD, the Minamata Memorial was created. The roles of this construction were:

- As a prayer and requiem for those sacrificed to Minamata disease
- As a pledge, based on the experience of Minamata disease, to never allow the repetition of such a disease;
- So as to pass on the lessons of Minamata disease to future generations.

From 1997 to 2005, the Minamata Disease Victims Memorial Service was held annually on the Memorial Site”

We also visited the village where there are many MD cases and a monument for the cats used for experimental purposes during MD research (Fig.3.12).

Cats were chosen for investigation of this disease. After eating fish, the cats went mad and exhibited strange behavior before they died. The local people called it the “cat dancing disease”. They built a monument in order to remind them about MD recognition. Through this, the company found fish still contained mercury that led to MD when fed to cats.

4.2 Consideration of responsibility of Chisso Company

As a concept of social and ethical responsibility, the company has to balance between economy and the ecosystem during their production. The responsibility of one company avoids harmful activities for society.

According to the above concept, Chisso Company did not accept their responsibility at that time. It had a large number of high quality engineers but it took time to define "What is MD?". They focused on their products and did not think of the environment. They forgot the poisons they discharged.

In modern society, it should be thought of as the social responsibility of one company. This is related to the people's ethics. It is really difficult but it is very important. We can imagine that even though there are strong environmental laws there is very poor acceptance of responsibility, and there could be many problems with illegal activities.

Figure 3.13 shows the image of Hyakken drainage where waste was discharged from Chisso Company. Hyakken drainage was suspected to be the pollution source of wastewater from Chisso Company. From here, Methyl mercury poisoned the water of Minamata Bay and began the MD period.

Fig. 3.13 Image of Hyakken drainage. Photo: NGUYEN Tam, July 10 2013

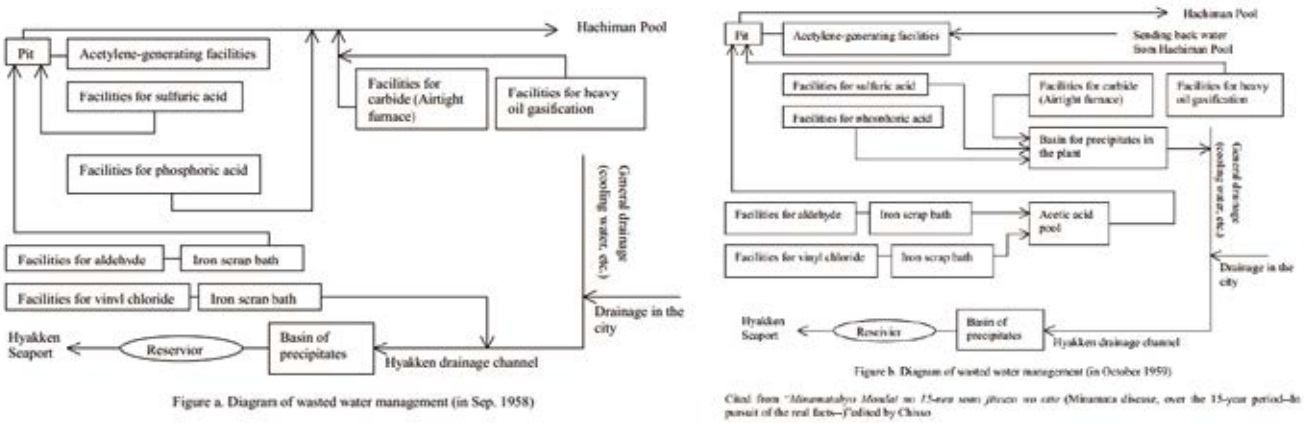

Fig. 3.14 The drainage system of Chisso Minamata plant (in September 1958 and October 1959)

4.3 Main lessons learned from Minamata Disease

Chisso was a big company with $200 million in assets in 1975 but it had to close because of trouble due to Minamata Disease in 1950. Chisso Company had a branch which discharged waste water into Minamata Bay and Methyl Mercury is the main reason cause of Minamata Disease. In 1953, the first case of this disease was recognized with symptom such as difficulty in moving hands and legs, hearing, language disorders and balance etc. In 1963, the Minamata authorities prohibited fishing in Minamata Bay.

From the fieldtrip, I learnt three main lessons from Mr. Yoshito Tanaka, that the prefectural government learned from Minamata Disease with which I totally agree:

First, he highlighted the importance of the natural environment and the source of all life. If they are destroyed, it will take much time and cost to restore.

Second, he recognized the responsibility of the prefectural government. Furthermore, I think that he should mention about the responsibility of Chisso Company also.

The last point he said concerned the attitude of government officials. They should stand in the position of the local resident. I think this is very important as officials should know and think as the local residents think.

In conclusion, the biggest lesson we should learn from MD is to think of the environment when we undertake any activity.

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Appendices

Schedule

Date	Schedule and Program	Transport
July. 7	05:30 Tsukuba center → Haneda Airport (07:10) Terminal 2	Bus
(Sun)	08:10 Haneda Airport → Nagasaki Airport (10:05): ANA661	Airplane
	10:30 Nagasaki Atomic Bomb Museum (12:30)	Bus
	12:50 Arrive at Tokiwa Ferry Terminal (light lunch, recommended)	Bus
	13:20 Depart for Gunkanjima Island (16:20)	Ferry
	16:30 Free time (around Glover Garden, Oura Catholic Church)	
	18:30 Hotel check in (Nagasaki Washington Hotel, Nagasaki City)	Bus
July. 8	08:00 Depart for Isahaya City	Bus
(Mon)	08:40 Megane Bridge (in Isahaya City)	Bus
	09:00 Shirakimine Highland	Bus
	10:00 Isahaya Bay Reclamation prefectural office (Reclamation land and dike)	
	12:00 Lunch	Bus
	13:00 Saga Ohura-Takezaki fishing port, Takezaki Castel Ruin Observatory	Bus
	13:30 Interview to Saga-Ariake Bay Fishermen association (15:20)→via Dike road (16:10)	
	17:30 Shimabara Port → Kumamoto Prot (18:00)	Ferry
	18:30 Hotel check in (Kumamoto Washington Plaza Hotel, Kumamoto City)	Bus
July. 9	09:00 Kumamoto Prefectural Government Building	Bus
(Tue)	11:00 Depart for Minamata (Lunch in bus)	Bus
	13:20 Interview to Minamata city officers	Bus
	(@Minamata Kankyo Techno Center, MKTC) (14:30)	
	14:50 RBS (Night soil and sewage sludge treatment plant) (15:50)	Bus
	16:00 Field work with SOSHISHA, the supporting Center for Minamata Disease	Bus
	1. Tour from window (around Chisso company)	Bus
	2. Minamata Disease Historical Investigation Museum	
	3. Tubodan district (Place of Official recognition)	
	4. Minamata bay reclaimed land water park	
	19:30 Hotel check in (Umi to Yuyake, Minamata City) and dinner	
July. 10	08:30 Hotel departure (via Hyakken Drainage outlet)	Bus
(Wed)	09:00 Minamata Disease Municipal Museum	Bus
	12:00 Lunch (Lunch box @National Institute for Minamata Disease)	
	13:00 National Institute for Minamata Disease (16:00)	Bus
	16:00 Depart for Kagoshima Airport	Bus
	19:10 Kagoshima Airport → Haneda Airport (20:55): ANA630 Terminal2	Airplane
	21:45 Haneda Airport → Tsukuba Center (23:15)	Bus

Group Photographs

▶ Nagasaki Peace Park [7th July, 2013]

▶ National Institute for Minamata Disease [10th July, 2013]