

N-2 Workshop with Local Students for a Better Understanding of Environmental Problems in Kathmandu, Nepal

Hiroaki TOMOI¹, Hiroshi AOKI¹, Kyoko KIMURA², Jumpei SUMI², Daisuke MURAKAWA², Satoshi OISHI³, Saki FUKUOKA⁴, Tetsuya KUSUDA⁵, Takayuki SHIMAOKA⁴, ○Shuhei TANAKA⁶, Hirofumi NAKAYAMA⁴, Tomoko NAKASHIMA⁵, Kazuyuki OSHITA⁷ and Shigeo FUJII^{6*}

¹Graduate School of Engineering, Kyoto Univ. (Yoshida-honmachi Sakyo-ku, Kyoto, 606-8501, Japan)

²Graduate School of Engineering, Kyushu Univ. (744, Motoooka, Nishi-ku, Fukuoka, 819-0395, Japan)

³Faculty of Engineering, Kyushu Univ. (744, Motoooka, Nishi-ku, Fukuoka, 819-0395, Japan)

⁴Faculty of Engineering, Tottori Univ. (4-101, Koyamacho-minami, Tottori, Tottori, 680-8552, Japan)

⁵Research Institute for East Asia Environments, Kyushu Univ. (744, Motoooka, Nishi-ku, Fukuoka, 819-0395, Japan)

⁶Graduate School of Global Environmental Studies, Kyoto Univ. (Yoshida-honmachi, Sakyo-ku, Kyoto, 606-8501, Japan)

⁷Graduate School of Global Environmental Studies, Kyoto Univ. (Kyotodaigaku Katsura, Nishikyo-ku, Kyoto, 615-8540, Japan)

* E-mail: fujii.shigeo.6z@kyoto-u.ac.jp

1. INTRODUCTION

The 16th Japan Society of Civil Engineering (JSCE) study tour of environmental problems was held in Kathmandu, Nepal from 28th February to 8th March (including a flight delay of two days caused by the closure of the airport). Kathmandu, which is located at the foot of the Himalaya Mountains, is the capital of Nepal. The population of Kathmandu Valley is more than 2.5 million¹⁾. The area is well known to tourists as a world heritage site. It is also known to experience a lot of earthquakes. The population of Kathmandu is rapidly increasing, which is causing a variety of environmental problems. The objectives of this tour were to observe and assess the environmental issues in the Kathmandu Valley and discuss possible solutions (**Picture 1**). Seven undergraduate and graduate students from Japan and five graduate students from Tribhuvan University joined the discussion. In addition, this tour also

aimed to promote international exchange between Japanese and Nepalese students. This report provides information about the environmental problems in Kathmandu, which was gathered during the tour.

2. WATER POLLUTION

Water pollution is one of the most serious problems in Kathmandu. Nepalese people have a custom to use shallow groundwater for their daily needs (**Picture 2**), but the groundwater has been contaminated by sewage in many locations. Therefore, there is a high risk of exposure to pathogenic microorganisms²⁾. In addition, rivers have been polluted and ecosystems has been destroyed with the extinction of biodiversity. The major cause of these problems is the lack of sewerage systems. There are five wastewater treatment plants (WWTP) in Kathmandu, however, four-fifths of them are out of operation. This means that almost all wastewater is discharged directly into



Picture 1. Discussion in Tribhuvan University



Picture 2. Groundwater Intake Facilities



Picture 3. Guheshwori WWTP (left) and Foaming Effluent at the Discharge Port (right)

rivers. We visited Guheshwori WWTP, which is the only operational plant in the city (**Picture. 3**). The plant operates an oxidation ditch process, which has high operating costs. The quality of the treated water was not sufficient and it foamed at the discharge port. In general, a high degree of technical skills are required for the operation of an oxidation ditch process; otherwise floc flows into the effluent and spoils the treatment. Thus, there is a need for a different treatment process. There are four other WWTPs, stabilization ponds or aerated lagoons, in Kathmandu that are not operational. In general, these treatment processes are easy to maintain and manage, and tend to be more applicable to developing countries. However, these WWTPs are not working, because the accumulated sludge is not regularly removed. One of the reasons for this situation is considered to be a lack of education among the technical staff.

Although, in other developing countries, on-site wastewater treatment, such as a septic tank, is widely used, septic tanks are not common in Kathmandu. Hence, domestic sewage is directly discharged into rivers without treatment. In Kathmandu, old and high-rise apartments are densely built, which makes it difficult to install septic tanks in existing buildings.



Picture 4. Waste Scattered on the Road

The development of a sewerage system with an emphasis on sustainability is required.

3. SOLID WASTE MANAGEMENT

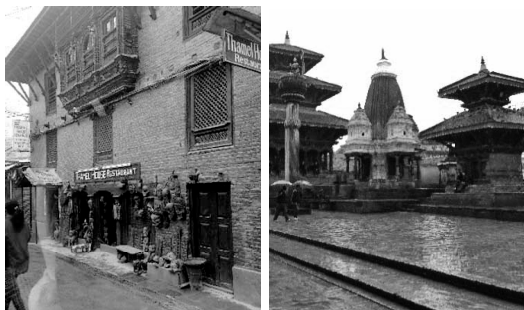
Solid waste management is as important an issue as water pollution. In Kathmandu, even in the world heritage area, piles of waste are left on the streets (**Picture 4**). In the Bagmati River, a major river in the valley, people dispose of solid waste on the riverside, which pollutes the river water and groundwater.

Inadequate waste collection and a lack of disposal sites are one of the causes of this situation. Waste collection is not conducted regularly. The number of waste collecting tractors is not adequate. Even though waste is collected, it is disposed of on the riverside, due to the lack of disposal sites. The Japan International Cooperation Agency (JICA) supported and constructed a disposal site in 2005³⁾. At this time, it appeared that the disposal of waste on the riverside ceased. Waste in Kathmandu is collected from around the city and transferred to the Teku transfer station, from where it was transported to a disposal site. We visited the Teku transfer station and we witnessed an interesting trial; that involved sprinkling water containing microorganisms onto the waste, this process was being conducted to decrease odors. According to Kathmandu Metropolitan City Office, the amount of waste generated is 0.3 kg/person/day and 336 tons/day in total. The total waste collection is 306 tons/day. Organic matter comprises 72% of the waste stream.

The government makes an effort to utilize solid waste. At the Teku transfer station, solid waste is sorted by hand. Around 25% of the collected metal is treated in Kathmandu and the remainder is exported to India⁴⁾. Waste grass is exported to India, because there is no domestic industrial use in Nepal. Plastic and paper are processed in Nepal. The practice of sorting waste or applying the 3R waste management hierarchy is not common. Thus, it is necessary to educate people on the importance of such activities.

4. CITY PLANNING

With regard to city planning, there are urgent issues regarding traffic congestion and housing. The population of Kathmandu is increasing and traffic



Picture 5. Brick Buildings in Kathmandu

volumes are getting larger. The number of small vehicles, such as motorbikes, is particularly large. The number of motorbikes in Nepal is 1.2 million, which is nearly ten times larger than the number of cars/jeeps/vans⁵⁾. In addition, there is little public transportation. Therefore, streets in the urban area are always congested. Tourism is one of the main industries in Nepal, however, the traffic situation is not convenient for tourists.

The affordable housing for low income groups is not adequate. The rent of a single room is generally 20-25 US dollars per month, which is expensive for low-income families⁶⁾. In addition, the average land price in Kathmandu has doubled in the last 10 years. Hence, squatters now comprise 7 to 10% of the urban population and are living beside rivers. Due to the piles of waste that have accumulated along the river, this situation is not hygienic. Better housing provisions and employment opportunities are needed for all income groups.

One of the characteristics of Nepalese architecture is brick buildings (**Picture 5**). We saw residents laying bricks and extending their buildings during this tour. Such buildings have little ability to resist seismic shocks, compared with reinforced concrete. Thus, earthquakes cause significant damage in this region. This vulnerability is well known by the Nepalese people, because earthquakes frequently occur in the country. On the other hand, the brick industry is a major industry in Kathmandu. Construction costs from building with brick are less than the cost of building with reinforced concrete; therefore, bricks are commonly used by people with low-income groups. In the discussion, a sustainable, eco-friendly, affordable housing concept was recommended to be established as a housing policy. The importance of developing satellite towns was also mentioned.

5. CONCLUSION

As part of the 16th JSCE study tour of the environmental problems in Kathmandu, Nepal, we visited several locations experiencing environmental issues in this area and tried to clarify the problems through a discussion.

In the water environment, wastewater was discharged directly into rivers because the sewerage system was poor, and four-fifths of the WWTPs are not working, due to insufficient management. Solid waste was left on riversides, because waste collection is not adequate; eventually the solid waste pollutes the surface water and groundwater. With regard to city planning, there are problems caused by rapid population growth, such as inadequate roads, squatters living on riversides, and buildings that are vulnerable to seismic activity. It is necessary to not only develop infrastructure but also improve "software" aspects such as providing education to engineers or changing the citizens' way of thinking with regard to environmental issues.

ACKNOWLEDGEMENTS

This tour was supported by the Committee of Environmental Engineering of the JSCE, through a joint study tour of the Strategic Program for Fostering Environmental Leaders and the Research Institute for East Asia Environments, Kyushu University, Tribhuvan University, and Kathmandu University. We gratefully acknowledge the contributions made by these partners.

REFERENCES

- 1) National Population and Housing Census 2011 (2014) ネパール中央統計局
- 2) 志村禎章ら (2012) ネパール・カトマンズ盆地における浅層地下水の下水汚染の解析, 第46回日本水環境学会年会講演集, p. 292
- 3) JICA (2005) ネパール国 カトマンズ盆地都市廃棄物管理計画調査ファイナルレポート 要約
- 4) Government of Nepal National Planning Commission Secretariat (2012) ネパール中央統計局
- 5) Statistical Pocket Book Nepal 2010 (2011) ネパール中央統計局
- 6) Nepal urban housing sector profile (2010) ネパール中央統計局