

## 2016 Ashio Field Trip Report



June 28, 2016  
SUSTEP Program  
JDS Program  
University of Tsukuba

## **Preface**

This is the second study trip to the Ashio area funded and organized by the SUSTEP Program and the JDS Program of the University of Tsukuba. As I wrote in the preface of the first report last year, the field trip to Ashio under these programs are very special as we brought environmental leaders from developing countries. In the past, many Japanese school programs, including our Master's Program in Environmental Sciences, have sent many Japanese students to this area for better understanding their own history. Global perspectives, however, have not been important part of these education programs.

On the contrary, most of the participants in the SUSTEP Program and JDS Program for this trip are young government officials from various countries where mining issues, including pollution and environmental destruction, are on-going and urgent problems. The participants' countries included China, Ghana, Kenya, the Kyrgyz Republic, Mongolia, Myanmar, Sri Lanka, and Vietnam. Our educational goals to bring these young promising individuals to Ashio is mainly to think about what may happen after the environment gets destroyed by mining activities. We wanted them to go beyond identifying problems; so, we showed the outcome of environmental restoration works that people in Ashio and volunteers have continuously undertaken in the last fifty years or so. In short, our message is this: with the strong will and efforts of people, it is possible to transform the desolate and barren valley into green forests.

Having read students' reports carefully, I can proudly say that they not only got our message right but also went beyond our expectation by providing insightful future visions. Some essays show how much they care about the future of their own countries. These essays also convinced me that Ashio can be the living heritage for those people in developing countries to learn about human ingenuity and perseverance.

In this trip, Mr Mikio Aoki and the Ashio History Museum helped us considerably. Mr Aoki, former resident of Ashio, is very knowledgeable guide for us. His wide ranging knowledge spanned from history to industrial development. He has also been actively involved in planting trees in Ashio. The rich historical resources at the Ashio History Museum have also aided and enhanced the learning of our students and me. So, on behalf of our students and the programs, I dedicate this report to them.

Kenichi Matsui (SUSTEP Program Committee chair, University of Tsukuba)

## **Schedule for Ashio Trip**

June 28, 2016

- 8:00      Leave the University of Tsukuba
- 10:30     Arrive in the Ashio Environment Study Center
- 11:30     Japan's first hydroelectric dam site and former village area
- 12:30     Ashio History Museum (lunch)
- 13:30     Kotaki area (former mine site)
- 14:30     Leave for Tsukuba
- 17:30     Arrive in the University

## The brief description of places to visit on June 28

### 1. The Ashio Environment Study Center and Matsuki area



[Above left] Tailing dam and reservoir in the Matsuki area. This photo was taken in 1971. It has held sludge produced from copper refinery downstream.

[Above right] This photo shows the same area and after reforestation effort for about 30 years. The photo was taken in 2011.

[Left] The on-going reforestation project by the Ministry of Land, Infrastructure, Transport and Tourism.

### 2. Ashio copper refinery building



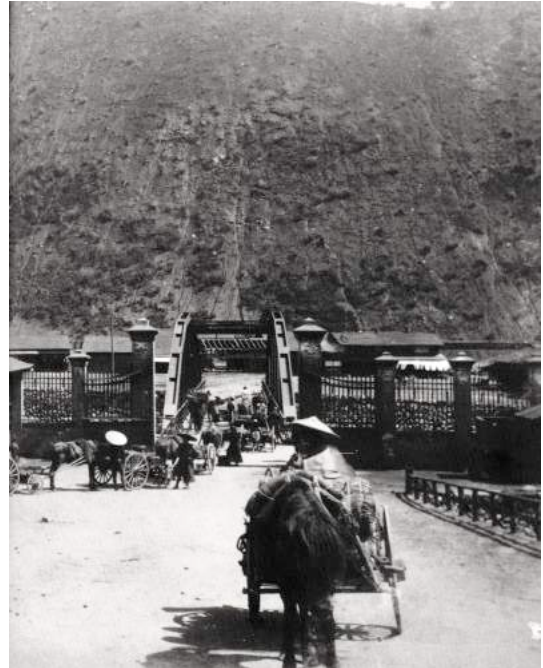
The refinery was originally established in this location in 1884. In the process of producing refined copper, it produced a large amount of sulfur dioxide gas into the air, partly contributing to the deforestation of the valley. In 1956, the refinery adopted new technology that dramatically reduced the amount of sulfur dioxide. It stopped operation in 1989. This building was designated as national historical heritage in 2014.



### 3. Furukawa Bridge



This bridge was built over the Watarase River in 1890. This is the oldest building structure still remain in Ashio and was designated as nation's important cultural heritage in 2014. The photo on the right was taken in the 1890s.



### 4. The remain of hydroelectric dam in Mato

The Furukawa Company, which managed copper mining business, introduced hydroelectric dam technology in the 1880s, after learning from German Siemens Company technician. This dam was completed in 1890 and was one of the first hydroelectric dams in Japan. The electricity was used for pumping water, discharging water from mine tunnels, and operating electric vehicles. A larger hydroelectric dam was built in 1906 and replaced this small-scale dam.

### 5. Public bath in the former Kotaki village site



After extracting copper ore in dusty tunnels deep underground, miners came here to clean. There were two layers of bathtubs. In the outer layer, miners cleaned the dust. Then they entered into the inner layer. When it was a rainy day, children were seen waiting in front of this public bath. They waited to give umbrella to their fathers.

## 6. Kotaki Mine Tunnel Entrance



In this area, copper was mined as early as the eighteenth century. In 1885, this area expanded and became the driving force for the rapid expansion of copper mining in Ashio. At one time, the population reached 10,000 with residential areas, shops, hospital and schools. The mine in this area closed in 1953 when the copper deposit exhausted.

## 7. Cenotaph for Chinese laborers



During World War II, about 257 Chinese laborers were forced to come from China to Ashio to work in the mine. Among them, 109 persons were said to have passed away. This cenotaph was placed in 1973 partly to keep this ugly part of Ashio's history remembered. Mr Kenzo Inose, former Japanese soldier who was involved in abducting Chinese laborers, mainly conducted this research. This research was published originally in the 1970s. Later Mr Inose found four survivors and conducted interviews, which were included in his later publication in 1994 (『痛恨の山河』).

# Ashio's Past, Present and the Future: In the View of Sustainable Development

B.G.S. Karunaratne (Sri Lanka)



## INTRODUCTION

The Ashio environmental pollution case is one of the renowned spatio-temporal incidents in Japanese industrial history. Ashio is an area in Tochigi prefecture, Japan. This area is famous in the world because of the first environmental pollution case in Japanese history. As the researches have proved, copper mining along the banks of the Watarase River since the seventeenth century was the cause of environmental pollution in the area. In the 1880s, the Ashio copper mining invested in basic machinery under the modernization policies of the Meiji government as it aimed to strengthen the Japanese economy through industrial development. As a result, the entire ecosystem, including water, air and soil, were polluted (1). The focus of this paper is to investigate the possibilities of sustainable development in the Ashio copper mining area.

## DISCUSSION

The Ashio pollution was not a single problem but a series of complicated issues. The copper mining operation continued for more than 170 years in Ashio, and made its adverse effects on both flora and fauna. This was true not only in Ashio but also in other parts of the Kanto area, because water of the Watarase River was widely used in the Kanto area. Deforestation is another remarkable effect as there was a great need to supply timber to the mining industry. The environmental conditions became unstable, frequently causing floods and landslides. Insects, birds, and others species disappeared. Crops in many parts of the lower stream were sterile. Child mortality grew high and diseases spread. As a result, some residents left their homelands (3).

According to article 10, paragraph 3 of the Japanese Mining Law, when mining activities become harmful to the public interest, the Minister of Agriculture and Commerce has legal power to concession. Mr Shozo Tanaka, MP in the government, actively stressed the responsibility of the government and dedicated to resolve the problem. Research findings of Yokoi Tokiyoshi and Nagaoka Muneyoshi used the court to urge the government to take actions on behalf of the public. The Kawamata trials are also vital in having the Japanese government to pay attention to this copper pollution problem.

Restoration efforts of the Ashio valley began in the mid-twentieth century.(7) The local community launched together with the government to facilitate these efforts for the future generations. This type of reforestation activities is absolutely important and advisable for the further development of restoration projects. The writer's opinion for this reforestation project is



that it is better if the community (the public) plant different kinds of suitable plants, which are also edible for both humans and animals. Further, it is better if the community can implement SALT technique (Sloping Agricultural Land Technology) for soil conservation activities in the area, because most of the land in the valley is over 60° slope. To launch new development programs such an attempt would further ensure the future sustainability in the Ashio area. Environmental protection programs can be included in the school curriculum regarding this issue for the betterment of both the environment and awareness of children. Schools may assign specific land blocks to each student to promote environmental protection activities.

Under the present situation of instability of land structure, it is better if more new programs will be launched to protect the land from gully erosion. It seems that no thorough attention has been paid for the construction of check dams in the catchment area to sustain the hydrological system.

Another considerable issue in Ashio is the decreasing population. In the last few decades, the population decreased from about 50,000 to less than 10,000. Now is the time to enhance the public facilities in the Ashio area. The central government and the prefectural government have legal power to do so. The private companies can initiate tourism promotion campaigns by introducing adventure parks. A heliport can be established and ecotourism can be developed for both residents and businessmen. Hydroponics and greenhouses can be promoted to enhance the production and the sustainability of the livelihoods. By doing so negative impacts of environmental hazards can be minimized. Apiculture can be developed because there are sufficient wilderness areas and flowers with rich in nectar. Power generation projects can be introduced to attract entrepreneurs to invest money and by aid of that, employment rate can be increased. Therefore, more people could be shifted back to Ashio.

## CONCLUSION

In conclusion, Ashio has a huge possibility to develop and to be more populated if more awareness campaigns be held in the future. Development in physical infrastructure is one solution, and also the one in communication technology is another to further revitalize businesses. The final decision is up to policy makers.

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## **The Role of Society in Case Study Ashio Copper Mine, Japan**

Karpaeva Aisha (The Kyrgyz Republic)

*True civilization is not to despoil mountains, not to ruin rivers, not to destroy villages, and not to kill people. -- Shozo Tanaka*

During a trip to the Ashio copper mine we learned that the mine was one of the largest suppliers of copper in Japan. It was also one of the first known cases of environmental pollution in Japan. The goals of our trip were to acquire knowledge about the history of Japanese industrial development and pollution in Ashio, and examine the restoration efforts of the valley environment.

The first cases of environmental pollution in Japan occurred in the Meiji era or the late nineteenth century, shortly after the beginning of industrialization. Japan began to strengthen its military power and increased the production and development of the industry.<sup>1</sup> This was accomplished by the use of natural resources. As a result, it polluted the environment. Copper played an important role in the early development of capitalism in Japan, and the Ashio copper mine was the main producer of copper in Japan. Pollution from the Ashio copper mine became one of the biggest cases in the environmental pollution history of Japan. The copper was discovered in Ashio as early as 1600, but in 1800 the mine, which was operated under the government, closed. In 1877 it became the property of Furukawa Ichibei, and in 1880 new copper deposits was found. With the use of modern technologies, the production of copper increased dramatically.<sup>1</sup>

Since 1880, people living along the Watarase noticed the changes in water color. The fish perished or became very weak, so the children could catch them by hand.<sup>2</sup> Also, as the Ashio mine needed more wood for expansion, extensive deforestation took place. Because the mountains lost trees, which held water, the flood began to happen more frequently. The floods brought pollutants to rice fields. Settlements suffered from major floods, depositing mine wastes in the rice fields. Many local farmers were left without harvest.<sup>2</sup>

However, the environmental damage caused by the mine development was publicly justified by the interests of national defense.<sup>3</sup> The authorities were reluctant to inform the public about the pollution issues.<sup>4</sup> Local people began protests against the Ashio copper mine. In October 1890 Chugo Hayakawa headed a movement against the mine work. Then, in December the residents of Azuma Village and Tochigi Prefecture, appealed to the governor of the prefecture to stop the mining operations.<sup>1</sup> Farmers also began to organize volunteer groups against the extraction of copper. Shozo Tanaka became the public voice of the protest against Japan's industrial pollution. Tanaka was a politician and social activist. Today he is considered to be Japan's "first conservationist."<sup>2</sup> After retiring from the National Parliament, Tanaka made an appeal to the emperor, but failed. The protests continued for several years. In 1911, the Diet passed the Factory Law, Japan's first law to address industrial pollution.<sup>5</sup> Later, Japan became one of the first countries to protect the environment as a national security priority.

During a trip to the Ashio copper mine, we learned that today there is a public association, which annually mobilizes volunteers to plant trees in the Ashio valley. As a result, green space areas have increased. From visiting Ashio, we can understand how important the role of people is to protect the environment.

After reviewing the history of the Ashio copper mine, we learned by the example of Shozo Tanaka, one of the first public leaders which protested against industrial pollution, how important is the role of society and leaders in protecting the environment. In Ashio the role of society is very important. For example, today there is a public association which annually mobilizes volunteers to plant trees in Ashio Valley. As a result, the number of volunteers in the Ashio copper mine from



has increased and the area with green spaces also has increased. From all this we can conclude that society plays a huge role in protecting the environment.

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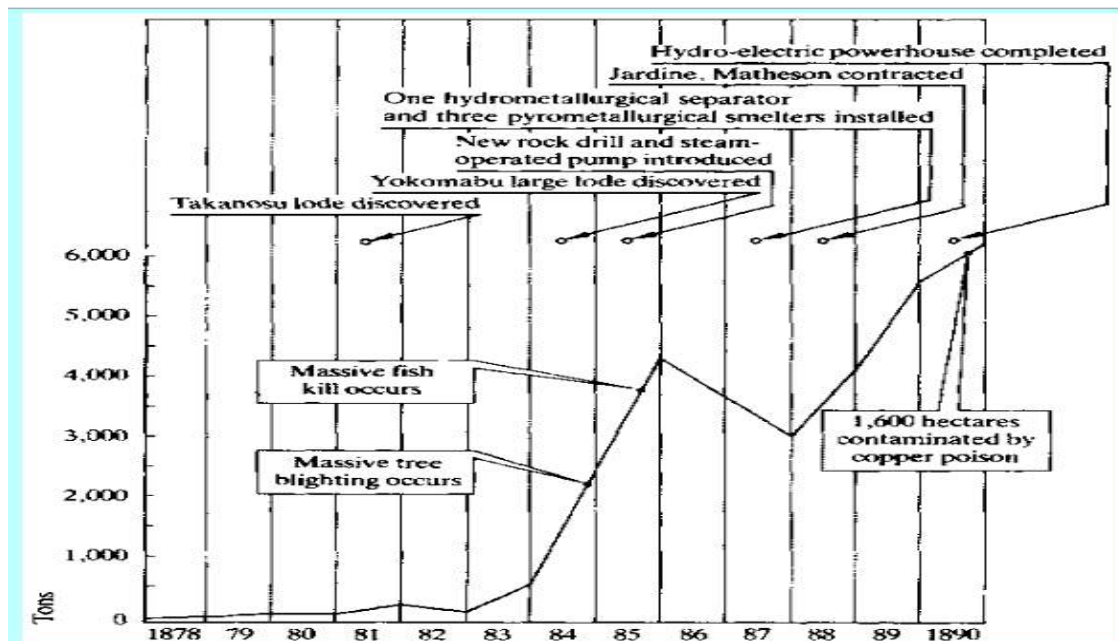
## Lessons Learned from the Ashio Copper Mine for the Letpadaung Copper Project in Myanmar

Tin Min Htoo (Myanmar)

The Ashio Copper Mine in Ashio, Tochigi prefecture, gained much attention from the end of the nineteenth century to the mid-twentieth century because it caused major pollution problems. This history reminds me of the Letpadaung Copper Project in Myanmar, which is now starting the mining process. The Letpadaung Copper Project is to exploit the largest of four copper deposits in Salingyi Township of the Sagaing Region. It is owned by Myanmar Wanbao Mining Copper Limited, Myanma Economic Holdings Limited and Mining Enterprise 1. It is operated by Myanmar Wanbao Mining Copper Limited. There are many important lessons to be learned from Ashio copper mining experience for the Letpadaung Copper Project to strike a better balance between development and the environment.

The first important thing I learned from Ashio copper mining trip is the environmental impacts that resulted from the mining operation. Copper extraction produced two kinds of pollutants such as sulphurous acid from the refining processes and dusts containing heavy metals from the refinery smoke. Acidified water was used in the process of mining, ore-selection, and refining, and once discharged into rivers, the water led to the destruction of top soils downstream. In the refining processes, a large amount of sulphurous acid was produced and discharged into the air. Copper ore also contains a certain amount of arsenic, cadmium, zinc, lead, and small amounts of gold and silver. If arsenic is also released into the air with sulphurous acid gases, it can damage all forms of life. Highly concentrated sulphurous acid gases can kill the leaves and it is very dangerous for tress. As a result, the recovery of forested areas becomes very difficult. When trees are damaged and then destroyed, the area is not able to retain water. Apart from that, sulphurous acid and arsenic affect other animals, and soon the health of human beings living in affected areas is seriously compromised. With regard to the production of the Ashio copper mine, big environmental destruction was seen as shown in figure (Ui, 1992).

**Figure: The Process of Environmental Destruction around Ashio Copper Mine**



The Letpadaung Copper Project in Myanmar may cause severe damage to river systems. The Chindwin River, which is located approximately 2.8 km northeast of the project area, flows southward toward the Yama Stream. The mining site is located near the Chindwin River floodplain (over 12 km wide). The Chindwin catchment area was 106,000 square kilometers and the Yama Stream catchment area was 2,046 square kilometers. From the mining operation, dust with metal arising from the operations may cause problems later. Rocks exposed by the mining operation contain a high level of sulphur (mean concentration of 1.7 %) and have the propensity to generate acid rock drainage (ARD). This occurs when sulphur bearing minerals become oxidized when exposed to the air and produce acidic by-products and liberate trace minerals. These materials can be extremely damaging if discharged to the environment in the Chindwin River catchment. It requires storage dam that prevents them from running into the river. Moreover, forests around this area must be maintained not to destroy by the requirements of mining activities.

The second important thing I learned from the Ashio trip was the role of environmentalists and community participation. After experiencing the impact of mining, farmers' movements against mining in Ashio occurred. One politician proposed to lay the groundwork for negotiations between farmers and the Ashio company and the national government. The government responded by ordering the company to install the effective treatment facilities in mining process. Later the government laid down the factory law, which was Japan's first law to address industrial pollution.

In the case of the Letpadaung Copper Project, recently people's movement was initiated by the media, politicians and non-governmental organizations. Later farmers around this area, especially the township of Salingyi, participated in demonstrations. The population of Salingyi is about 130,000. Most people in the project area engage in farming crops such as wheat, sorghum, green gram, sesame and chickpeas. Villagers protesting against the Letpadaung copper mine have expressed dissatisfaction with the resettlement process, compensation schemes, environmental and health effects, and the destruction of an important religious site. After that, the Letpadaung Taung investigation commission was organized by the government. This Commission issued its final report that emphasized a balance between development and the environment. The commission did not recommend to close the mine. Then, some negotiations for compensation ensued between local people and the company. In 2015, the environmental impact assessment procedure and environmental quality guideline were developed and the company must follow the rules and regulations. The government still needs to address the effective monitoring system.

In conclusion, the pollution from the copper mine can be very dangerous as the lessons from the Ashio copper mine demonstrate. In order to monitor the environment around the Letpadaung copper project, treatment facilities/technologies and research and development are important. At the same time public awareness and environmental education are also necessary. In the government side, it needs to address the effective regulatory system and institutional arrangement for monitoring processes.

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## **A History of Environmental Pollution and Restoration Efforts at the Ashio Copper Mine**

Than Naing Win (Myanmar)

The richest copper vein of Japan was found in the Ashio area, present-day Nikko City of Tochigi Prefecture as early as 1610. It later led to the largest historical copper mining and also the first environmental pollution case in Japan. The waste from copper refinery was deposited along the bank of the Watarase River. In the late nineteenth century, copper was one of the important raw materials and the major export commodity (Tsuru, 1999). As mining accelerated to fulfill the industrial requirements, environmental pollution was inevitable. Specifically, copper extraction destructed the forest and polluted the river resulting from the sulphurous acid, metal-containing dusts and acid water discharging from the refining process.

Prior to the industrialization of Ashio mining activities in the late nineteenth century, the Ashio valley had been fully forested. But after the industrialization, sulphurous acid from the refinery process was released into the air and destructed the growth and survival of trees. A great number of trees was also cut down in the surrounding mountains to be used as fuel for the copper refinery. Therefore, forest cover was gradually reduced (Kichiro and Sugai, 1992). Discharging wastewater from the refinery into the river contaminated water and killed the fishes and devastated livelihoods. During heavy rain, floods frequently happened in the downstream causing the erosion of topsoil. The slag along the mountain slopes were accumulated at the river bed or washed down to lower stream areas. Heavy metals in the slag polluted water and affected people not only in the mining area but also the downstream area, forcing them to abandon fishing and farming. Their health also was affected from the consumption of contaminated fishes. Although mining company subsidized social welfare facilities such as schools and hospitals, Ashio must have faced many difficulties and challenges to survive and work for the people (Ashio Historical Museum, 2009).

Pollution control started in 1890. In 1956, the advanced treatment facilities, including smog filter technology, were installed at the copper refinery in order to reduce the level of smog. To control the erosion and sediment accumulation, the square needle mat was established at the hill slope. Flood control measures such as dams and weirs were also established. The government promulgated two laws to regulate water quality (the Water Quality Conservation Law and the Factory Effluents Control Law). It built the research building and conducted research activities. Finally, mining activity in Ashio stopped in February 1973 (Sugai, 1983).

Afterwards, the local government and societies have taken action on the restoration of Ashio mining area. They have rehabilitated the soil and replanted trees. The restored area brought back monkeys, deer, and birds. Research activities continued on river water improvement. Some awareness activities for reforestation have brought many people.



Figure 1. Reforestation activity



Figure 2. Slag residue at hill slope



Today, the Ashio copper mining site is one of the historical heritage sites and famous tourism places. It shows the best example to learn about the copper mining and its environmental impacts for both Japanese people and foreign tourists, including students. Those from other countries have a good opportunity to apply the historical lesson to similar issues in their countries. In Ashio we also observed the successful restoration of tree canopy, although a few areas showed traces of soil degradation that resulted from sulphur dioxide pollution. Ashio people have preserved some historical buildings, bridges and other sites for the purpose of tourism and the awareness for conserving the environment by younger generations. This success is due partly to active participation of local societies in restoration activities together with the Japanese government.

Myanmar has also one ongoing copper mining project, namely the Letpadaung copper mining project, located in the Salingyi Township of the Sagaing Region. Starting from June 2010, it has been operated by the Wanbao Mining Cooperation subsidized by China's state-owned company and Myanmar Economic Holdings Limited. This project area is about 7,867.78 acres of land in which 5,057 acres are cultivated land (Letpadaung Investigation Commission, 2013). It affects 26 villages at the foot of Mount Letpadaung. As a result, 441 households from 4 villages were displaced (Diane Tang-Lee, 2015).

According to the Environmental and Social Impact Assessment (ESIA) report issued in January 2015, this mining project, including the construction of processing plants and other infrastructures, would make negative environmental and social impacts on water, soil, and cultural sites (e.g., pagoda). Protests against the project have spread widely, claiming the lack of transparency, inequity in farmland acquisition, compensation and resettlement, and inadequate social welfare facilities such as hospitals and schools. Nevertheless, the government decided to continue this project after assessing and evaluating it by a parliamentary investigation committee in March 2013. So we will keep monitoring mining activities.

Reflecting on the knowledge and lesson I learned from Ashio field trip, I think that Myanmar copper mining should focus on the adequate implementation of environmental and social safeguards, such as the installation of most advanced treatment technologies in the copper refinery process, the promotion of the public awareness and participation in environmental conservation activities through public-private partnership approaches, and the restoration of the natural environment. Further research and tourism should also be promoted.

In conclusion, this Ashio copper mining field study trip contributed us to better understanding the environmental and social impacts caused by the industrial development. It gives me the valuable knowledge about the situation of copper mining and living conditions of people who struggled in the past. This past experience can be used and shared when I participate in environmental conservation activities in Myanmar. Therefore, I would like to express my special thanks to Professor Kenichi Matsui and Mr Mikio Aoki, the tourist guide from Ashio for his explanation and sharing knowledge along the field trip.

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## **Mining Conflicts**

Ondiba Hesborn Andole (Kenya)

Although mining is important for economic development, it has a grave impact on the ecosystem. In particular it leads to air pollution, water acidification, soil quality decline, loss of biodiversity, deforestation and landscape destruction. Also, in both developed and developing countries, mining often sparks conflicts between corporations, the government and communities that are affected by mining. This paper highlights conflict experiences in the Ashio copper mine and Kenya. It also suggests solutions that ensure mutual benefits for all stakeholders from mining operations.

Environmentalists in Japan remember Ashio as the site of Japan's first major industrial pollution disaster. This was a large copper mine not far from Tokyo owned by the Fukurawa corporation. Peasants in the downstream areas complained of pollution caused by mineral wastewater containing the high level of copper, which damaged not only crops but also their health. The smelting process destroyed the beauty of the landscape, gaseous smoke killed all plant-life for miles round the refinery buildings; the streams were putrid with effluent, and the town itself seemed to be buried under monstrous heaps of slags (Kenneth, 1977). At that time, copper played a major role in the Japanese economy, ranking second to silk among Japan's exports (Kazuo, 1997). What I learned from this field trip experience to Ashio was the step taken by the informed community led by Tanaka Shozo who stood up to fight for a clean environment despite the economic gains the copper mine gave the country and the surrounding community. They looked into the future and realized the copper mining activity had no benefits whatsoever but a great liability.

Mining in Kenya is mainly open pit due to the nature and occurrence of minerals. Instances of environmental degradation and conflicts due to mining are therefore more severe. The first example is the Kerio Valley area in western Kenya which is heavily polluted by the fluorite. The second example is Kwale where in 2007, over 3,000 residents were displaced from their ancestral lands to pave the way for titanium mining (Mines and Communities, 2007). Recognizing that social displacement can have a negative impact on communities the Government of Kenya offered a compensational package to the local Kwale community, but the community declined to accept. Since 2001, when the first of these measures was implemented, the local community has been in conflict with the government and the operating company, Tiomin (K), over the mining project. Different from the Ashio copper mine case, in which the major conflict was over environmental damage, the one in Kenya disputed over land ownership and compensation. They also feel that the government undervalues their land when it comes to compensation.

In Kenya locals in mining areas always believe that they are victims and tend to expect tangible compensatory projects and services from mine developers. This feeling is particularly intense if local communities have ethno-ecological value attached to the displaced land. However, the most important factor to consider is how environmental damage can be minimized and how the healthy ecosystem can be saved within the mining site. I also argue that mining companies should consider CSR in dealing with conflicts between them and local communities. But for this CSR to work, mining companies should complete the envisaged projects within the specified timeframes. The community, companies and government should work together to minimize the environmental damage caused by mining operations by rolling out conservation measures together.

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## **Effect of Mining on the Environment: Case of Japan and Ghana**

Adwoa Oforiwa Antwi (Ghana)

The discovery of mineral resources marks a point of transformation in the economic, social and living standards of the people. This is often accompanied by investments from foreign countries. Despite the immense contributions of mining to the economic development, its social and environmental effects cannot be over-emphasized.

Ashio copper mine started in the seventeenth century when copper was first mined along the banks of the Watarase River. During this period, the mine supported Japan's foreign trade with Holland and China. Despite the mine's economic contribution, it also became one of Japan's earliest industrial pollution cases.

The capitalistic production system that began in the late nineteenth century resulted in immense environmental destruction. The discovery of large copper ore deposits made Ashio the most productive copper mine in the country. In 1885, the Watarase River experienced the loss of many fish because of water pollution. This pollution was partly due to heavy metal discharge from rock-crushing machines and steam-operated pumps in the mine. The outcome of these resulted in the destitution of 3,000 fishermen and loss of all marine life in the lower valley of the River (Obeng et al, 2015).

In the late nineteenth century, Ashio-derived heavy metals began to destroy agricultural lands. In August 1890, for example, a flood with contaminated sludge ran into the Watarase River Basin and affected 1,600 hectares of farmland and 28 towns and villages. This provoked farmers' movements to stop the mine operations and seek compensation for damages caused. To prevent the pollution the mining company installed a settling basin for removing heavy metals from wastewater along with erosion control dams as early as 1897.

In the last fifty years Ashio residents and volunteers from other parts of the country have done tremendous reforestation efforts which I think is innovative. With relentless effort and commitment from people, NGOs and volunteers, Ashio will see its formal glory. During our visit to Ashio, we noticed how restoration works have improved the environment even though there remain signs of damages caused by the mine. For me this shows how the people of Japan are committed to achieving environmental restoration and sustainability for now and the future.

Ghana is rich in mineral resources such as gold, diamonds and manganese. Its mining activities dates back to the nineteenth century. Mining has contributed enormously to the economic development of the country, but environmental damages have caused more damages than economic benefits to the country. For example, Obuasi, which has rich gold deposits, has suffered from heavy mining impacts.

In Ghana, mining-derived environmental problems can be grouped into three categories. The first is land degradation. Miners leave behind vast barren lands with pits. These pits, filled with water, become breeding grounds for mosquitos, which are potential danger to humans and animals. Agricultural lands have been lost as a result. Secondly, mining pollutes major water resources by heavy metals like mercury. This has resulted into the loss of species. The polluted water makes drinking unsafe for local communities. Finally, mining contaminates air and causes respiratory diseases among those who inhaled fine particles in the polluted air. Small-scale mining generates some hazardous dust that miners and local residents inhale. Small-scale miners also openly burn gold amalgam, which produces harmful mercury fumes.

To safeguard the environment from mining, the environmental protection agency was established under the Ghana Environmental Action Plan of 1991. This action plan seeks to improve the quality of life of both present and future generations. It also aims to create a synergy between economic development and environmental development in ensuring sustainable development in



mining communities. Despite these promising words, the Plan has hardly been implemented. Little visible efforts have been made in restoring vegetation and forest lost. Many communities are still prone to floods and earthquakes.

Obuasi can learn from Ashio experiences. Here I do not mean that Obuasi people wait for government and mining companies to engage in restoration activities. Obuasi people can take their future into their own hands by, for example, planting trees themselves.

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# **Effects of Rapid and Uncontrolled Industrialization on the Environment: A Comparative Study of Ashio Copper Mine, Japan and Escondida Copper Mine, Chile**

Abiemo Jerome Edem (Ghana)

The industrialization, which transforms a nation from a primarily agricultural society to a manufacturer of goods and services, has brought economic development in some countries. Rapid and uncontrolled industrialization has negatively affected several developed nations all over the world. Many countries such as Peru, Mexico and Indonesia that rapidly developed from mining their naturally resources, especially copper, have faced devastating human health and environmental problems. Governments in developed nations need control rapid development that negatively impacts the environment.

The Ashio copper mine, the history of which dates back to the beginning of the seventeenth century, was one of the leading modern industries that supported the Japanese government's foreign trade. The export of copper, from the one-time productive mine, under the control of the Tokugawa government, accounted for 9.5 per cent of Japan's export earnings at the time. The earnings from the mines, like the norm in many rapidly growing industrialized countries, was used in pursuit of technological advancement, such as the purchase of sophisticated mining equipment, military weapons and other industrial machinery. In contrast, very little attention was paid to the numerous mining-induced environmental and social problems.

The field trip to Ashio copper mine gave us a glimpse of how industrial development could adversely affect the environment. The Ashio community and its environs, which were once vibrant with inhabitants, are now desolate. The periodic flooding (contaminated with poisons) and emission of air pollutants like sulphuric acid, destroyed several farmlands and forced the majority to relocate. The barren area on the mountain surrounding the mines, attest to the fact that at the end of the nineteenth century, Japan attempted to catch up with advanced industrialized nations without considerations for environmental preservation (Shoji and Sugai, 1992).

Chile's economic development, which draws heavily on copper mining, reveals that it might suffer from a similar fate of mining-induced environmental destruction to that of Ashio. Chile is the world's leading copper producer, with copper accounting for 56 per cent of its \$59 billion in total exports in 2006 (Oyarzún and Oyarzún, 2011). As a result, it suffers from the impact of smelting emissions on air quality, agricultural productivity and loss of biodiversity. Similar to the mass protest of peasant farmers against the Ashio mines, several social movements like the "Pascua Lama" have attempted to stop the mine operations, partly to safeguard the environment. However, the Chilean government, poisoned by the materialism of the industrial revolution, focuses on foreign earnings from the copper trade than protecting the environment.

In spite of the ill fate suffered by Japan at the Ashio copper mines, governments (past and present) and other self-help organizations have put some innovative measures to avoid similar occurrences in the future. They also have engaged in restoring damaged ecosystems. A typical example is the reforestation of the surrounding mountains of Ashio by a non-profit organization called Grow Green in Ashio. Through its tree planting activities, water quality in the Watarase River and biodiversity on the previously bared mountain have improved. Environmental laws, especially air pollutant emission policies have been made more stringent. In addition, the Japan government has engaged in public awareness promotion about environmental issues, especially among children who are the future leaders. In contrast, the enforcement of environmental laws in Chile is very weak. Ranked in the 10th position (after Russian and China), amongst the highest sulfur dioxide emitters in the world, there is an urgent need for Chile to improve its environmental performance to withstand the current industrial pressure (Esty and Porter, 2005).

The Ashio and Escondida mines, for sure, have created new job opportunities for citizens, improved the transportation system (railroads), introduced advanced technologies, and contributed to national development, but their negative impacts on human health and the environment cannot be discounted. In Chile, I recommend that it draw on Japan's experience to avoid irreversible future damages to the environment. The government should ensure that its mines, by adhering to strict emission standards, and proper sludge disposal measures, avoid soil and water contamination. Here, there is the need for periodic public awareness campaigns on specific environmental issues like pollution, so that children can be trained to become global environmental leaders.

In conclusion, nation's rapid industrial development may have many positive effects on its economy. However, when development is not controlled, the environment often pays the price. It is therefore imperative that industrialized countries, whose economic development depend on natural resources, like copper should endeavor to protect environment and human life.

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# **Impact of Mining on the Environment and Biodiversity: Japan and Ghana**

Ernest Ohene Nkansah (Ghana)

## **Introduction**

The thirst for increased productivity and economic growth necessitates vibrant industrialization. This encourages the search and exploitation of mineral resources to feed the various industries for continual production at the expense of nature and biodiversity existence. This was the case in the Ashio copper mining situation. The mine helped the Japanese economy to experience tremendous growth through foreign trade, but it also caused severe environmental pollution and degradation. From my perspective, little effort appeared to be made to improve the devastated environment and the community. This paper seeks to discuss the menace of mining pollution in Japan and Ghana. I will give my perspective and suggest corporate strategies efficient to diffuse situations.

The field trip was organized to Ashio in June 2016. It gave me an insight on the peril of mineral exploitation on the environment. Even though the mining industry in Ashio contributed to the growth of the Japanese economy, it raised grave concerns about the environment, its biodiversity, and human health. Records show that prior to the industrialized Ashio mining activities (before 1880), Ashio and its surrounding area were densely forested and rich in biodiversity. However, with the commencement of Ashio copper mining activities under the Furukawa Corporation, a number of environmental issues emerged in the area ranging from pollution and environmental degradation to resources depletion. The destruction of forests used as fuel for powering the mining plant partly left the forest lands bare and prone to erosion. The polluted river system swept down the valley in 1896 inundating 13,000 households (Pyle et al., 1975). Without trees to hold water under heavy rain, in August 1880, the lower Watarase river Basin got flooded, damaging 1,600 hectares of farmland and 28 villages in Tochigi and Gunma prefectures (Sasaki, 2014). Agriculture was no longer worthwhile on the polluted lands and rivers. This caused a larger number of the inhabitant farmers to relocate from the mining area to other neighboring towns (Shoji et al., 1992). Furthermore, the copper refinery released large amounts of sulfur dioxide gas into the atmosphere, a precursor of fine particulate soot, posing a significant health threat and major cause of acid rains.

The environmental harm caused by the Ashio copper mine is not much different from that of the Obuasi gold mine in Ghana. The Obuasi gold mine is dominated by small-scale gold mining. In Ghana this practice is termed as “galamsey”. These galamsey operations yield high levels of mercury and cause water pollution and land degradation (Ahmed, 2013). Mercury is heavily used for gold extraction from ore due to its affordability and reliability. Records show that mercury has the tendency of weakening one’s immune system, reduces life expectancy and hence the productivity of a country’s labour force (Ahmed, 2013).

Knowledge from the pollution history of the Ashio copper mine and the Obuasi gold mine behooves us to take vibrant measures that ensure sustainable development. For years, there has been tremendous cleanup efforts in Ashio. The experience, knowledge and technology emanating from this small town are worth pondering. The Obuasi mine may consider the construction of a settling basin for removing poisonous metals from wastewater, an afforestation program organized by the prefectural and central governments. The mine also can learn from the local people in Ashio who built the Ashio History Museum for tourism and education.

## **Conclusion**

If one considers minerals as an asset of the environment, we may have different ideas about the exploitation of our mineral resources. Corporate social responsibility (CSR) is a helpful conceptual framework for exploring the corporate attitude of companies towards stakeholders (Wheeler et al.,



2002). The concept of CSR is a means by which companies frame their attitudes and strategies towards, and relationships with, stakeholders, be they investors, employees or, as is salient here, communities, within a popular and acceptable concept. Governments must ensure that mining companies perform their CSR. This could be done by way of giving incentives or tax reliefs to companies that perform their CSR.

Additionally, social and environmental reporting, encompassing the social and environmental aspects of company activities, is a necessary tool in the current social and business climate as increased pressure on business performance also places a need for mining companies to distinguish themselves in a competitive marketplace (KPMG, 2000). One of the central issues facing companies is how they define their relationships with their communities (Waddock and Boyle, 1995), and respond to their rapidly changing demands and expectations. A further research must be done on the changing needs of communities in order to direct their activities to meet such needs.

Finally, should we exploit our mineral resources and pollute our natural environment to meet our needs? There must be a balance in meeting our demand through using technology and ensuring the reduced levels of pollutions. This will help the natural environment offer its ecosystem services for the survival of people and biodiversity. Governments have a crucial role to play in ensuring that citizens and cooperate bodies can have good environmental standards.

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## **The History of the Ashio Copper Mine: A Lesson Learned for Vietnam**

Vu Van Nam (Vietnam)

Ashio is located about 20 km southwest of central Nikko city and about 10 km south of Lake Chuzenji. In the Tokugawa shogunate period, Ashio annually produced about 1,500 tons of copper in productive years, but the production decreased significantly in 1800, and the site was temporarily closed. Ashio was privatized in 1871. Then, it belonged to Furukawa Ichibei in 1877. The capacity of the copper mine reached over 4,090 tons of copper in 1885, producing 78 percent of total output of Furukawa mines, and 39 percent of copper production of Japan. Finally, the Ashio copper mine was closed in 1973.<sup>(1)</sup> It can be seen that Ashio had played a significant role in the Japanese copper mining industry for a hundred years.

However, Ashio copper minning activities also caused a serious environmental issues. Due to the energy need for mining activities in the Ashio area, many trees were cut down. It led to the reduction of forest areas in this area. Because of the decreased forest cover, flood water frequently affected the lower Watarase River area after heavy rains. The floods poisoned the agricultural land and the environment with copper and other poisonous elements. In addition, because of the lack of disposal sites, solid wastes were piled in the hillsides. The slag and leachate contaminated the lower river.<sup>(2)</sup>

When we visited the Ashio copper mine area, we found that some solid waste disposal sites in the hillsides of the former Matsuki village site. The tailing dam in a high mountain area prevented the run-off of slags. So in my opinion, the Furukawa Company needs to treat all solid waste and slags. To reduce the solid waste, authorities have sold them to marine companies to clean their boats. We also observed that many areas of the Ashio valley were restored with trees. Thanks to the support from the government, local people, NGOs, and volunteers for only fifty years, we cannot imagine that these areas were totally treeless. They terraced and planted thousands of trees in high mountainous areas. It must have been huge and difficult works. There were some flood control constructions along the Watarase river. The aim of these is to prevent or reduce flood risks to the downstream. Gravels from the river also provide materials for construction industries. We believe that, with the effort of local people, government and volunteers, this area will recover soon.

In my country, Vietnam, there was a huge coal mine site in a coastal province named Quang Ninh near Ha Long Bay, a world heritage site. The coal mine started in 1836 by French colonialists.<sup>(3)</sup> After the August Revolution in 1945, Vietnam's independence, it belonged to the government of Vietnam. By 2010, it had produced 47 million tons of coal, providing jobs to 132,000 workers.<sup>(4)</sup> However, Quang Ninh province has faced the uncontrolled exploitation of coal. Some heavy rains caused flooding, landslides and toxic sludge spills from open mine sites. It also caused health problems for workers and residential areas around. Coal contains a lot of sulphur and acid elements, which quickly pollute the water environment. The heavy metals such as lead, zinc and mercury affected the sea, agricultural activities and human health. There were also some thermal power plants using coal as the fuel energy in Quang Ninh which heavily polluted the Gao River and residents in surrounding areas.

In responding to the negative impacts of coal mines in Quang Ninh, the Ministry of Natural Resources and Environment and experts have suggested that residue be kept in a separated area from residential areas. Trees should be planted in the area between the mine and villages to limit pollution levels instead of simply covering the residue with canvas. Investors and local authorities generally neglected in dealing with these issues, and the province has to restructure deposits of coal residue in preventing the floods and sludge from mining industries.

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## History of the Ashio Copper Mining Restoration

Shagdarsuren Chantsalnurmaa (Mongolia)

This time, we went to Ashio Copper Mine site, which was one of the biggest copper mines in Japan. When I first saw the environment and surrounding areas, it was very beautiful with river, mountains and trees. Even I did not notice that the mining activity happened here before.

Ashio Copper Mining operation started in about 1600, and the extensive environmental destruction began to occur in the 1880s. At that time, the mine became the biggest copper producers in Japan, and people living surrounding area of the Watarase and Tone rivers noticed changes in water color and dying fish. Within a decade, the fish population was almost completely destroyed and about 3,000 fishermen in the area were put out of work (Wikipedia 2016). In addition, the Ashio mine destroyed forests to meet its fuel and other needs. From 1890 to 1896, the several larger floods occurred and intensified environmental damage. In 1897, after the considerable disaster damage, the Japanese government decided to act and the Furukawa Corporation, a company running the mine, began to build filtration systems to reduce these problems. However, protest activities against this company continued for several years. Partly due to the environmental problems caused by Ashio mining, the Japanese government passed the Factory Law in 1911, which was Japan's first law to address industrial pollution (Wikipedia, 2016). The Ashio Copper Mine closed in 1973 (Wikipedia, 2016).

I visited the Ashio History Museum, which showed that the Ashio Copper Mine was the very highly developed mine at that time. Miners used the electronic railway, constructed large iron bridges and complex engineering systems, and developed powerful working tools. Because of mining development, many schools, hospitals, and other services were established in the town. This social development became an important part of the history of the industrial development in Japan.

In this trip, I was glad to see the Japanese mine development history with my own eyes. I understood that the government support and right policy could bring a lot of real effects in the mining development. In my opinion, Ashio has some good tourism development potential. For example, it may use the existing railroad, museums, models of miners, tools, and other related items. Also, Ashio has become a good example in organizing a tour that aims to provide education and knowledge among young generations. In addition, I would like to express my gratitude to Ashio for sharing its rich knowledge and experiences and a successful implementation of community-based environmental remediation model with the international students of developing countries. I believe that this experience would contribute to our countries' further development.

In conclusion, during this trip I gained much knowledge about the mine operation and nature restoration. As for Mongolia, where I am from, the mining sector is rapidly growing and it strongly influences economic and social developments. In Mongolia, there are many similar cases of mining-related environmental destruction and protest activities to those in Ashio. It is amazing to see that Ashio spent a few decades for environmental restoration. It is possible to implement the following activities in my country through the bigger mining companies: (1) it is possible and better to cooperate with local people in protecting and restoring nature during the mining operation; (2) it is possible to create community-based tourism destination like Ashio in our country; (3) we should motivate local people to join in environmental conservation and nature restoration.

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# **How to Establish a Harmonious Relationship between the Environment and Economic Development?**

He Xin (China)

“How to establish a harmonious relationship between environment and economic development?” With this question in mind, I participated in a field trip activity to Ashio on 28<sup>th</sup> June 2016. In a rainy morning, we set foot on the Ashio trip. We visited the Ashio cooper refinery building, where we learned about the refinery technology at that time, and also the environmental problems from this refinery process. In the following, we had the chance to visit the Ashio History Museum, which was built to display historical photographs, books and valuable materials of this town. The photo that impressed me most was about the green recovery in this area. It shows that the Ashio people had planted trees and it indicated that the people here made a good effort to the reforestation of the environment. On the way back, we visited the cenotaph for Chinese laborers, which was built in honor of Chinese laborers, especially many of them died of heavy labor here. From this activity, I acquired more knowledge about the history of Ashio, which was a typical case of Japanese industrial development. Moreover, I gained deep understanding of the relationship between the environment and economic development. In this report, I will introduce some basic information about Ashio, such as environmental pollutants from the cooper mine and solutions. Furthermore, I will try to discuss and analyze the similar city called Baiyin in Gansu Province, China as comparison.

In the mid-twentieth century Ashio looked like a desolate valley without plants and wildlife, but can you believe that this area was once a forested town. The Ashio mine existed as early as 1600. At that time it produced about 1,500 tons annually (Wikipedia). After the Meiji Restoration and Industrial Revolution, Ashio acquired many advanced technologies of that time and played an important role in the process of Japan Industrialization. By the 1880s production had increased dramatically, reaching 4,090 tons by 1885 or 39 percent of Japan's copper production (Wikipedia).

However, the environment did not “prosper” as the economic did. The government put more emphasize on economic development than the environmental consideration. From 1880, people living along the Watarase River, downstream of the mines, noticed the water changing color and the fish dying (Notehelfer, 1975). Within a decade, the fish population was almost completely destroyed and about 3,000 fishermen in the area lost their livelihood (Notehelfer, 1975). It also meant the heavy loss of biodiversity. Further, with the increasing expansion of mines, more timber was demanded as fuel woods so that the situation of deforestation became severe, which meant the town tended to lose its protection from floods. As a result, in 1896, a large flood followed and caused damage on the environment and people (Notehelfer, 1975).

Moreover, serious human health problems emerged, such as food insecurity, unknown or uncertain complex risks and death (Environmental Justice Atlas, 2016). The people living in this area protested strongly against the mining activity. In October 1890, Chugo Hayakawa led a movement against the mine and asked the prefectural hospital to do some tests for water-borne poisons. In December, the residents of Azuma Village in Tochigi Prefecture, appealed to the governor of the prefecture to halt mining operations at Ashio. This was the first of such appeals against Ashio (Shoji and Sugai, n.d.).

In 1897, the Japanese government decided to act and ordered the copper operator to build filtration systems to reduce the problem of pollution (Notehelfer, 1975). In 1911, the government passed the Factory Law which was Japan's first law to address industrial pollution (Notehelfer, 1975). The Ministry of Agricultural and Business provided the technology and financial support to the reforestation. Moreover, in the appeal of environmentalist, more and more people and organizations committed to the environmental protection movements. In Japanese schools today,



this history of Ashio was introduced to student as typical environmental movement case so that they can improve their environmental awareness. Today the environment of Ashio has been restored well.

Reflecting on the history of Ashio, I want to examine the case in “Chinese Copper Town,” Baiyin. This town is rich with copper and many mineral resources. Mineral resources were firstly discovered in the 1950s by the Ministry of Geology. The Chinese Government assigned university graduates and experienced metal workers to Baiyin to explore the economic potential in this area. By 1989, Baiyin had become the second-biggest industrial city in Gansu Province after the provincial capital, Lanzhou (Zhang, 2016).

However, the industrial development did not occur in harmony with the local environment. In particular, factories built near the Yellow River heavily contaminated water by discharging up to 1,900 tons of waste water every year. The irrigation water was polluted and affected farms with heavy metals. Similar to Ashio, the color of water changed and a large number of fish died. The damage caused by the dust from the copper refinery was evident in the 3,000 hectares of surrounding area (Gansu Baiyin, n.d.).

For solving the severe environmental problems, the Chinese government asked the company to do waste collection in a designated point to decrease the unnecessary waste disposal. Moreover, it sponsored to plant trees to prevent from dust and flood. In addition, 12,000 m<sup>3</sup> of wetland was created (Gansu Baiyin, n.d.). Drawing on the experience of Ashio, I think this mine area needs to improve the filtering process of copper refinery to reduce the emission of dust and pollutants. However, the boom at Baiyin is subsiding and city’s former glory seems to be nearly gone. In 2008, Baiyin was called as “resource-exhausted city” (Zhang, 2016).

Both of Ashio and Baiyin are definitely bitter lessons for people in the world. These facts tell us that economic and industrial developments would no doubt result in the environmental disasters and potential problems which always tend to be long-lasting. In addition, I understand that taking necessary measures in time plays a crucial role in protecting the environmental. For this purpose, awareness and consideration for environmental preservation is essential. Overall, it is a global issue to establish a positive relationship between sustainable environmental development and industrialization. The Ashio fieldtrip was a meaningful experience and enriched my knowledge. I expect getting more chances in the following study.

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## What I Learned from Ashio Field Trip

Jia Wang (China)

It was a raining day. We gathered in the front of the University administration building at 8:00am and then set off to Ashio. On the way to Ashio, I was very excited. Because my hometown was famous for the coal mines in China. I found a lot in common between my hometown and Ashio. I paid attention to its environmental governance. Although the Ashio Copper Mine has long been abandoned, the government have taken many measures to recover the seriously damaged environment. I wanted to take this opportunity to learn more about the effective measures to remediate contamination in Ashio.

The first place we visited was the Ashio Environment Study Center and the Matsuki area. We arrived at approximately 10:30am. Our guide told us that there was tailing dam and reservoir in the Matsuki area. We saw that the area had held sludge produced from the copper refinery downstream in the past. The vegetation in the mountainous area was severely damaged before. Our guide also said that the destruction of the surrounding vegetation was the result of the smelting of the copper and the poisonous gas emission.

Through the long-term governance of the basin and the mountain, we could see a better recovery now. The mountains were filled with many trees. A lot of volunteer and government support workers made contribution to the reforestation for about 30 years. The clean water came down from the dam, making it so majestic. As far as the eye could see, it was all full of vigour. There were many ladders on the mountains. They were built for the on-going reforestation project by the ministry of land, infrastructure, transport and tourism.

Next we visited the Ashio copper refinery building. It had been abandoned for a long time. From the point of view of the present, I could feel how developed once the copper industry was. The refinery was originally established in this location in 1884. At that time it had produced copper in large quantities. In the early twentieth century, this was the largest mine in Japan, so the population was increased to the second largest number after Utsunomiya in Tochigi Prefecture.<sup>[1]</sup>

In the early 1880s, local residents noticed that water changed color and the fish died.<sup>[2]</sup> Lots of fishermen had to leave.<sup>[3]</sup> The damage to the area was so serious, however, the government and the prefecture remained inactive. At last, this mine was closed in 1973.<sup>[1]</sup> Today, the copper refinery building is designated as a national historic site. This building helped us a lot to know more about the past development of the copper mining industry in Ashio.

Before we had lunch, we observed Furukawa Bridge and the hydroelectric dam site. This bridge was completed in 1890. It was the oldest building structure which was still remained in Ashio and was designated as nation's important cultural heritage in 2014. The hydroelectric dam in Mato was completed in 1890 and was Japan's first hydroelectric dam site. It was used for providing electricity to pump water, discharge water from mine tunnels and the operation of vehicles. In 1906, a larger hydroelectric dam replaced the old one. These places helped have a glimpse of the old technology that helped the copper industry.

At noon we went to the Ashio History Museum. On the way to the museum, our guide told us that with the efforts these years, many animals came back. I looked out the window for a few minutes, and then saw two monkeys on the stone. This was due to the Ashio people's effort for the environmental recovery.

We arrived at the Ashio History Museum in the afternoon. This place serves people who are interested in Ashio history. The museum has two floors, exhibiting many different kinds of photographs about Ashio history and culture from the Edo period to the Showa period. The photographs were reproduced the original appearance of Ashio from a variety of angles.<sup>[4]</sup> On the corner of the second floor, many souvenirs about Ashio were displayed. It was a good arrangement

for us to remember Ashio. After seeing the related pictures, we saw the panorama model of Ashio. Our guide carefully explained to us about environmental recovery and the future of Ashio. As environmental issues have become big problems in not only Japan but also many other countries in the world, we could learn a lot of experience from Ashio. It was good reference for us to know the importance of sustainable development and coordinate the relationship between economic development and the environment.

On the way, we saw a public bath in the former Kotaki village site, and the guide told us that the miners cleaned the dust in the outer layer and then entered into the inner layer of bath. I was surprised to hear that. Making a living must have been so hard. At the last destination, we had a short glimpse at the cenotaph for Chinese laborers from the bus. Our guide told us about the history of this cenotaph. During World War II, about 257 Chinese laborers were forced to come from China to Ashio to work in the mine. Among them, 109 persons were said to have passed away. This cenotaph was placed in 1973 partly to keep this ugly part of Ashio's history remembered.

In a word, I was so thankful to catch this good opportunity to learn more about the development of Japanese history. Although Ashio issue represented one aspect of environmental problems, we could learn a lesson from it. I look forward to participating in such a field next time.

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## Ashio: A Model for Sustainable Development

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We left school to the famous copper mine in Ashio on June 28, 2016 at 8:00 am. This field trip gave me a deep impression about ecological restoration. The large-scale copper mine began in 1880. The copper extraction continued until 1973, and the refinery closed in 1989. In the last fifty years or so, local residents, volunteers and the government of Japan have been committed to ecological restoration in this area. Since then the forests have been steadily restored and some wildlife like bears, deer, and monkeys have returned. However, according to our guide, Ashio has suffered from the rapid decline of the population, the number from heyday of about 50,000 down to about 2,300 today. According to Wikipedia and the Nikko City website, at its heyday Ashio had about 38,428 people,<sup>[1]</sup> but today it has 2,086 (as of September 1, 2016)<sup>[2]</sup>.



The copper production from 1877 to 1891 rapidly increased. While the increasingly well-off miners in Ashio had something to celebrate, this was not the case among farmers and fishermen who lived along the Watarase and Tone rivers. As early as 1880 local residents along the Watarase noticed the water turned into “bluish white”<sup>[3]</sup> and that dead fish came floating down the river. Those who ate such fish became ill. Pollution in the Watarase River was caused by copper discharged from the Ashio Copper Mine. It became worse and led to one of the most well-known environmental pollution problems in Japan<sup>[4]</sup>.

Partly because of Ashio’s inaccessibility, most of the timber needed by the mine was initially taken from the surrounding hills. With the increase in production, the natural environment was destroyed. Local residents asked the government to make the company reduce pollution. But the copper mining in the 1880s and 1890s was an ecologically dirty operation worldwide. Furukawa and other Japanese copper producers were competing with major Western companies, and the Japanese government was naturally reluctant to impose restrictions on the Ashio Copper Mine. As the safety of residents was threatened constantly, anti-mining movements emerged.

Now, through more than 50 years of restoration efforts of the valley environment, including volunteers and government support, most mountains are covered with plants. Mr. Mikio Aoki, our guide, told us that the descendants don’t forget what Ashio was like. Clear water flows in rivers. When we took the bus across the mountain road, we found monkeys playing on the road side. Mr. Aoki also told us that now there are hundreds of deer appear in winter and spring.

At the Ashio History Museum, our guide spoke systematically about the copper mine. As I became very interested in this copper mine, I carefully reviewed each photograph and items. Then I could image the prosperity in this area. Ashio had the glorious past. To me, Ashio is a microcosm of Japan's development. It is also a huge cultural treasure. It is a model in the ecological restoration for other countries, which still have smelting factories or abandoned

mines. Before our lunch, I bought two sets of postcards related to Ashio in the past. I wanted to remember the prosperous days of Ashio. I felt I must come here again in the future.

After lunch, we took the bus to see the cenotaph for Chinese laborers. During World War II, about 257 Chinese laborers were forced to come here to work in the mine. Among them, 109 persons were said to have passed away. This cenotaph was placed in 1973 partly to keep this ugly part of Ashio's history remembered. I think this tiny memorial shows the Japanese love for peace and respect for history. Besides that place, we also saw the public bath in the former Kotaki village site on our return road, now it was dry, but I could imagine the lively scenes of miners who, after leaving dusty tunnels, came here to clean. At last, when we returned to one of the famous bridges in Ashio, we took a group photo, and said goodbye to Mr. Aoki. At this time, I clearly remember he, who grew up in Ashio and was about 70 years old, said: "You have to study hard in Japan and make contributions to your country in the future." As the bus taking off, I looked back twice waved to him, and he also waved goodbye to me.

In the future, I hope Ashio will invite people from over the world who are somewhat related to mines and government officers, by organizing, for example, environmental restoration meeting about mines every two years. By so doing, participants and Ashio people share and listen to their efforts for ecological restoration in similar kinds of mines. I also believe one day the Ashio copper mine will become the World Heritage site, and more people will select here as their settlement.

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