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MODELING AND INFORMATION SYSTEM OF RIVER WATER QUALITY – CASE STUDY CIKAPUNDUNG RIVER BANDUNG

1st year report of 2-year research duration

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SUMMARY

One method to assess the river water quality is by means of simulation results of a model verified with the measurement data obtained from in the field. Modeling is a method that is easy, inexpensive, and saves time. The use of river quality model is very useful to predict the future condition using kinds of scenarios, so that the river environmental management can be formulated prior to the occurrence of pollution, environmental damage, or other disasters.

Modeling of river water quality was introduced by Steeter Phelps equation using oxygen depletion curve equation (oxygen sag curve) which is using coefficients, i.e. deoxygenation rate and reaeration rate. These rates are environmental condition dependent values; therefore the specific research to find the suitable rates is needed. Furthermore, to make simulation simpler, the development of software of river water quality model is necessary. The 'KUALA.V01', software to simulate BOD and DO of river water is now being prepared and planed to be finished this year.

In the other hand, the increasing of environmental conservation awareness needs a system of information which is useful, informative, up to date, complete, and easy to be analyzed. To develop such system, a comprehend research needs to be conducted, especially to gather information considering data collection system, its publication, and distribution. These information would be very useful also for environmental education in order to increase awareness and enforcement to young generation, especially students in conserving the environment. Besides that, information of the river water quality would be also useful for researchers, government, and other stakeholders for many kinds of purposes. To have an effective system of the environmental system, the need of development of its concept is urgent.

The information system of environmental quality embedded with the environmental modeling has already been applied effectively in Japan, especially in the Kitakyushu City which is well-known as an eco town. Therefore, to be able to apply the system in the Bandung City river, i.e. Cikapundung River as a case study, the collaboration with the expert from the University of Kitakyushu is definitely necessary.

There are a range of scales which must be considered within an integrated approach to land and water management in parallel with two sets of factors which we argue have the greatest influence on successful implementation, i.e. human dimension, and ecological space dimension. Human dimension means the interest of individual or group. Ecological space dimension means the interest of natural environment. It's important to understand the relationship between local activities and their impacts downstream. Issues where, when and how human activities interact with the hydrological processes and the impact they have on the quantity and quality of water in the entire catchment of Cikapundung River.

PREFACE

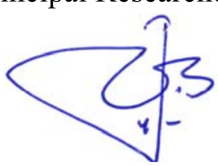
Modeling environmental quality and its integration within the environmental information system in one region becomes very important when we talk about environmental improvement and maintenance of a healthy environment. In a simple but difficult research, we are trying to do something for the environment for a limited location as a model. The difficulty that arises is a cliché illnesses suffered by Indonesian people by laziness, selfish, and ignorance attitude. Abundant natural resources were exploited without thinking of the future generations to come, without thinking of others who are also in need. Therefore, this study has no meaning without mental improvement of Indonesian society.

We are very grateful for the help of Directorate General of Higher Education (DGHE) Ministry for Research, Technology and Higher Education, which has funded this research. Hopefully the research can be useful in improving the environment, at least in data transparency aspect. Also we are grateful for the cooperation effort of the Laboratory of Prof. Matsumoto and Mrs. Indriyani Rachman as research partner.

Forming the information system for Indonesian community is somehow not easy. Several attempts need to be conducted to aware all stakeholders the importance of open publication of data, including environmental quality data. Thus, the activities in considering improvement of the bad quality could be carried out appropriately and give benefits for many people.

Bandung, 4 November 2015

Principal Researcher,



(Dr. Yonik Meilawati Yustiani)

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CHAPTER I
INTRODUCTION

1.1 Overview

The comprehensive solution of the environmental issues must be supported by three aspects, i.e. human resources, system/ procedure/ strategy (software), and technology / devices (hardware) (see Fig. 1). Therefore various researches need to be conducted to sustain one aspect to another.

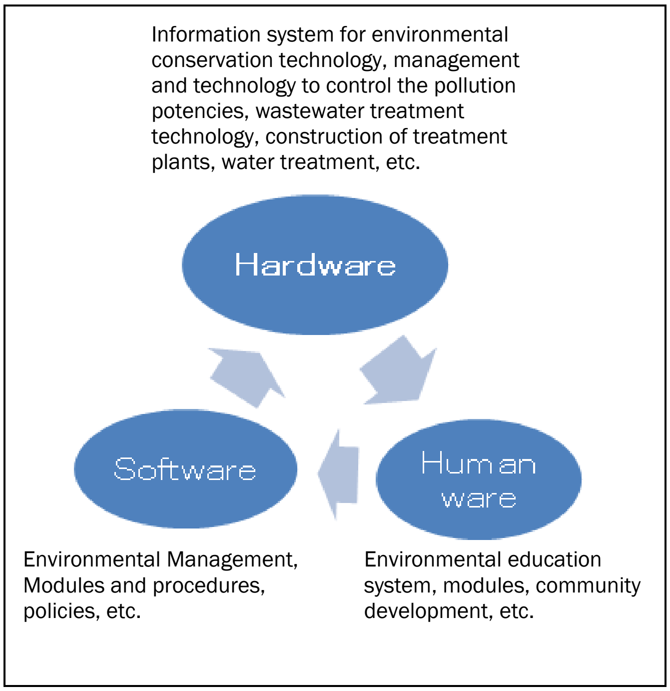


Figure 1. Important aspects of environmental control strategy for urban area in Indonesia.

For the human ware aspect the involvement and cooperation of each stake holders are indispensable. Those stakeholders are community – government – university - private company. The government acts as the policy formulater who will govern the environmental management system, while the universities are in charge of implementing their three pillars, i.e: teaching, research, and community service. Aspect of human ware is also related to the awarness of the community on the environmental quality conservation. In order to control the polluted water and to treat the wastewater to prevent the pollution, the design and research on treatment technology is needed. This measurement is included in the hardware aspect. The environmental management can run well when arranged in a comprehensive system which is equipped with procedures and technical guidelines. For example, for waste sorting system, before being implemented, it should be equipped with the distribution of sorted wastes and collection system of each type of waste.

1.2 Collaboration Research

Implementation of comprehensive research can be significantly recognized with the involvement of a wide range of scientific fields. Several universities in Indonesia, which have MOU (Memorandum of Understanding) with the Faculty of Environmental Engineering of the University of Kitakyushu (UOK), are the University of Andalas (UNAND), Pasundan University (UNPAS), Indonesia University of Education (UPI), University of Langlangbuana (UNLA), State University of Malang (UM), and Institute of Technology Bandung (ITB). The team from several universities will conduct research in the theme of ***Study on Urban Environmental Management of Indonesian Cities Considering Applicability of "Kitakyushu Model" as a Japanese Advanced Eco-model City***.

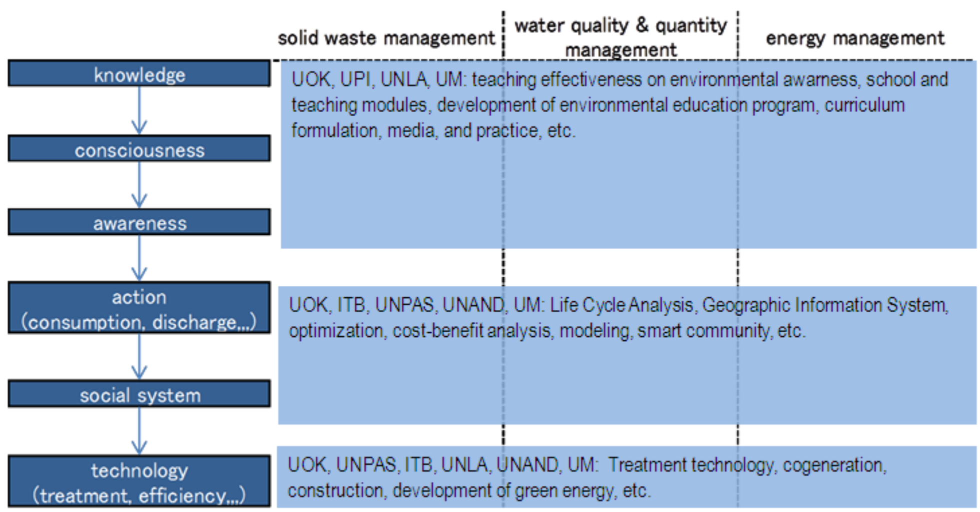


Figure 2. Distribution of research on the *Study on Urban Environmental Management of Indonesian Cities Considering Applicability of "Kitakyushu Model" as a Japanese Advanced Eco-model City.*

1.3 River Quality Management

The high pollution load into the urban water bodies cause the deterioration and damaged condition of the river water quality and aesthetics. It happens also in Cikapundung River, whereas its water is often used to irrigate agricultural areas in the downstream area. Some pollution control efforts have been made, including the use of prediction modeling and calculations for the formulation of environmental management and enforcement of quality standards, both for wastewater (effluent standards) as well as for the river water as waste receiving water bodies (streams standard).

Recently, the function of rivers located in Bandung City turns into the discharge place of domestic and industrial wastewater. The water quality in Bandung Basin becomes deteriorated, especially in Citarum River. The dominant pollution source is domestic activities. The West Java Environmental Protection Agency estimates that the domestic wastewater was discharged from 3.5 million people directly and indirectly into the urban rivers around Bandung City. The domestic wastewater reaches up to 60% of total wastewater pours into the rivers (Yustiani, et.al, 2013a).

The use of system analysis and mathematical modeling for formulating and solving river pollution problem is of relatively recent vintage and has been used widely during the last three decades. Seeing the mounting public pressure at water bodies the need to protect it from pollution is essential where mathematical modeling is the best alternative as accepted by the decision makers. Water quality modeling has proved as a reliable and economic method of assessing pollutant distribution in surface waters and can be effectively used in management decisions (Karim and Badruzzaman, 1999). Modeling is not an alternate to observations but under certain circumstances, can be powerful tool in understanding observations and in developing and testing theory (Khanna, 2007). To perform mathematical modeling of aquatic chemicals, four ingredients are necessary (1) field data on chemical concentrations and mass discharge inputs (2) a mathematical model formulation (3) rate constants and equilibrium coefficients for the mathematical model and (4) some performance criteria with which to judge the model (Kanna, 2007).

The use of water quality models in environmental management in Indonesia is still very rare, but this modeling can save the cost, effort, and time, especially for monitoring activities. In addition, the modeling also has the ability to predict water quality conditions in the past and predict the water quality conditions in the future. The results of modeling can help in the formulation of environmental management programs.

This research was conducted in order to develop a software model of river water quality suitable for the condition of rivers in Indonesia. The design is made attractive interaction, user-friendly and attentive to the needs of the user. Modeling results can be displayed and printed in accordance with the desired format, can also be simulated. Name of software that is built is 'KUALA.V01'. In the second year, the software 'KUALA.V01' will be integrated with a geographic information system.

Collaboration with the Matsumoto Laboratory, Department of Life and Environment Engineering, the University of Kitakyushu has been conducted since the year of 2013. On January 2014, the Environmental Engineering Department of Pasundan University conducted a workshop with the Department of Life and Environment Engineering of the University of Kitakyushu to investigate the Cikapundung River water quality and the elementary students moduls on environmental education.

1.4 The Need Information

Effective water resources development and management is not possible without adequate information and benefits when the quality of information is improved. Information on relevant characteristics supports and guides decision makers to determine the best ways to proceed and is the basic source to evaluate the effects of specific policies. Vast effort is hence put into the collection and dissemination of environmental information, especially by the government-related institutions.

The need for information in the field of water quality management has steadily increased over time. Water quality management was virtually non-existent up to approximately 1850, by which time local environmental conditions deteriorated severely with foul smelling, developments in urbanization and industry after World War II in western Europe led to deterioration of the quality of surface waters. New industrial processes emerged, that increased the standard of living. These same processes produced increasing streams of wastewater quality situation were conducted whenever locally problems occurred. However, slowly water managers came to realize that these problems became long lasting and omnipresent. Irregular studies were not enough to deal with the pollution and a structured system of information gathering was needed. (Timmerman, 2015)

1.5 Research Road Map

Fig. 3 shows the stages in the comprehensive *Study on Urban Environmental Management of Indonesian Cities Considering Applicability of "Kitakyushu Model" as a Japanese Advanced Eco-model City*, which will be supported by research conducted by several universities that currently has a cooperative agreement with the University of Kitakyushu. This study is a collaboration research which will be carried out by six research universities with a different focus but mutually integrated with one another. Interconnection and relation between the focus researches can be illustrated as below (Fig. 4).

The road map of this research on Modeling and Information System of River Water Quality – Case Study Cikapundung River is shown in Fig. 5. Research on river water quality modeling has been initiated with the use of Hydroscience equation model calibration process. In the years 2011-2012, the research on deoxygenation rate coefficient for urban river in Indonesia based on laboratory analysis has been conducted. The value of deoxygenation coefficient becomes the basis for calculating the decay of BOD in river water quality models in software development research of river water quality modeling 'KUALA.V01’.

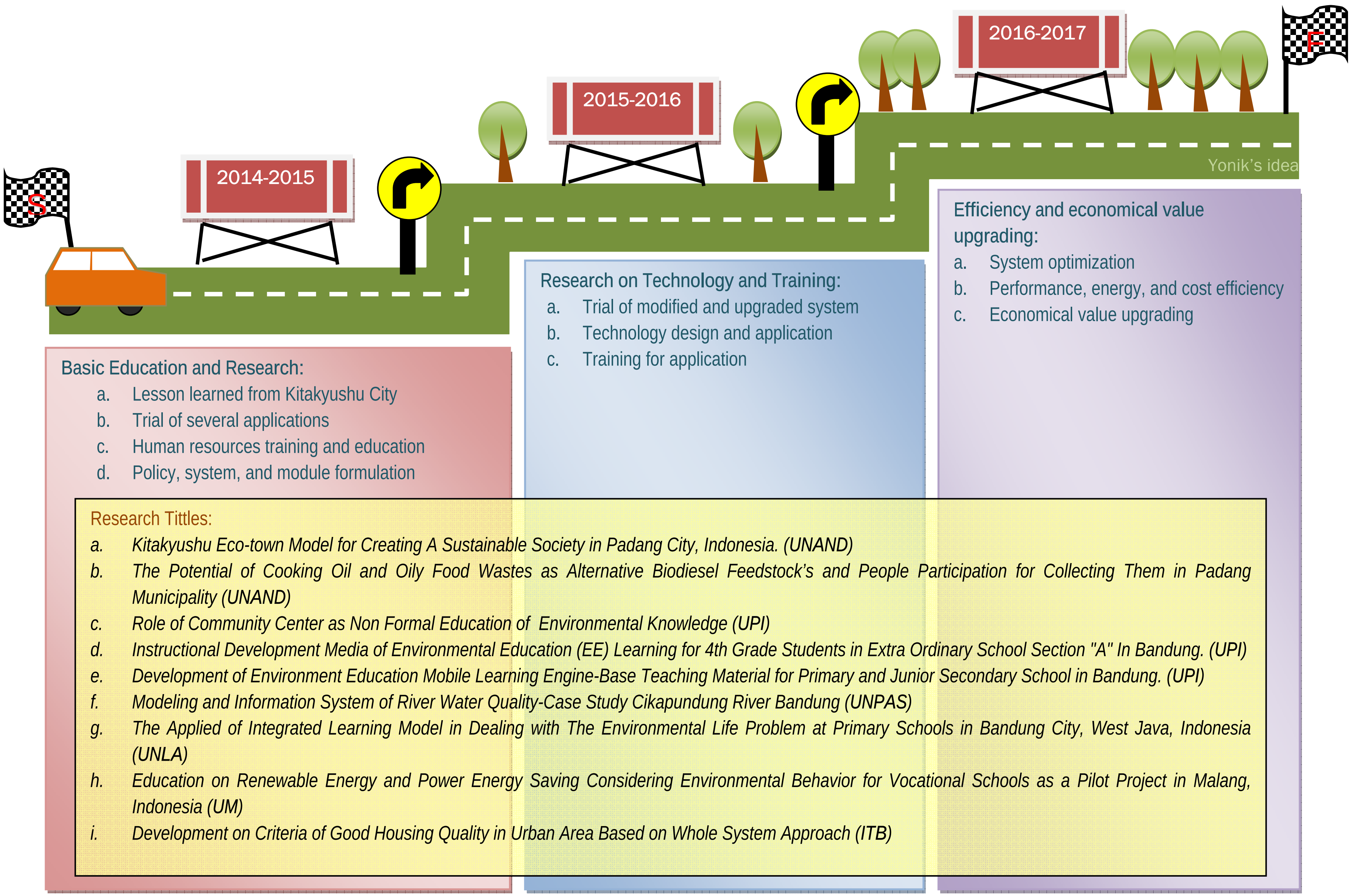


Figure 3. Roadmap of the collaboration research of the *Study on Urban Environmental Management of Indonesian Cities Considering Applicability of "Kitakyushu Model" as a Japanese Advanced Eco-model City*.

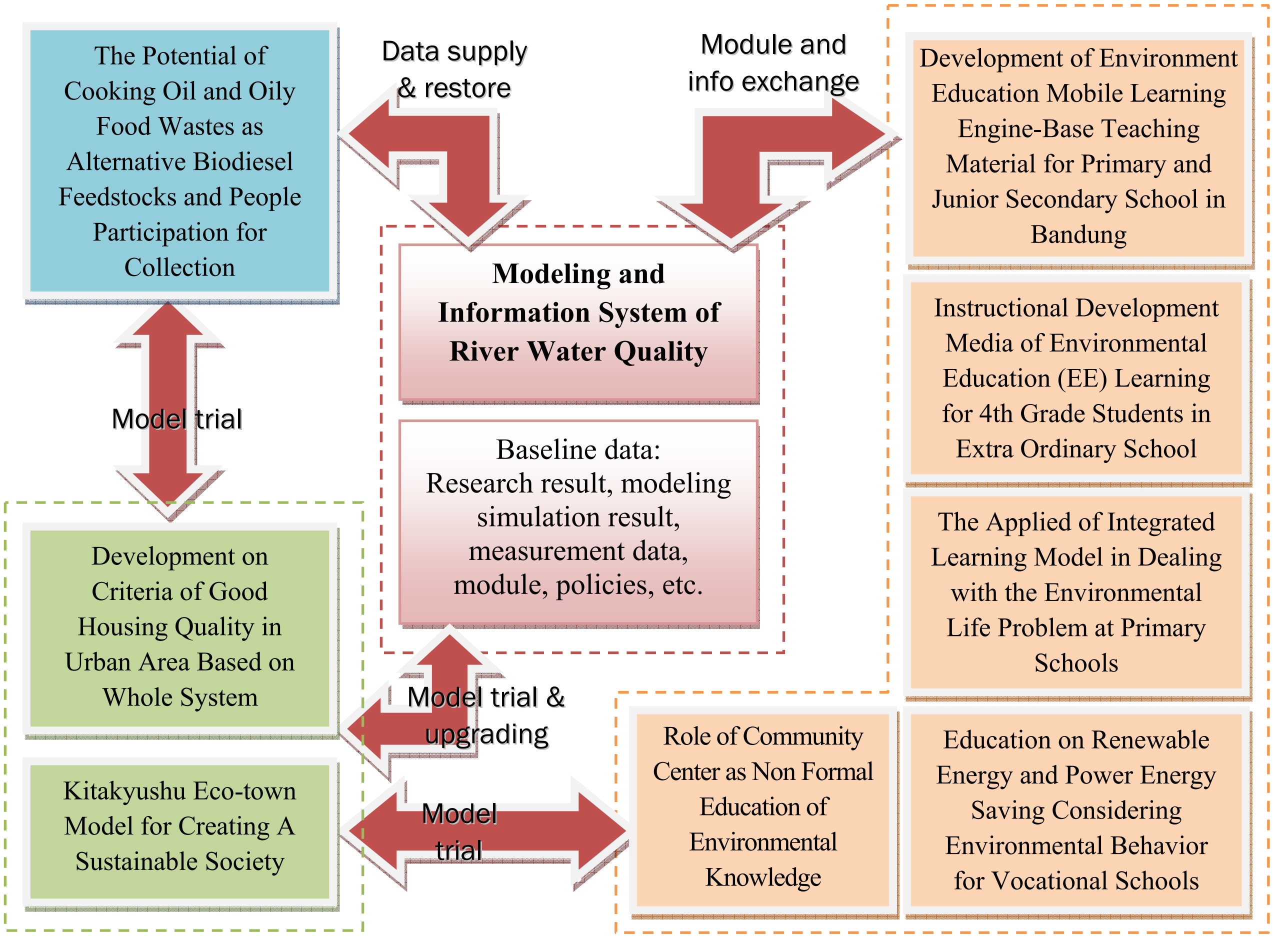


Figure 4. Interconnection and relation between the focus researches.

Models and software development will be finished in this year. After the software KUALA.01 is formed, it will be integrated with GIS (Geographical Information System). The integration will provide the presentation quality of the river water is modeled with a more informative, particularly in relation to the allotment of river water. In the first year (2015), the prototype software 'KUALA.V01' is planned to be integrated with GIS. Also in the first year, there will be identification of the existing information system network of environmental quality management. In the second year (2016), the model and the information system will be integrated.

Output	Product	BOD rate using model calibration process	BOD rate using laboratory analysis	Software Prototype	Software KUALA.01	KUALA.01 in GIS	Integration of river water quality information system	Environmental modeling and information system KUALA.V02
	Findings	Citarum River Water Quality	Cikapundung & Citepus River Water Quality	Software Requirement	Analysis of Urban Water Quality	Bandung city river water quality	Bandung city river water quality	Analysis of Urban Water Quality
	Publication	International conference	International and national conference	International publication and national conference		International publication and conference		International journal
Method	Data Processing	Sampling & Model Results	Sampling, lab analysis	Programming	Simulation	Model simulation	Information display	Users interpretation
	Analysis	Water Quality	Statistical process	Model comparation	River water standard	Descriptive and statistics	Descriptive and analysis	River water standard
PARAMETER	Implementation	Characterization of River Water Quality (Citarum River)	Characterization of River Water Quality (Cikapundung & Citepus River)	Design of water quality software	Simulation output	Display of water quality integrated with GIS, comprehensive network of information system		Data and simulation
	Process			Characterization of river condition	Descriptive			Descriptive
	Design			Computer programming	Comparative and Statistics			Comprehensive network
Activity Year		**2008-2009**	**2011-2012**	**2013**	**2014**	**2015**	**2016**	**2017-2019**

Figure 5. Roadmap of ther research on Modeling and Information System of River Water Quality – Case Study Cikapundung River

CHAPTER II
LITERATURE REVIEW

2.1 Pollution in Waters

Surface water such as lakes, rivers and ponds must be able to support aquatic life and aesthetic requirements. Surface water quality is indentified based on the condition of specific parameters, i.e. physical, chemical, and biological. The pollution of river water is mainly caused by the domestic waste. A very high pollution can stimulate the health problems and other material damage.

Human activities can generate wastewater causing pollution in waters depends on the type of activities, materials used, and the process or the technology applied. These human activities in general can be categorized as follows:

1. Industrial activities

   Industrial activities generate wastewater discharged into the waters. The quality of wastewater discharged depending on the type of industry.

2. Domestic (household) activities

   Derived from wastewater generated by household activities such as water used from bathing, washing, latrines also from the food processing.

3. Agricultural activities

   Contaminants of agricultural pollution in the wastewater is generally the result of fertilization and pest control. Residues from crop fertilization activities consisted mostly of inorganic compounds such as nitrogen and phosphorus compounds that can cause eutrophication.

4. Husbandary/farm activities

   Farm activities that can cause pollution are from animal waste, cleaning stables, slaughterhouses, etc.

2.2 Organic Pollutants

Domestic activities, which are easily found near the Cikapundung River, generate wastewater mainly contained organic matters. In ther water body, the organic pollutants will be used by microorganisms as energy source to reproduce. This uptake is the degradation mechanism of pollutant by microorganisms. During the degradation process, the microorganisms will consume oxygen, thus the concentration of oxygen will be depleted when the organic pollutants are abundant. The depletion of oxygen concentration will cause anaerobic condition which is unpleasant environment for biotas.

Dissolved organic matter in waters defined in two categories:

1. Biodegradable organics

Biodegradable organics can be decomposed by natural biological processes. Decomposed organic matter used as a natural food by microorganisms. These substances are usually composed of carbohydrates, fats, proteins, alcohols, acids, aldehydes, and esters. Decomposed organic matter derived from the decay of plant, animal or from domestic and industrial wastewater.

2. Nonbiodegradable organics

Nonbiodegradable organics is substances that are resistant to biological decomposition. For example: tannins, lignin, acid, cellulose and phenol are nonbiodegradable organics that always found in the waters. Molecules that have strong bonds and ring structures (benzene) are also non-biodegradable. For example, alkyl benzene sulphonate detergent compounds (ABS) is a benzene ring which is non-biodegradable. Some are non-biodegradable organic substances are toxic to microorganisms.

Decomposition process of organic substances in the water will cause the decline of oxygen concentration in water quality that can be illustrated into four zones, as follow (Srinivas, 2008):

1. Zone of degradation; this zone is situated just below the outfall sewer while discharging its contents into the stream. In this zone, water is rendered dark and turbid, having the formation of sludge deposits at the bottom. The DO is reduce to 40% of the saturation values. There is an increase in CO_2 content, and reaeration is much slower than deoxygenation. (Though conditions are un-favorable for aquatic life, fungi at shallow depths and bacteria at greater depths breed along with small worms, which 'work over' and stabilize the sewage and sludge). The decomposition of solid matter takes place in this zone and anaerobic decomposition prevails over aerobic decomposition.

2. Zone of active decomposition; this zone is just the continuation of degradation zone and is marked by heavy pollution. Water in this zone becomes grayish and darker than the previous zone. The DO concentration in this zone falls down to zero. Active anaerobic organic decomposition takes place, with the evolution of Methane (CH_4), Hydrogen sulfide (H_2S), Carbon dioxide (CO_2) and Nitrogen (N_2) bubbling to the surface with masses of sludge forming back scum. Fish life is absent in this zone but bacterial flora will flourish with the presence of anaerobic bacteria at upper end and aerobic bacteria at the lower end. However, near the end of this zone, as the decomposition slackens, reaeration sets in and DO again rises to its original level of 40% (of saturation value).

3. Zone of recovery; in this zone, the process of recovery starts, from its degraded condition to its former purer condition. The stabilization of organic matter takes place in this zone. Due to this most of the stabilized organic matter settles as sludge, BOD falls and DO content rises above 90% values. Near the end of the zone, fungi wave out and algae reappear.

4. Zone of cleaner water; in this zone, the natural condition of stream is restored with the result that:

(i) Water becomes clearer and attractive in appearance
(ii) DO rises to the saturation level, and BOD drops to the lowest value
(iii) Oxygen balance is attained

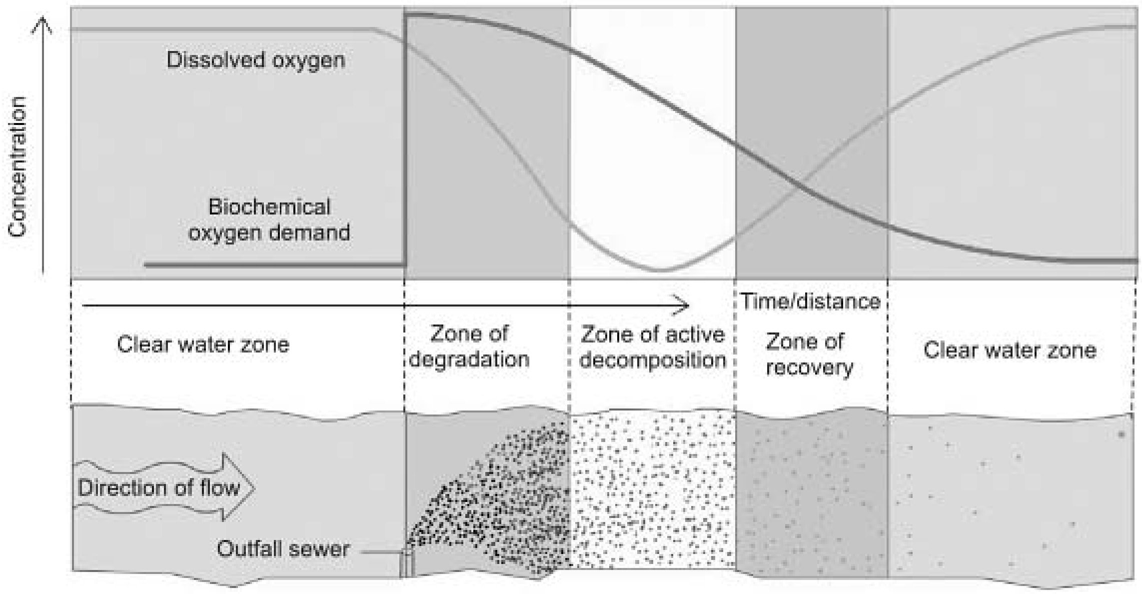


Figure 6. Zones of pollution in streams (Oxygen sag analysis) (Srinivas, 2008)

2.3 Organic Pollutant Indicators

Wastewater to be reviewed is a domestic waste water so that it can be assumed parameters sused as the basis for a review of water quality effluent is Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO).

1. Biochemical Oxygen Demand (BOD)

One of the parameters that are commonly used as an indicator of organic pollution in a water body is BOD. BOD (Biochemical Oxygen Demand) is an empirical analysis that tried to approach the whole process - microbiological processes that occur in water. Figures BOD indicates the amount of oxygen required to decompose bacteria (oxidize) almost all the dissolved organic substances and some substances - organic matter suspended in water. Examination of BOD based on the oxidation reaction of organic matter with oxygen in the water and the cleaning process due to the presence of aerobic bacteria.

2. Dissolved Oxygen (DO)

Dissolved Oxygen (DO) is essential to maintain aerobic conditions in surface water and also an indicator of the feasibility of water to support aquatic life (aquatic). Ideally, the concentration of dissolved oxygen in natural water will approach the saturation concentration. However the presence of organic matter, oxygen will be used on natural oxidation process. Of course this will lead to a smaller value than the value of the saturation concentration.

All the gases in the atmosphere can be dissolved in water at a certain level. Oxygen gas has classified the small solubility in water and its solubility is proportional to the partial pressure, and oxygen saturation levels in the water will follow Henry's law. The solubility of oxygen increases according to different atmospheric pressure and at various temperatures. The solubility of oxygen in water ranging from 14.6 mg / l at a temperature of 0 ° C to 7 mg / l at a temperature of 35 ° C at a pressure of 1 atm. (Sawyer, et.al. 2003).

2.4 River Self Purification

When the wastewater or the effluent is discharged into a natural stream, the organic matter is converted into ammonian, nitrates, sulphates, carbon dioxide, etc. by bacteria. In this process of oxidation, the dissolved oxygen content of natural water is utilized. Due to this, deficiency of dissolved oxygen is created. As the excess organic matter is stabilized, the normal cycle will be in process known as self purification wherein the dissolved oxygen is replenished by its reaeration by atmospheric oxygen of wind (Srinivas, 2008).

Water bodies have basically known as the carrying capacity of the water carrying capacity. River discharge has a large and high dissolved oxygen has a large carrying capacity. If organically polluted river water oxygen concentration will decrease over time because it is used by microorganisms for decomposition of organic substances. The decrease in the concentration of oxygen is called deoxygenation. While the presence of turbulence in the stream, oxygen from the air can get into the water, a process called aeration.

2.5 Development of River Oxygen Sag Model

The shape of the oxygen sag curve, as shown in Fig. 6, is the result of adding the rate of oxygen use (consumption) and the rate of supply (reoxygenation). If the rate of use is high, after the introduction of organic pollution, the dissolved oxygen level drops immediately because the supply rate cannot keep up with the use of oxygen, creating a deficit. The deficit (D) is defined as the difference between the oxygen concentration in the stream water (C) and the total amount the water could hold, or saturation (S).

After the initial rate of decomposition when the readily degraded material is used by the microorganism, the rate of oxygen use decreases because only the less readily decomposable materials remain. Because so much oxygen has been used, the deficit is great, but the supply of oxygen from the atmosphere is high and eventually begins to keep up with the use, so the deficit begins to level off. Eventually, the dissolved oxygen once again reaches saturation levels, creating the dissolved oxygen sag (Vesilind, et.al, 2010).

The oxygen sag curve has been formulated by Streeter and Phelps in 1925, based on two phenomena as key processes in self purification of water, i.e. deoxygenation of organic matter containing carbon (carboneceaus) by bacteriological decomposition, and reaeration caused by turbulence process.

This model can be applied by taking the assumption that the cross section along the same river flow being simulated, the flow rate is constant, the concentration of oxygen and BOD uniform in lateral and vertical direction on the entire cross-section. Effects of algae and silt are ignored. In addition, the reaction rate deoxygenation and reaeration are considered constant. Furthermore, in the analysis, it is assumed that the wastewater stream that enters the river distributed uniformly throughout the cross section of the river.

Streeter Phelps equation can be seen in Eq. 1. The first term is deoxygenation process part, while the second term is the process of reaeration part (Schnoor, 1996).

$$\bar{u}\frac{dC}{dx} = -k_d L + k_a(C_s - C) \qquad \text{(Eq. 1)}$$

where: u = average velocity of the river flow
K_d = first order of deoxygenation rate coefficient
L = BOD concentration
C = dissolved oxygen concentration
C_s = saturated concentration of dissolved oxygen
k_a = first order of rearation rate coefficient

$$D = D_o \cdot e^{\frac{-ka}{u}X} + \frac{Kd.Lo}{Ka - Kr}\left[e^{-\frac{kr}{u}x} - e^{-\frac{ka}{u}x}\right]$$

where :
D = deficit of defisit oxygen in t time, (mg/l)
X = distant (km)
U = average velocity of river flow (m/s)
K_d = deoxygenation rate coefficient (day^{-1})
K_a = reaeration rate coefficient (day^{-1})
K_r = total removal coefficient (day^{-1})
L_o = initial concentration of BOD (t = 0),(mg/l)
D_o = initial deficit of oxygen concentration (t = 0), (mg/l)

2.5.1 Deoxygenation

Oxygen in a body of water can be reduced due to the oxidation of bacteria suspended and dissolved organic matter derived from natural sources/ human activity. Deoxygenation coefficient used for the calculation model of organic pollution of water used formula is the formula according to O'Conner and Dobbins for normal flow is as follows (Hydroscience, 1971):

$$\mathbf{K_d = 0{,}3}\left[\frac{H_{average}}{8}\right]^{-0{,}434}$$

Where :

K_d = deoxygenation rate (day^{-1})
H = water depth (m)

The previous research has obtained specific value of the deoxygenation rate of Cikapundung River in the range of 0.01-0.37 per day in rainy season (Yustiani, et.al, 2013b), and 0.016-0.0233 per day in dry season (Yustiani, 2013a).

2.5.2 Reaeration

Source of additional oxygen enter into water bodies resulted from atmospheric reaeration. The process of oxygen introduction in this case is based on the transfer of gas from the air into the water via its surface. Gas transfer is a physical-chemical process that occurs continuously at the surface between the gas and liquid. Simultaneously some dissolved oxygen molecules released into the atmosphere through the surface. Movement takes place in both directions at different speeds - each of which is determined by temperature and other variables. If there is no oxygen used in the water, a dynamic balance transfer rate of oxygen from air to water at the rate of oxygen transfer. This will result in a fixed oxygen concentration in water saturated conditions.

The reaeratioin equation :

$$r_R = K_2 (C_s - C)$$

where :

r_R = reaeration coefficient
K_2 = reaeration rate coefficient, d^{-1} (exponential based)
C_s = saturated concentration of dissolved oxygen, (mg/l)
C = concentration of dissolved oxygen (mg/l)

Oxygen transfer coefficient depends on the nature of water (Thomann, 1987):

- internal mixing and turbulence due to velocity gradients and fluctuations
- temperature
- wind
- waterfalls, dams
- surface films

Several methods can be used to get the price of Ka is using a model that O'Conner and Dobbins formula according to the normal flow is as follows:

$$\mathbf{K_a = 3,93} \frac{U_{average}^{0,5}}{H_{average}^{1,5}}$$

Where :

K_a = reaeration rate coefficient (day$^{-1)}$
U = average velocity of water flow (m/s)
H = average of water depth (m)

Some research on the modeling of water quality in the area has been carried out, among others, water quality modeling Upstream Citarum River (segment Wangisagara-Nanjung) was simulated using the field data. Research on the Citarum River water quality showed that the condition of BOD pollution in 2001 was 226mg/L in the WWTP (Waste Water Treatment) Cisirung. In this study, the model is not built but using an existing model. In this research, the coeffient of deoxygenation was obtained by means of calibration process of the model, acquiring the value of 0.03-0.95 per day (Yustiani, et.al, 2008)

2.6 Development of a Software

Software is only one element of a software project. Proper use and acceptance of the tool by staff is as important, if not more important. Figure below shows the three interrelated elements of any software project: business processes, technology, and people. It has already been noted that technology should be selected to fit specific business process needs; this topic is explored in greater detail in subsequent chapters. The people aspects of technology implementation include considerations such as staff involvement in the definition of requirements and software selection, but must carry through to implementation and ongoing use. Training is typically one of the most underfunded and under recognized critical success factors of any software implementation. While most COTS (commercial off- the-shelf) vendors provide training on the mechanics of using their software, additional training is often beneficial to educate end users on the role technology plays in performing their business processes, especially if these processes will change because of the introduction of a new software or technology tool. End-user and software support documentation is also critical to successfully maintain software over time, to provide a way for staff to explore lesser used functionality and to provide information to new staff that come on as end users after the initial implementation.

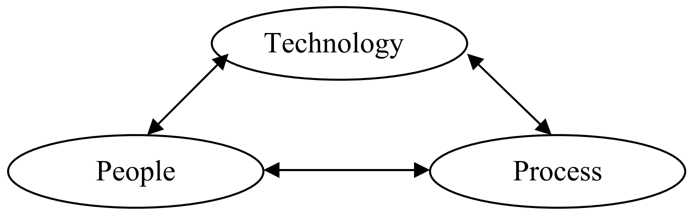


Figure 7. Key elements of software projects.

2.7 Developments in Information Technology

According to Water Environment Federation (WEF) WEF Manual of Practice no.33, information technology in water and wastewater utilities continues to progress from solely providing operational support toward serving as an enabler for a larger variety of business challenges. Information technology, n essence, is constantly evolving, thereby making it difficult to manage. New developments are steadily replacing or enhancing previous innovations.

There are two trends in the application of technology to supporting facilities. The firs has ti do with traditionally "unintelligent" assets such a pumps, pipes, and vehicles becoming instrumented, interconnected, and "intelligent" through the use of inboard IT systems. This opens up many possibilities, evidenced by things such as an intelligent utility network that IBM Corporation (Costa Mesa, California) has designed to tune maintenance programs based on highly accurate and timely asset performance information. The application of a sophisticated smart network, however, opens up many new management challenges for utilities in terms of redefining maintenance needs and the staff skills required to provide maintenance for the technology vs physical asset maintenance that is currently done. By educating the workforce and clearly defining roles and responsibilities associated with the use of technology, utilities will be able to achieve the potential value of technology for the organization.

The second trend has to do with the consolidation of business processes and supporting IT systems, an area that is receiving increasing attention in terms of the value of applying technology to support utility decision making and operations is asset management. From utilities across the United States to military bases, the desire to more effectively and efficiently manage a utility's assets is putting demands on utilities to transform from largely paper-based processes to computerized asset life-cycle management that involves the synchronization or direct integration of multiple information systems, including computerized maintenance management system

(CMMS), geographic information system (GIS), computer-aided design, financial systems, and content management systems.

Over time, the use of technology to support management will evolve and increase, this will include the use of technology integrated with assets such as self-diagnostic and radio frequency identification (RFID) chips that communicate status, problems, and performance metrics directly and in real time to operations management. Permanent assets, such as pipelines, will be to monitor and report back their capacity, use, and downtimes.

2.8 Environmental Quality Information System

The evolution in environmental management in the last decades parallels the evolution of information technology, in terms of change in approaches and players. Increasing knowledge about the environment has brought about a better understanding of the complexity of the issues, and more information publicly available has resulted into a steady shift from centralized decision making to increasing levels of participatory processes. The evolution of information technology that came about as a result of the increased complexity of the available hardware and software, and the devvelopment of the World Wide Web, has resulted in a change from centralized mainframes, to the wide popularity of personal computers collaborative sites, and online, social and professional networks (Dalcanale,F., et.al, 2011).

While these are seen as good developments, they come as a cost. The management of information, in turn, is increasingly complex. For water quality in particular, three main factors lead to that complexity: (a) the lack of understanding of environmental interactions and independency, leading to increasing uncertainty (Djordjevic 1993) and consequently the need of more data (Ganoulis 1999; Vantsteenkiste, et.al, 2008; Pahl-Wostl 2006; Fontane 1999); (b) interdicipline approaches, participatory processes and non-linear decision-making (Perry, et.al, 1996; Porto, et.al, 2004), resulting in different levels of information needs (Ward and others 1986); and (c) the increase of transboundary issues and conflics-due mainly to pollution and scarcity (Vlachos 1982; Slobodan 2009)-leading to the need of negotiations and partnerships both regionally an internationally (UNESCO 2006; Naddeo, et.al, 2005).

One of the ways to deal with complexity of water quality information management is the development of tools that would allow all players, including managers, researchers, educators, stakeholders and the civil society, to be able to contribute to the information system, in any level they are inclined to do so. In such a system, organizations that collect data can have a common repository, research institutions can publish results, manages can publish reports, and the system can collect different views and perceptions.

While calls for collaboration and information sharing are many, some obstacles still prevent it from happening. On the technology side, proprietary, closed source applications can prevent databases from being able to communicate. Different systems and sources of data can make it difficult to navigate and sort through the available information. On te organizational side, there may be some resistance from certain groups to sharing data. On all fronts, inertia and resistance to change and innvoation can halt collaboration efforts.

The second world water development report (WWDR) calls for integrated water resources and responsibilities. It also concluded that this will only be possible with “focus on better water governance that embraces all stakeholders and civil society, in both the public and private sector…” (UNESCO 2006). Similarly, the European Water Framework Directive’s key principles include “sharing information and experiences, the development of common methodologies and approaches, and the involvement of expert and stakeholders from candidate countries” (Naddeo et.al., 2005). This implies the need for intense communication at all levels due to the number of factors and different interests involved in the process.

The management of information can be done at many levels, from small, local watersheds to large or transboundary basins. More important than the scale, is the accessibility to the information and knowledge generated at different steps of the management process. This paper discusses a basic framwork for a collaborative water quality knowldege base, an presents a reference implementation: a Water Quality Knowledge and Information Network.

Water Quality Management involves dealing with a number of environmental factors that interact and afffect the state of and flow a water body. Management decisions require the manipulation of the supplementary tools designed to collect and analyze data, as well as methods to transform data sets into useful information. Finally, the information developed must be conveyed to other managers, decision makers, and the public in general. In addition, management of water quality also includes the implementation, evaluation, and compliance to the set of regulatoins, practices, and programs designed to keep, or bring, the quality of water to desired level.

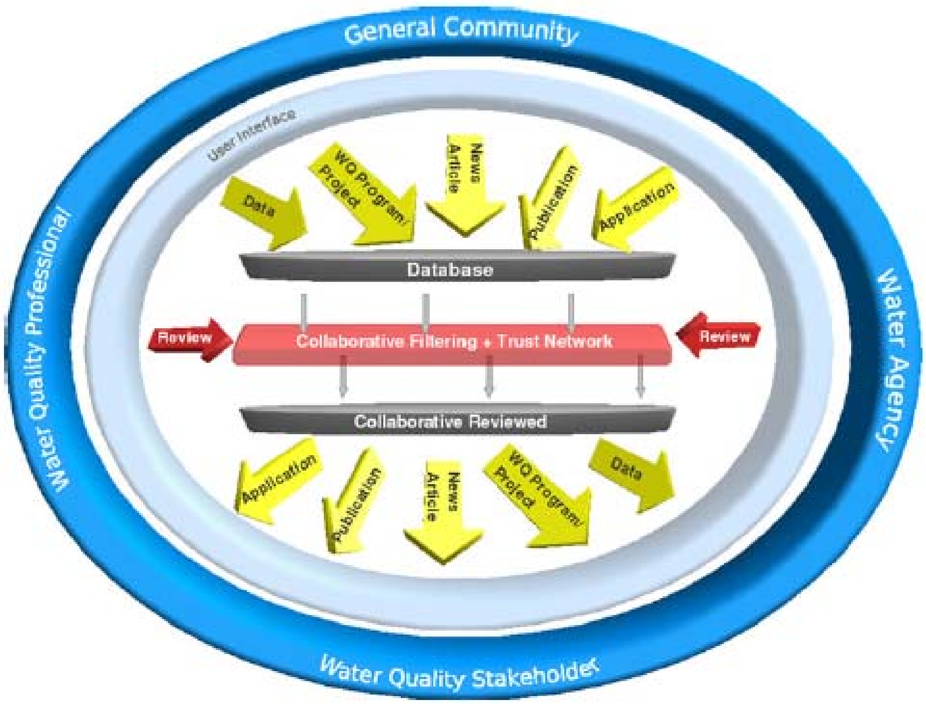


Figure 8. Collaborative network framework (Dalcanale, 2011).

Fig 7. shows the collaborative network framework that will be tested, modified, and enriched in this research. The river water quality will be integrated in the framework to alter the usage of the environmental management information system.

CHAPTER III
RESEARCH OBJECTIVE

This research is conducted to develop a useful simple model of river water quality embedded with the environmental information system. Kitakyushu city system is being studied as an advanced model of eco city which has been succeeded in treat its polluted environment. The use of river quality model is very useful to predict the future condition using kinds of scenarios, so that the river environmental management can be formulated prior to the occurrence of pollution, environmental damage, or other disasters.

The increasing of environmental conservation awareness needs a system of information which is useful, informative, up to date, complete, and easy to be analyzed. These information would be very useful also for environmental education in order to increase awareness and enforcement to young generation, especially students in conserving the environment. Besides that, information of the river water quality would be also useful for researchers, government, and other stakeholders for many kinds of purposes. To have an effective system of the environmental system, the need of development of its concept is urgent.

CHAPTER IV
METHODOLOGY

4.1 Visit Kitakyushu City Program

Kitakyushu City has been succeeded in restoring her environment from heavy polluted into best eco-city in the world. Including in this effort, the Kitakyushu City gives transparent information concerning the environmental condition. To study how the system of Kitakyushu City is applied, this research is conducting the program to visit and interview the Water Division of Kitakyushu City Government.

4.2 River Water Quality and Modeling

In the beginning of the research, the river water quality needs to be analyzed. Bandung has 46 rivers and tributaries that pass through the city. The Environmental Protection Bureau of Bandung City takes samples and analyzes them regularly. The data is then being studied to determine their condition. Examination of the river water quality is conducted by using STORET Index method.

Software 'KUALA.V01' which has been built is being further developed in order to simulate more complex calculations and integrated with the map.

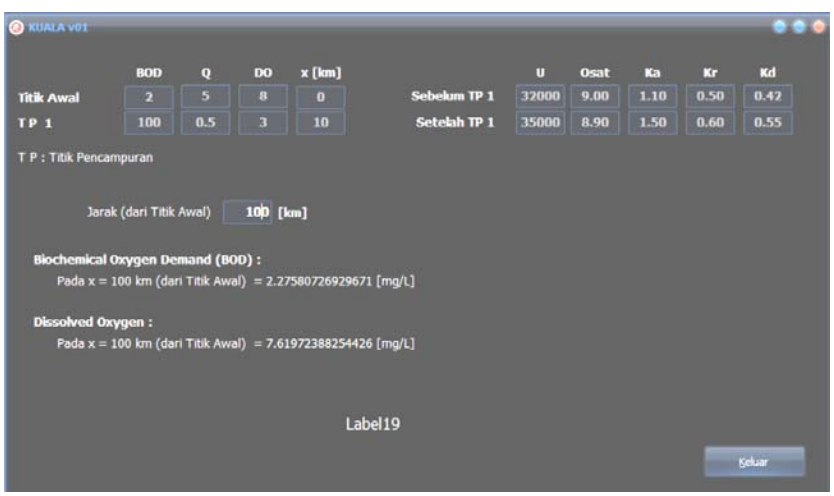


Figure 9. Software development of 'KUALA.V01'

In this study, the model was compiled using Steeter-Phelps equation, while the input data is using Visual Basic. The model that has been prepared in KUALA.V01 using the coefficients results of previous studies, i.e. the rate of decomposition coefficients BOD deoxygenation or representing river conditions in Indonesia. Prototype software "Kuala.V01" needs to be improved to be able to simulate the conditions of a more complex case.

In addition, the integration should be done with the data processing software, spreadsheet for ease of analysis, especially in showing trends in the water quality of the river. Integration was done with the map will be applied to this software in actual conditions. River to be used for the integration of these maps is Cikapundung River.

Concerning the usability of this software, survey on potential users was conducted. It will also be carried out to find out important parameters. The survey is being conducted with interview method and FGDs. The software will also be tested for potential users.

4.3 Flowchart of Reseach Works

This research is conducted in collaboration with Prof. Matsumoto and Indriyani Rachman of the University of Kitakyushu. Figure below shows the research flowchart involving both teams in conducting the research.

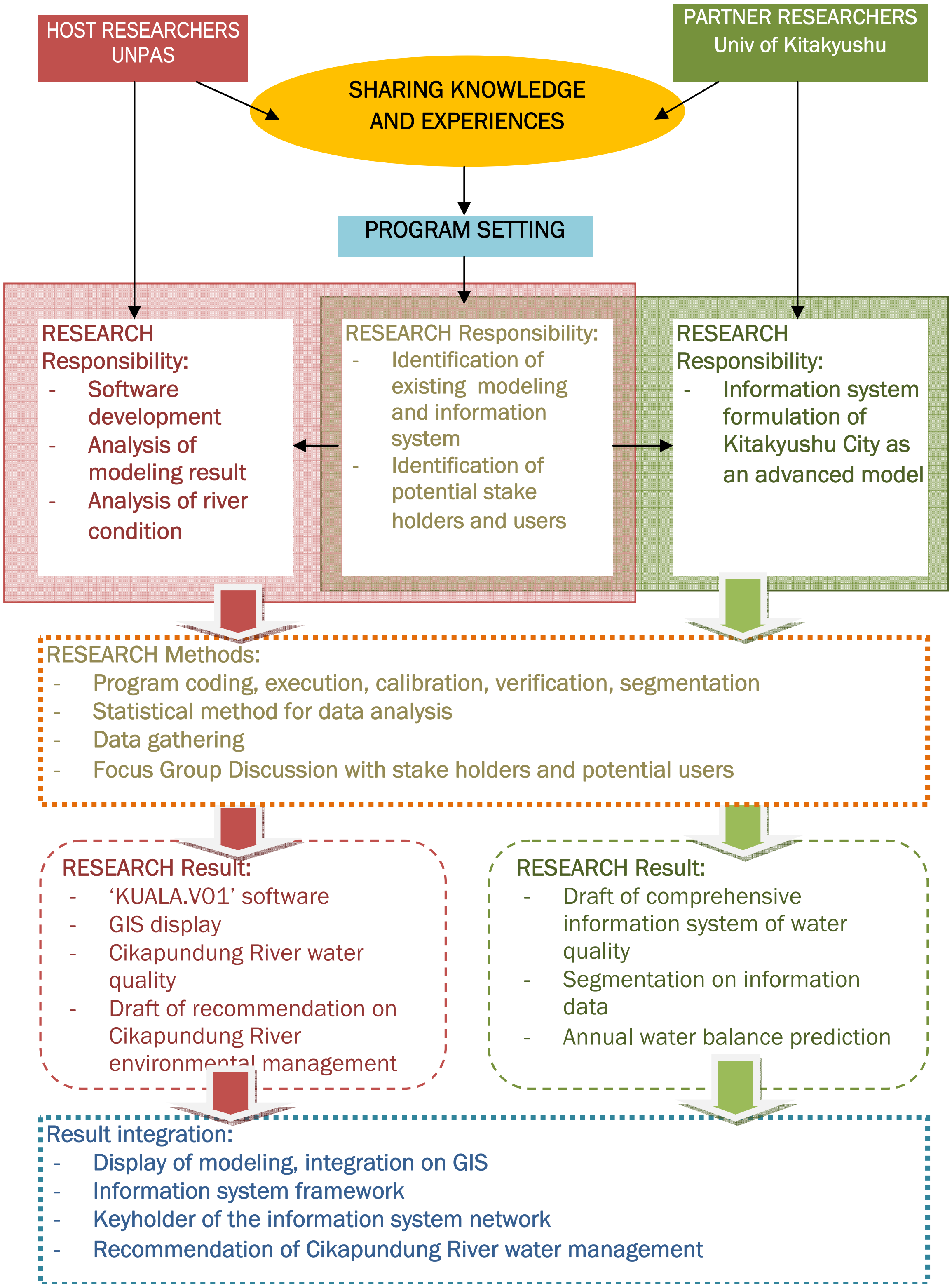


Figure 10. Flowchart of Collaboration Research.

4.4 Research Location

For the case of Cikapundung River, this research is focused on the segment between Babakan Siliwangi area and Asia Afrika Street. The segment is selected because this segment is the main concern of the Bandung City Government to be rehabilitate. Fig 10. Show the map of the Cikapundung River in the segment of Bandung City.

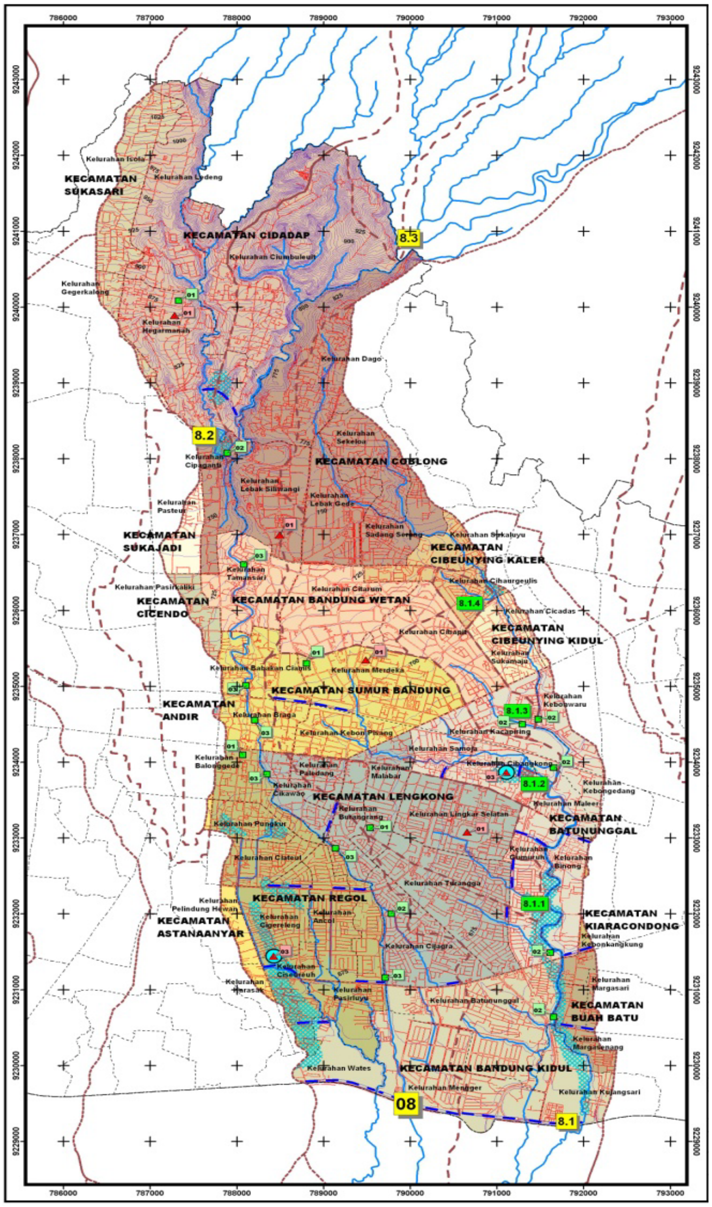


Figure 11. Map of Cikapundung River Watershed.

CHAPTER V
RESULTS AND DISCUSSION

5.1 Overview of Kitakyushu City Environmental Condition

Kitakyushu City has Murakami River as a main river that passes through the city. This river suffered of heavy pollution back in 1960's. Sources of pollutants were industries as well as domestic activities. The below figure shows that many citizen houses were dwelled on the Murakami River. This condition is similar to the condition of urban river in Indonesia today.

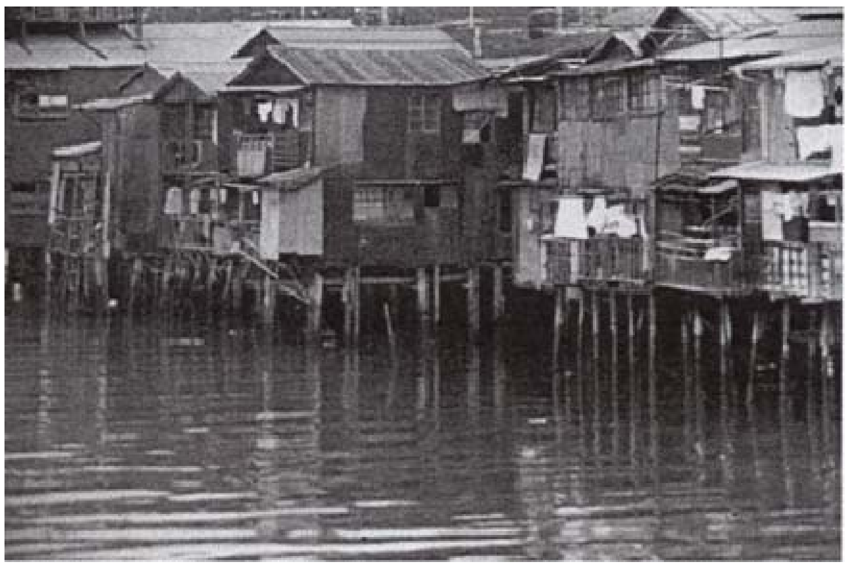


Figure 12. Houses on Murakami River in 1960's
(source: Division of Water Environmental, Kitakyushu City Government)

The Kitakyushu City started to restore the river in many aspects:

- water quality improvement
- water quantity stabilization
- river bank re-establishment
- citizen awareness and education

Nowadays, the river condition is very good, healthy, and clean. To maintain this condition and to prevent pollution, Kitakyushu City has many activities, educational tools, and infrastructures, such as:

- environmental monitoring
- strict laws
- interactive museum of water, museum of environment
- wastewater treatment plants
- renewable energy system
- secure rainfall catchment area
- intense monitored water dam
- rich and interested curriculum of environmental education for students
- kayaking on the river, swimming competition
- etc.

Figure 13. Murakami River (picture was taken June 4th, 2015).

5.2 River Monitoring and Information System of Kitakyushu City

The Kitakyushu City has 2 types of Environmental Quality Standards (EQS):

- EQS for Protection of Human Health
- EQS for Preservation of Living Environment

Table 1. EQS for Human Health

Item	Standard Values	Item	Standard Values
cadmium (Cd)	0.003 mg/l or less	1,1,2-trichloroethane	0.006 mg/l or less
total cyanide	in no detectable amounts	trichloroethylane	0.03 mg/l or less
lead (Pb)	0.01 mg/l or less	tetrachloroethylene	0.01 mg/l or less
chromium (VI) {Cr(VI)}	0.05 mg/l or less	1,3-dichloro propane	0.002 mg/l or less
arsenic (As)	0.01 mg/l or less	thiram	0.006 mg/l or less
total mercury (T-Hg)	0.0005 mg/l or less	simazine	0.003 mg/l or less
alkyl mercury (R-Hg)	in no detectable amounts	thiobencarb	0.02 mg/l or less
PCBs	in no detectable amounts	benzene	0.01 mg/l or less
dichloromethane	0.02 mg/l or less	selenium (Se)	0.01 mg/l or less
carbon tetrachloride	0.002 mg/l or less	nitrate-N and nitrite-N (NO_3-N+NO_2-N)	10 mg/l or less
1,2-dichloroethane	0.004 mg/l or less	fluoride(F)	0.8 mg/l or less
1,1-dichloroethylene	0.1 mg/l or less	boron(B)	1 mg/l or less
cis 1,2-dichloroethylene	0.04 mg/l or less	1,4 - dioxane	0.05 mg/l or less
1,1,1-trichloroethane	1 mg/l or less		

1,4-dioxane was added to the list in 2009.

(Source: Division of Water Environmental, Kitakyushu City Government)

Table 2. EQS for Living Environment

class	Item	Standard value				
	Water use	pH	BOD	SS	DO	Total coliform
AA	Water supply class 1, conservation of natural environment, and uses listed in A-E	6.5-8.5	1 mg/l or less	25 mg/l or less	7.5 mg/l or more	50 MPN/100ml or less
A	Water supply class 2, fishery class 1, bathing and uses listed in B-E	6.5-8.5	2 mg/l or less	25 mg/l or less	7.5 mg/l or more	1000 MPN/100ml or less
B	Water supply class 3, fishery class 2, and uses listed in C-E	6.5-8.5	3 mg/l or less	25 mg/l or less	5 mg/l or more	5000 MPN/100ml or less
C	Fishery class 3, industrial water class 1, and uses listed in D-E	6.5-8.5	5 mg/l or less	50 mg/l or less	5 mg/l or more	-
D	Industrial water class 2, agricultural water, and uses listed in E	6.0-8.5	8 mg/l or less	100 mg/l or less	2 mg/l or more	-
E	Industry water class 3 and conservation of environment	6.0-8.5	10 mg/l or less	Floating Matter such as garbage should not be observed	2 mg/l or more	-

(source: Division of Water Environmental, Kitakyushu City Government)

Monitoring of environmental condition is conducted for river water, lake water, coastal water, bathing beach, soil and groundwater, effluent from golf park, PCBs, Dioxin, endocrine disrupter. The regulation of activities effluent is also being regulated strictly under the water pollution control law, law concerning special measures for conservation of the Environmental of the Seto Island Sea, soil contamination countermeasure law, and law concerning special measures against Dioxins.

There are 260 rivers pass through Kitakyushu City and 16 of those are given standard determined by type according the usage. Table below shows the 16 designated rivers.

Table 3. Designated Rank Rivers Flowing Through Kitakyushu City

Name of River	Monitoring Point	Rank	Environmental Standards value BOD (mg/l)	Name of River	Monitoring Point	Rank	Environmentall Standards value BOD (mg/l)
Egawa River	Egawa Bridge	C	5	Wariko River	Matoba Bridge	B	3
	Sakae Bridge	D	8		JR Railway Bridge	D	8
Shin-shin Hori River	Honjin Bridge	C	5	Kinzan River	Norimatsu Weir	C	5
Murasaki River	Kayoh Bridge	A	2		The front of the Shin-shin Hori River Junction Point	C	5
	Misono Bridge	A	2	Kanate River	Yatoi Weir	B	3
	Siigawa Losew Point	A	2		Kukikita Bridge	D	8
	Murasaki River Intake Weir	A	2	Okuhata River	Miyamae Bridge	A	2
	Katsuyama Bridge	B	3	Chikuma River	Shinkai Bridge	D	8
Kantake River	Tanga Bridge	B	3	Kiyotaki River	The entrance of underdrain	A	2
Itabitsu River	Sashiba Intake Weir	A	2	Okawa River	Dairi Bridge	B	3
	Sakai Bridge	A	2	Muranaka River	Muranaka Bridge	B	3
	Shin Minato Bridge	B	3	Nuki River	Kanada Bridge	B	3
Baeki River	Kohsei Nenkin Hospital Side	B	3	Aiwari River	Tsunemi Bridge	B	3
	JR Railway Bridge	C	5				

(source: Division of Water Environmental, Kitakyushu City Government)

Sampling activities for river monitoring purposes are carried out at 27 points determined by the government. Figure below shows points of sampling.

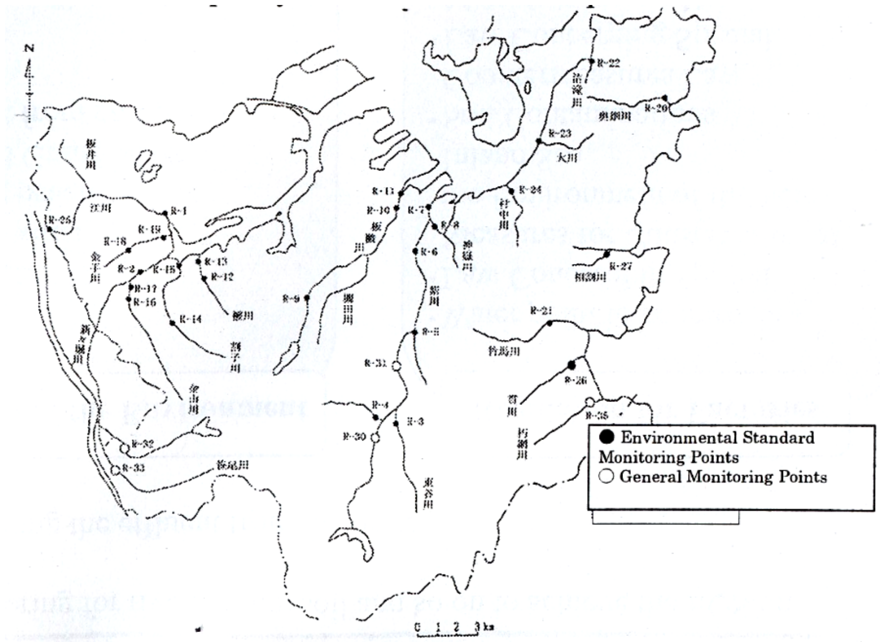


Figure 14. River sampling points of Kitakyushu City Government

(Source: Division of Water Environmental, Kitakyushu City Government)

Kitakyushu City has website in two languages, English and Japanese. The English version is information useful for foreigners. The environment information is not shown in this English version. In the other hand, there is much environmental information published in the Japanese version, for example the announcement concerning the 2.5 PM (particulate matter) pollution which is shown in the below figure.

Figure 15. Website of Kitakyushu City Japanese version

The website gives explanation about 2.5 PM, graphs, and data which can be downloaded and read using Acrobat Reader. Monitoring data of river water quality is also being published for public via this website. The website observers can read and download the data which were taken since 2004.

Figure 16. Environmental Data 2004-2015 in the Kitakyushu City website.

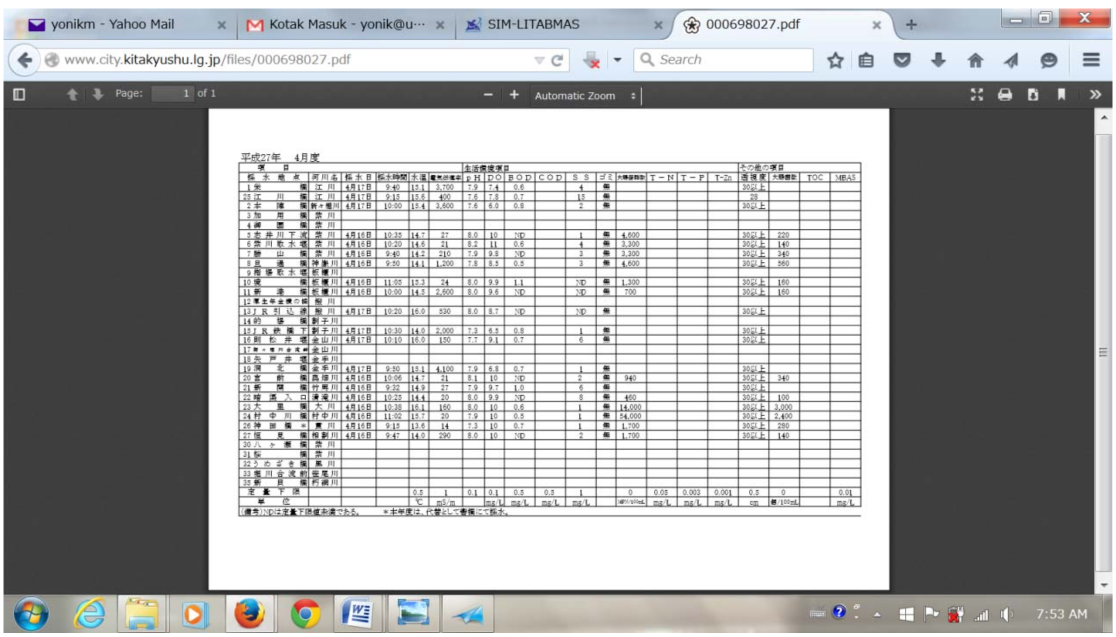
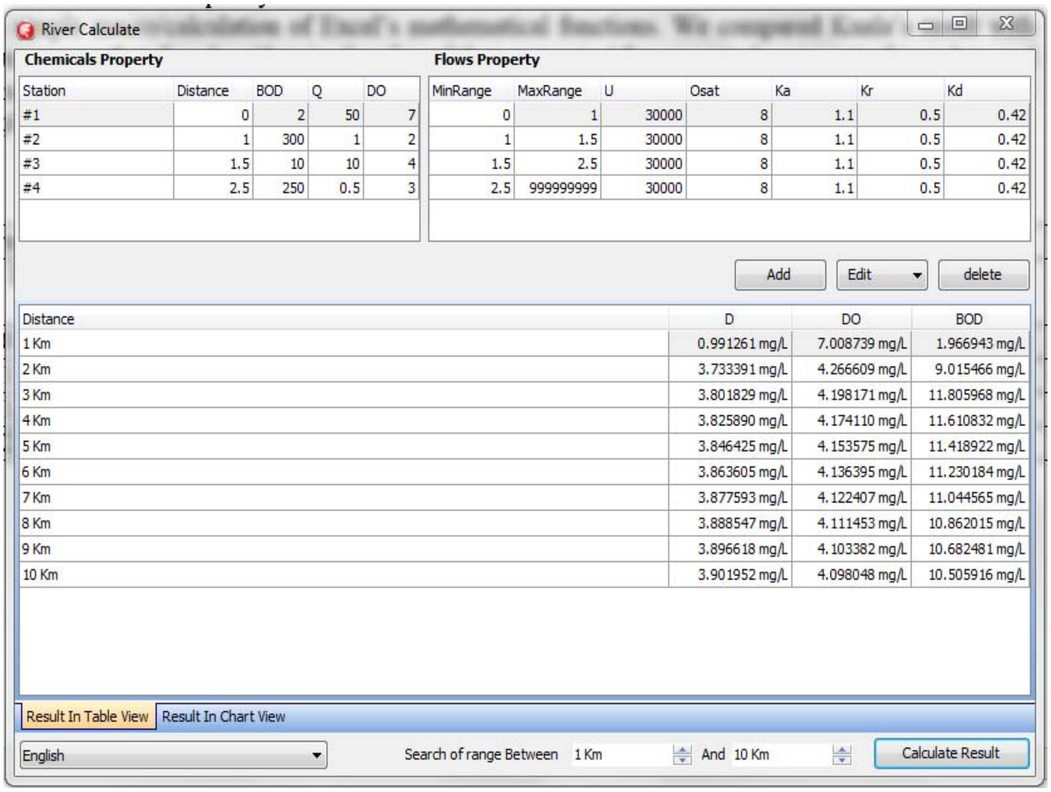


Figure 16. Monitoring data of river water taken April 2015 published in Kitakyushu City website.

5.3 KUALA.V01 Software and River Water Modeling

Software that has been built in the first year, 'KUALA.V01' will be further developed in order to simulate more complex calculations. Figure below shows the simulation of river water quality using developed ‘KUALA.V01’.



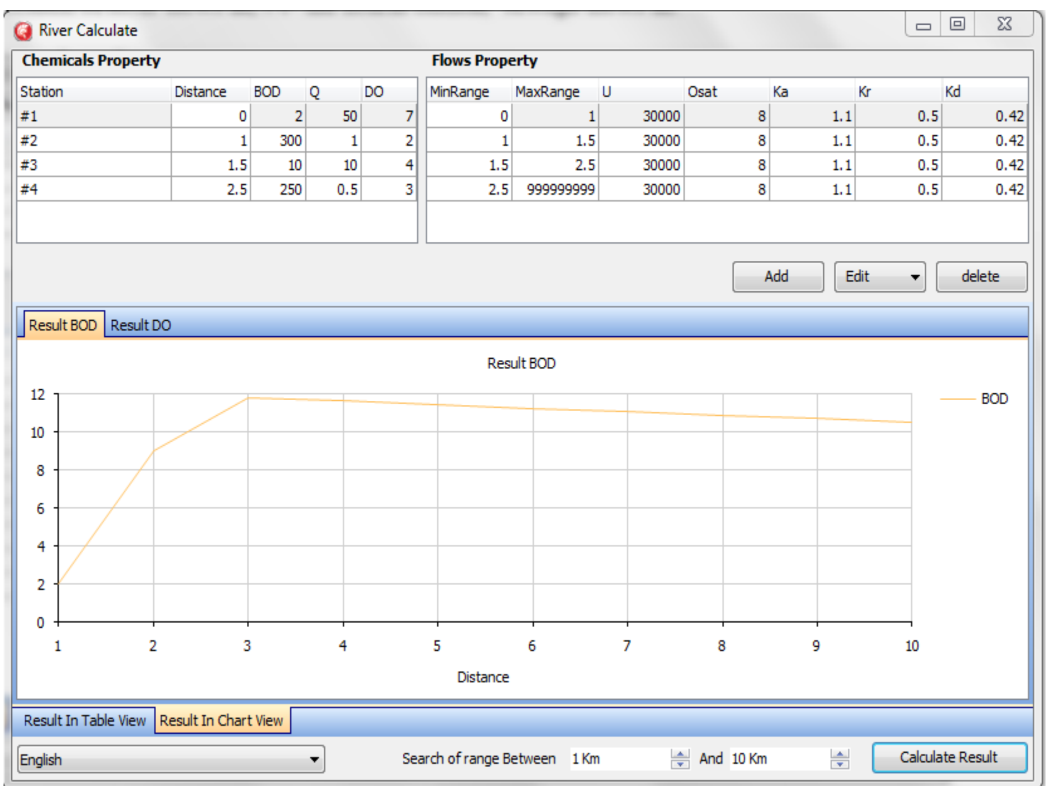


Figure 18. Developed KUALA.V01

5.4 Cikapundung River Water Quality

BPLH (Environmental Protection Agency) of Bandung City gave an assessment of the rivers that pass through the city of Bandung using Water Quality Status. Status of water quality is the level of water quality conditions that indicate polluted conditions or good condition at a water source in a given time by comparing the water quality standards set. To set the quality status of water can be used two methods: Method and Method STORET Pollution Index, but the method commonly used is a method STORET. By using the method STORET knowable parameters still meet or has exceeded the water quality standard.

In determination of each river condition, scoring is used based on the US-EPA STORET assessment method that classifies the water quality into 4 classes, i.e.:

A Class	:	very good, score = 0	comply to the standard
B Class	:	good, score = -1 ~ -10	slightly polluted
C Class	:	medium, score = -11 ~ -30	medium polluted
D Class	:	bad, score = –31	heavy polluted

According to Indonesia regulation of PP No. 82 year 2001, the water quality is classify into 4 (four) classes:

Class I, allocation of water can be used for the raw water of drinking water, and or other uses that require the same water quality with the usability

Class II, allocation of water can be used for infrastructure / facilities water recreation, freshwater fish farming, animal husbandry, water to irrigate crops, and or other uses that require the same water quality with the usability;

Class III, allocation of water can be used for freshwater fish breeding, animal husbandry, water to irrigate crops, and or other uses that require the same water quality with the usability;

Class IV, water allocation can be used to irrigate crops or other uses that require the same water quality with the usability.

Figure shows that by comparing the river water quality to PP 82 of 2001 on the Management of Water Quality and Water Pollution Control, Class I, all the rivers are considered classified in the category of heavy polluted.

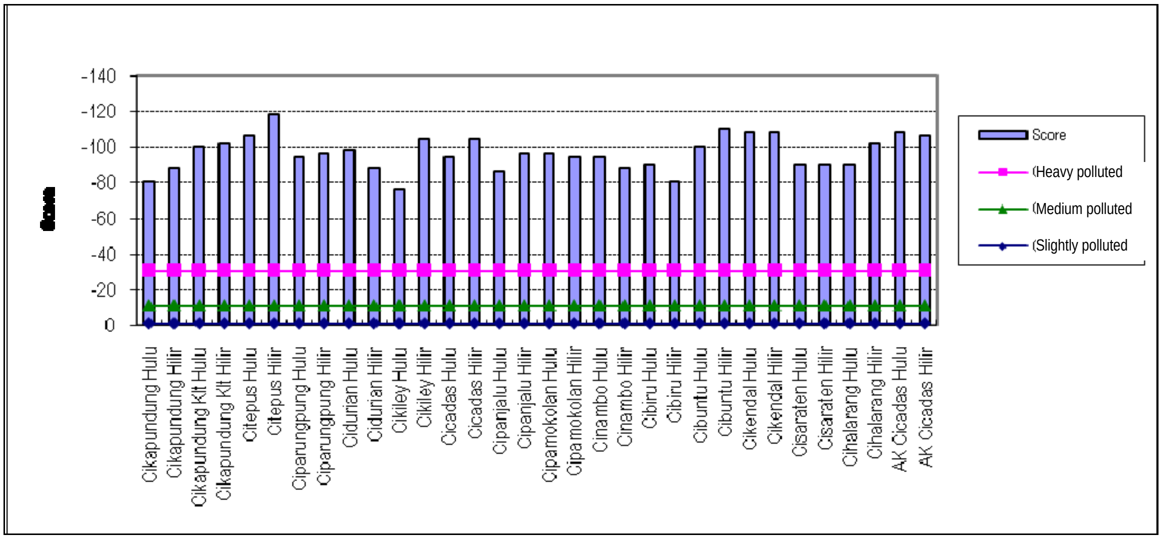


Figure 18. STORET Method Result Based on Regulation of PP No. 82/ 2001 Class I

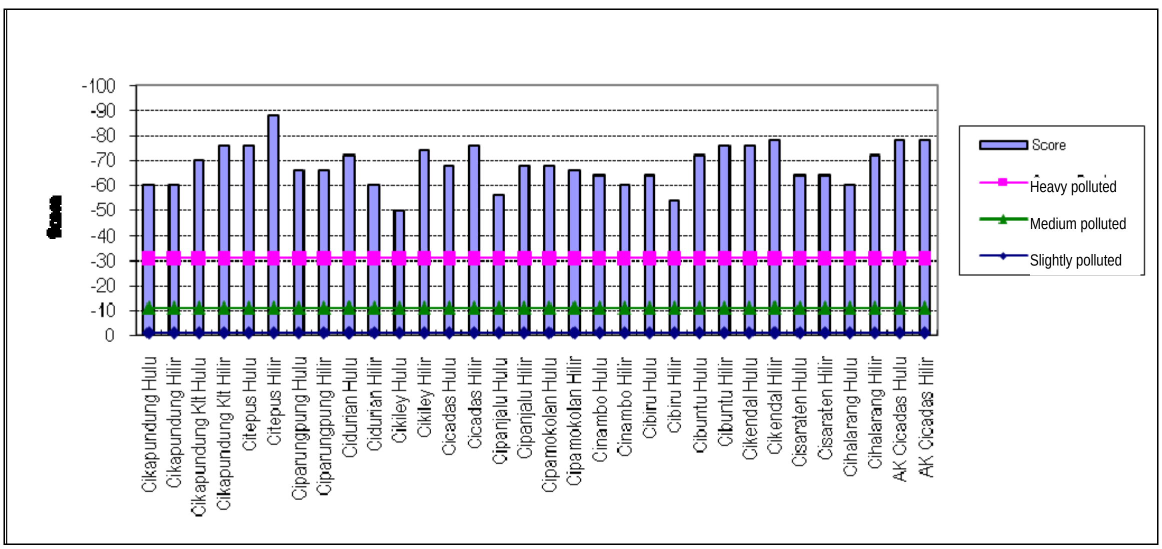


Figure 20. STORET Method Result Based on Regulation of PP No. 82/ 2001 Class II

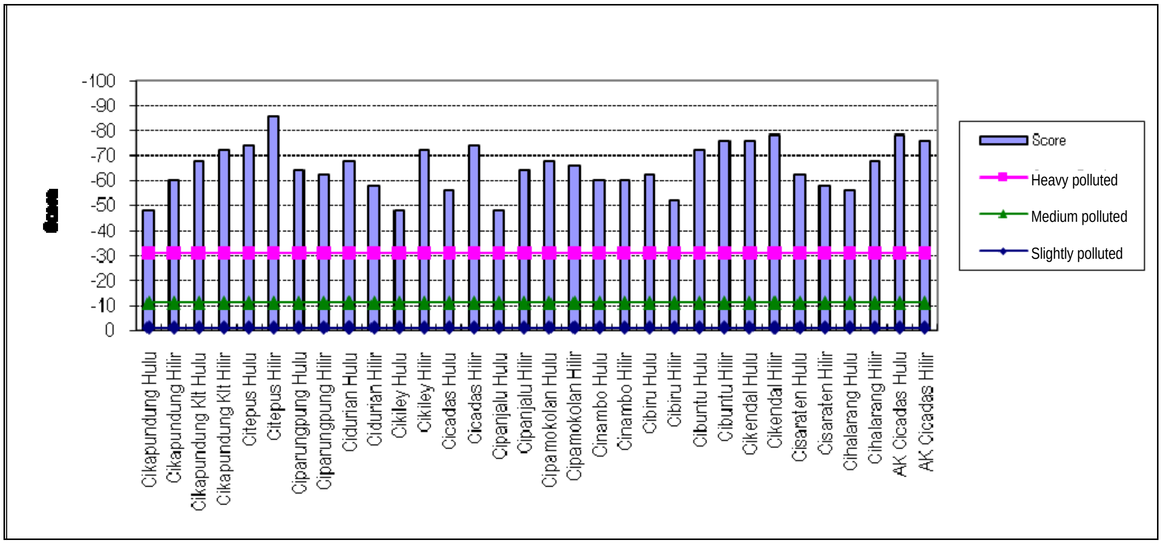


Figure 21. STORET Method Result Based on Regulation of PP No. 82/ 2001 Class III

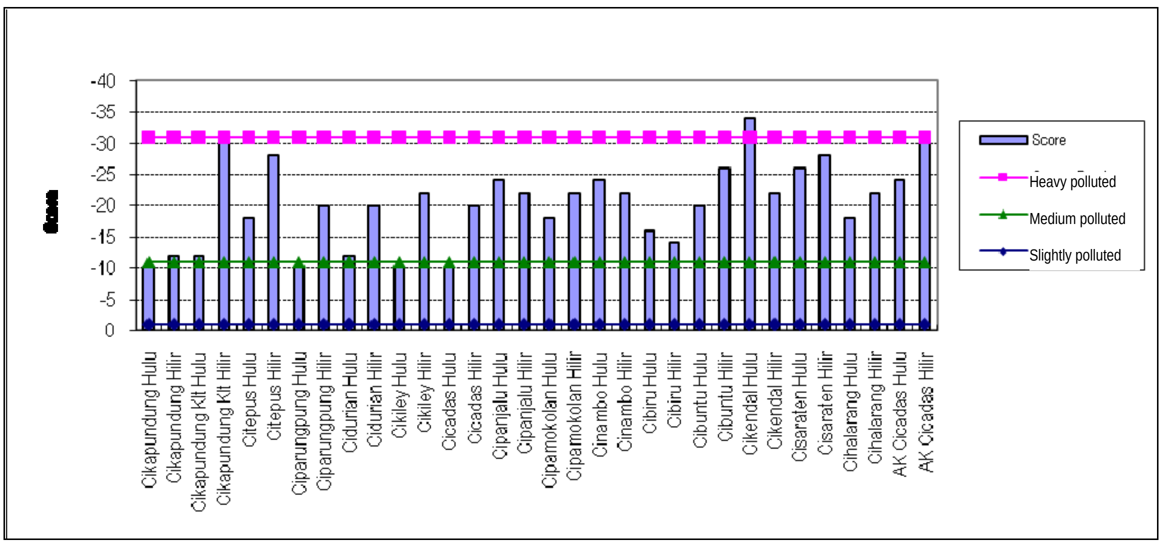


Figure 22. STORET Method Result Based on Regulation of PP No. 82/ 2001 Class IV

West Java Governor also published regulation to determine the usage of each main river in Decree No.39 year 2000. The decree classifies river type similar to PP No. 82/ 2001. Figure 22 shows that if the water quality of the river compared with SK. West Java Governor No. 39 of 2000 on Quality Standard Quality CRB and its tributaries in West Java, Class B, C, D, all the rivers are considered classified in the category of heavy polluted.

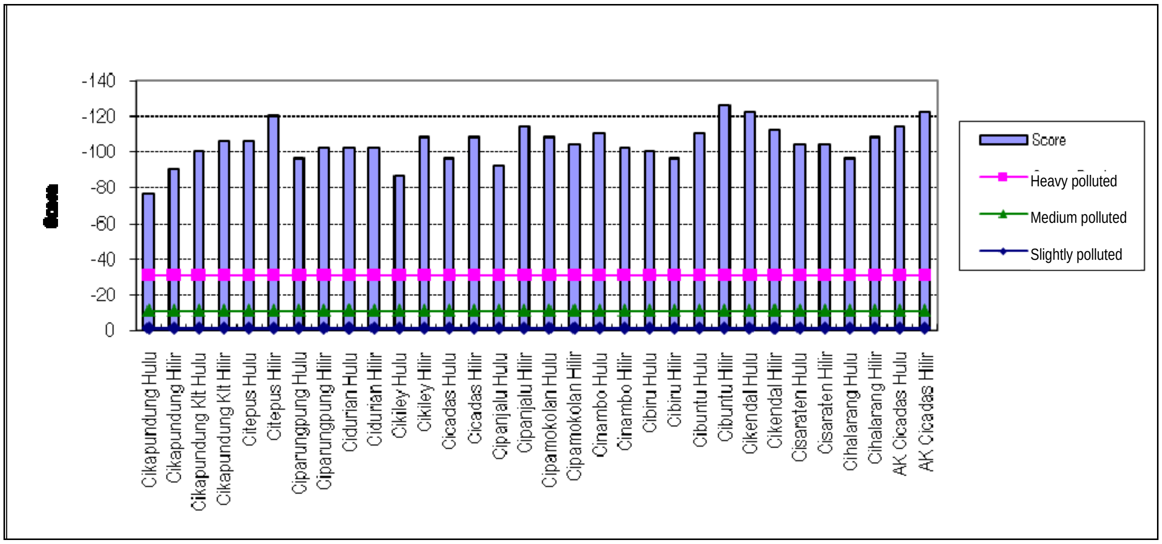


Figure 23. STORET Method Result Based on Regulation of Governor No. 39/ 2000 Class B, C, and D

5.5 Potential Users

Survey of the potential and user needs analysis shows that the water quality modeling software could potentially be used by government agencies, private companies, and individuals. Some agencies in Bandung and West Java that have been using river water quality modeling software are:

- Environment Protection Agency of Bandung City
- Environmental Management Agency of West Java Province
- Regional Drinking Water Company of Bandung City
- Research and Development Center Water Works
- West Java Provincial Irrigation Office
- Researcher and lecturer at the university of courses Environmental Engineering, Civil Engineering
- Consultant

Usage of the software:

- Determination of the policy
- Verification/confirmation of pollution phenomena
- Prediction of river water quality

- Preparation of the EIA (predicted significant impacts)
- Utilization of river water

Parameters required in river water quality modeling:

- BOD
- DO
- COD
- Nutrients
- Heavy metals

5.6 Water Quality Equations

The equations used in the model river water quality are:

- Streeter dan Phelps equation for dissolved oxygen simulation

$$D = D_o \cdot e^{\frac{-ka}{u}X} + \frac{Kd.Lo}{Ka - Kr}\left[e^{-\frac{kr}{u}x} - e^{-\frac{ka}{u}x} \right]$$

where :
D = Deficit oxygen, (mg/l)
X = distant of observation point, (m)
U = average of velocity, (m/s)
K_d = deoxgenation rate coefficient, (day^{-1})
K_a = reaeration rate coefficient, (day^{-1})
K_r = total removal coefficient, (day^{-1})
L_o = BOD concentration in the initial point (X = 0),(mg/l)
D_o = Deficit oxygen in the initial point pembuangan (X = 0), (mg/l)

- Degradation equation for non-concervative pollutant

$$L = L_o\, e^{\frac{-K_r}{U} X}$$

where :
L = pollutant concentration at point X (mg/L)
L_0 = pollutant concentration at point 0 (mg/L)
X = distant of observation point (m)
U = average velocity (m/s)
K_r = Total removal coefficient (day^{-1})

5.7 Coefficient in Modeling

In the equations that are used, some of the coefficients involved are:

- Reaeration rate coefficient
- Deoxygenation rate coefficient
- Degradation rate coefficient
- Settling rate coefficient
- Total removal rate coefficient

Coefficients used are a compilation of the results of previous studies conducted in the rivers both in Indonesia and other location.

5.8 Information System for Cikapundung River

The figure below shows the initial draft of information system for Cikapundung River. Monitoring data will be the input data for the River Information System (RIS). Cikapundung Rivers has many communities with their activities and events. Those activities would be a very useful data to be published in the RIS.

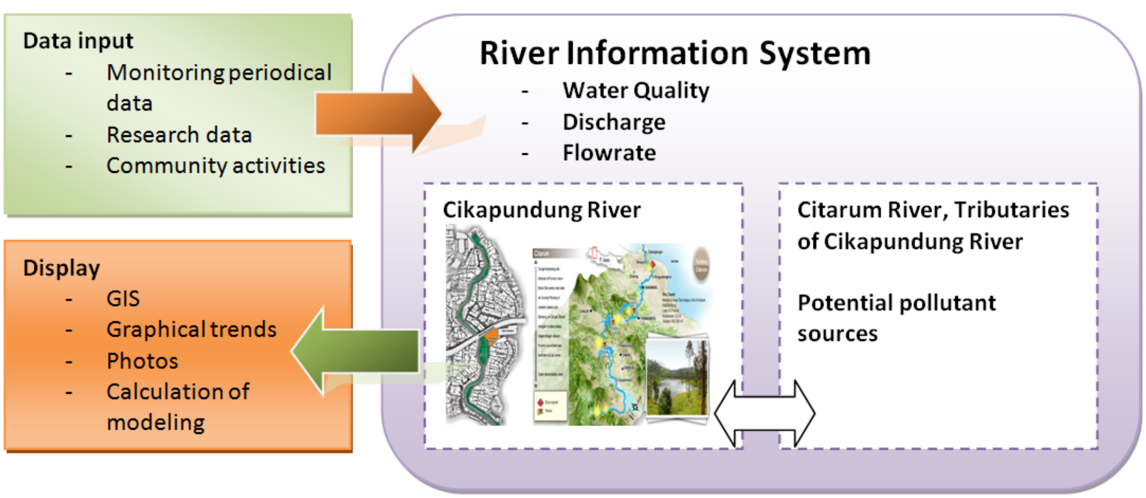


Figure 24. Draft of Information System of Cikapundung River Water Quality.

In Indonesia, aquiring data from the government institution need a permission from the Kesatuan Bangsa, Politik dan Perlindungan Masyarakat (National Unity, Politics, and Citizen Security)

Agency under the Minsitry of Internal Affairs. Thus, this kind of filter was set in the information flow. There is also Communication and Information Divison under the Ministry of Communication and Information which secure the published information.

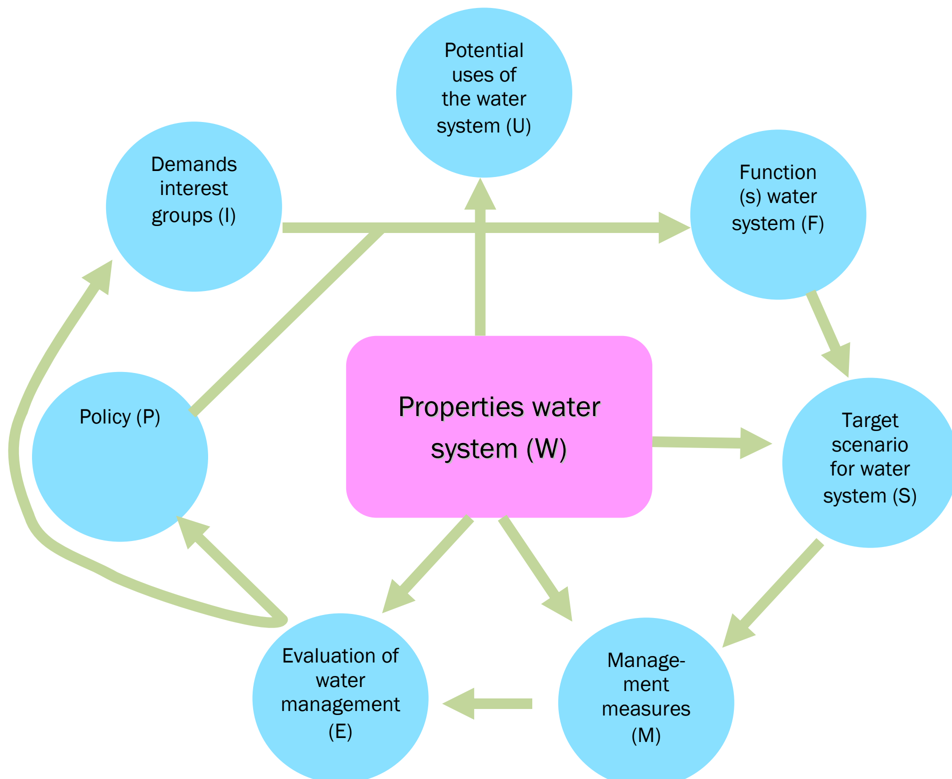


Figure 25. Flow of information in the water policy process (Timmerman, 2015)

According to Timmerman (2015), the demand of interest groups like drinking water suppliers, industry, agriculture, recreation, transport (navigation), and nature conservation are examined. Potential uses of the water system are determined by the propoerties of that water system. The policy, together with the demands of the interest groups and the potential uses determine the assignment of functions to the water system. These functions are limited by the societal constraints as put down in the policy, the demands the uses put on the water system as depicted by the interest group and the limations as set by the properties of the water system.

Derived from the functions, together with information on the properties of the wate system, target scenarios can be developed that represent the conditions under which the wate system can satisfy the demands as set by the assigned functions. These scenarios provide information for management measures like technical measures (for instance, construction of a weir) or legal measures (like imposing levies). Again these measures should be tuned to properties of the water system. The water management will be evaluated by checking whether the measures have had the desired effects. This requires comparing the (change in) properties of the water system to the management measures made.

The evaluation now provides new input to the policies and interest groups to start development of new water management and the cycle starts again. The entrire flow of information as described here is coordinated from the information environment of the mater management organization. Information to support enviromental decisions in this framework shold cover a wide range of issues and originates from various sources. Information from each of theres sources is complex, often abundat, contradictory, having a different quality, and is focused on scientific use rather than political use, as a result of which it is hard to access by policymakers or general public. Information and translating this variety of information into a coherent set, and is as a result an important function in water management.

5.9 Stakeholders Sharing, Networking, and Info Scale

Public involvement should be integrated in the management of water resources, including rivers. Hence the various disciplines of research needs to be put together on a scale of river watershed with the stakeholders in the network. Meetings between government, academia, researchers and users of data in local, national and international should be conducted regularly.

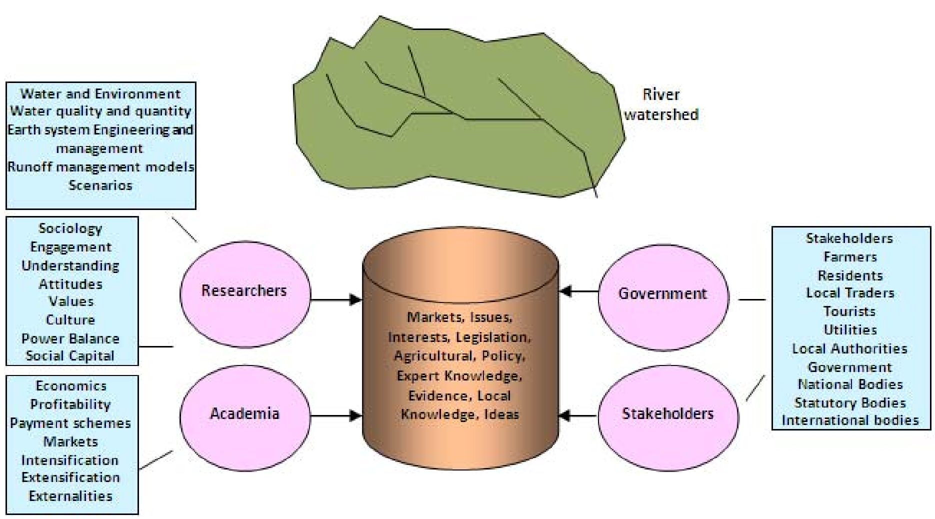


Figure 26. A balanced approached to integrated land and water management. (Hewet, et.al., 2010)

Figure above depict the integration and network of various stakeholders in the river water management system. It reflects the importance of natural scientists working closely with social scientists—in particular with economists and sociologists, who have the tools to design surveys, interpret data, understand and communicate stakeholders' concerns and perform action research which results in changes in practice. It supports the concept of mutual partnerships between the professional and research scientific disciplines. The researchers are forced to work together at the strategic scale of the river basin, both exchanging concepts and skills while studying local catchment properties and learning from end users directly. Local stakeholders are tied to the river basin scale as well as the regional, national or international scale. While there is clearly an input from regional, national and international drivers, those components must be translated into a local framework first. The key innovation is to place all the research and local end user needs into the "cooking pot" where all the issues can be simmered for a suitable period of time. This means much more than paying lip service to participation and involves real engagement with the concerns and needs of stakeholders. The key here is the willingness of all parties to listen to each other; there should be no dominant ingredient within the cooking pot and no matter how long and difficult the process is, any product from the pot will be a jointly owned, viable vision for the local catchment. As such, any proposed land use planning and policy can be created and enforced by the local community. With these points in mind we would recommend holding most or all of the stakeholder meetings close to the relevant farms. We have found this valuable in helping to build trust in the research team's commitment to the area and in improving the likelihood of farmers attending (Hewet, et. al., 2010).

There are a range of scales which must be considered within an integrated approach to land and water management in parallel with two sets of factors which we argue have the greatest influence on successful implementation, i.e. human dimension, and ecological space dimension. Human dimension means the interest of individual or group. Ecological space dimension means the interest of natural environment. It's important to understand the relationship between local activities and their impacts downstream. Issues where, when and how human activities interact with the hydrological processes and the impact they have on the quantity and quality of water in the entire catchment.

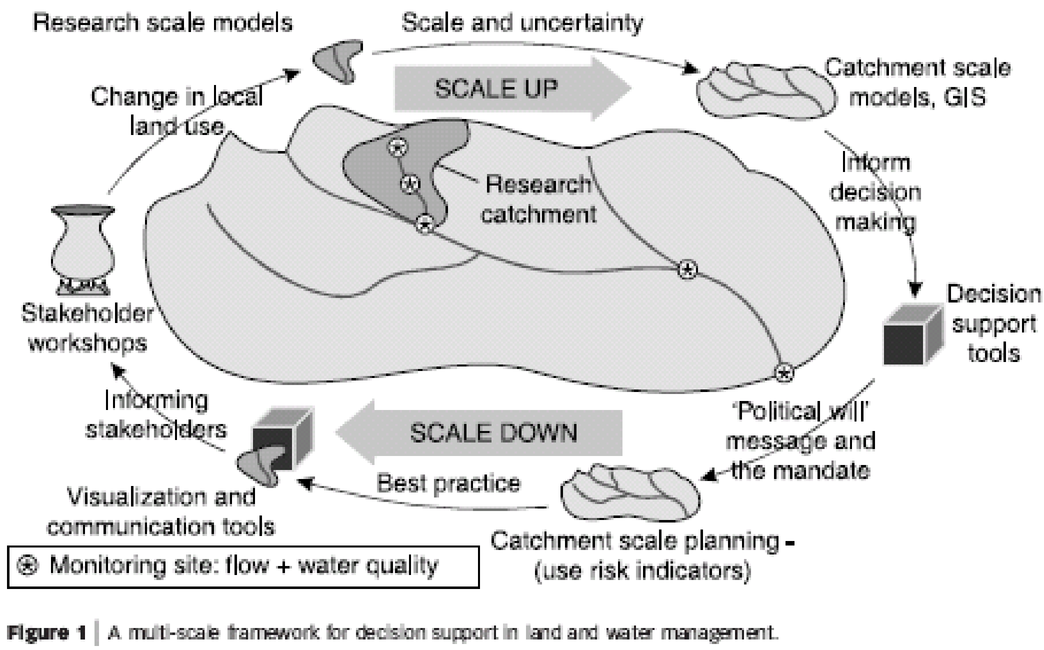


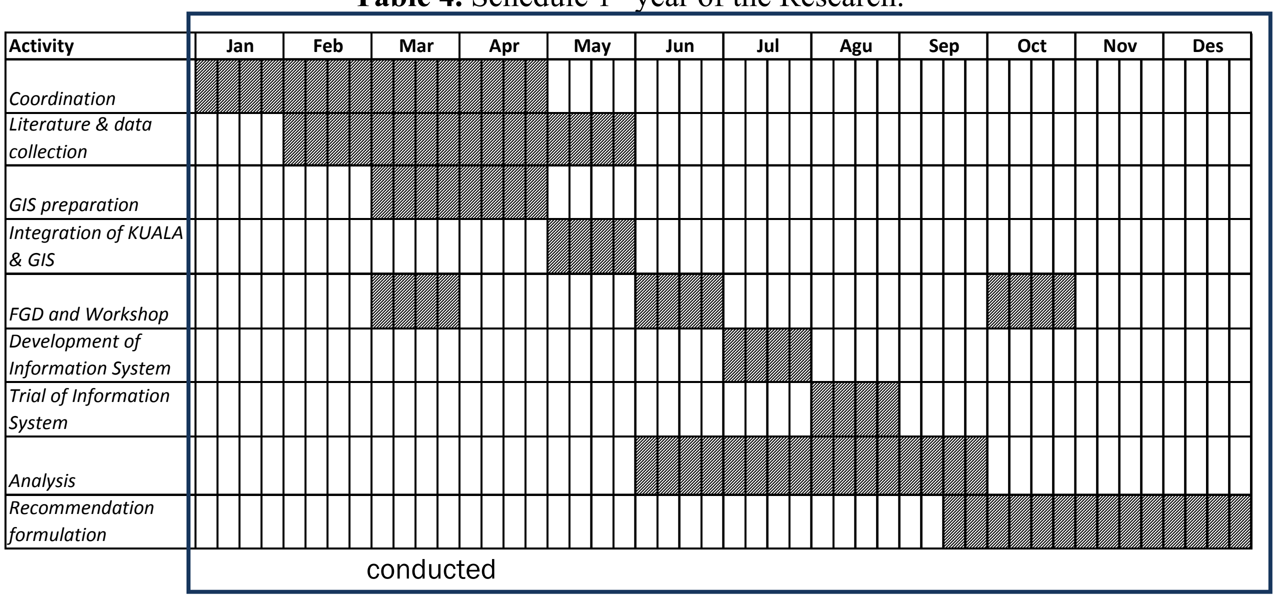
Figure 27. A multi-scale framework for decision support in land and water management (Hewet, 2010)

Loop is represented in figure above is a conceptual model of the process are discussed throughout this paper, which has a partnership discussed above at its core. Point represent frame as the loop is to emphasize the nature of the proceeding. Going round the loop once or twice is not likely to cause a large increase in land management. But only by continuing to nurture partnerships discussed above those improvements will take place. It should be noted that, although stakeholder workshops are only displayed on the left loop, it did not indicate how often they should take place and is not intended to indicate that they are only part of the implementation phase. In practice the greater involvement of end users in various stages of the process, the more likely that will generate improvements in practice.

CHAPTER VI
PLANS OF 2ND YEAR RESEARCH

Table 4 shows the schedule of activities that have been conducted in the first year (2015). Visit Kitakyushu program has been accomplished. The modeling is being done, particularly in response to user needs.

Table 4. Schedule 1st year of the Research.



The draft of information system for Cikapundung River has already been started and after completion it will be consulted to the Bandung City Government. The KUALA.V01 software will be tested and tried by potential users.

Table 5 shows the schedule of the 2nd year research plan. The information system of Cikapundung River will be trial implemented in the web basis.

Table 2. Schedule of Research Activity in the 2nd Year (2016).

Activity	Jan				Feb				Mar				Apr				May				Jun				Jul				Agu				Sep				Oct				Nov				Des			
Coordination and evaluation	■	■	■	■	■	■	■	■																																								
Literature & data enrichment					■	■	■	■	■	■	■	■																																				
Second trial GIS KUALA									■	■	■	■	■	■	■	■	■	■																														
Analysis of trial result																			■	■	■	■																										
FGD and Workshop													■	■	■	■							■	■	■	■							■	■	■	■												
Integration of GIS, KUALA & Information System																											■	■	■	■																		
Trial of Integrated Information System																															■	■	■	■														
Analysis																			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■										
Recommendation formulation																																					■	■	■	■	■	■	■	■	■	■	■	■

CHAPTER VII
CONCLUSION AND RECOMMENDATION

The Kitakyushu City has an established river information system. It was supported with periodic data which were taken from monitoring activities. All regulations are followed by stakeholders; procedures are set and conducted by all submissively.

In the other hand, the Cikapundung River severe with heavy polluted condition. The information system of river water quality is not yet being developed while there are many potential users need the data and information for various purposes.

Public involvement should be integrated in the management of water resources, including rivers. Hence the various disciplines of research needs to be put together on a scale of river watershed with the stakeholders in the network. Meetings between government, academia, researchers and users of data in local, national and international should be conducted regularly.

There are a range of scales which must be considered within an integrated approach to land and water management in parallel with two sets of factors which we argue have the greatest influence on successful implementation, i.e. human dimension, and ecological space dimension. Human dimension means the interest of individual or group. Ecological space dimension means the interest of natural environment. It's important to understand the relationship between local activities and their impacts downstream. Issues where, when and how human activities interact with the hydrological processes and the impact they have on the quantity and quality of water in the entire catchment.

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APPENDICES

Appendix 1. Seminar of Collaboration Research March 24, 2015

Appendix 2.

The 1st International on Interdisciplinary Studies for Cultural Heritage (ISCH 2015)

May 12-13, 2015

Analysis and Design Software of River Water Quality Model Case Study: Cikapundung River, Bandung

Lidya, L[1], Yustiani, Y.M[2]

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Abstract- Cikapundung River is the main river that located in the middle of Bandung City. It has polluted water due to the surrounding condensed houses and domestic-non domestic activity. The changing of the discharge pattern due to the climate uncertainty makes the difficulty to perform the river quality assessment. One method to assess the river water quality is by means of simulation results of a model verified with the measurement data obtained from in the field. Modeling is a method that is easy, inexpensive, and saves time. The use of river quality model is very useful to compute and to predict the future condition using kinds of scenarios, so that the river environmental management can be formulated prior to the occurrence of pollution, environmental damage, or other disasters. Modeling of river water quality was introduced by Steeter Phelps equation using oxygen depletion curve equation (oxygen sag curve) which is using coefficients, i.e. deoxygenation rate and reaeration rate. In this research, a software of river water quality model, KUALA (KUALitas Air) is developing incrementally to predict river water quality, creating various reports and providing online information for stakeholders. This such of software will help the stakeholders to share data or information and improving the use of river water.

Keywords□ *Cikapundung River, deoxygenation rate, river water quality modeling, software, Steeter and Phelps*

Appendix 3.

Paper acceptance of Sampurasun Journal

From: Interdisciplinary Studies of Culture Heritage 2015 <isch2015@unpas.ac.id>
Date: October 16, 2015 at 10:15:05 GMT+7
To: leony lidya <leonylidya@yahoo.com>
Subject: Sampurasun e-journal

Dear **Mrs. Leony Lidya**,

Warm greetings!

Congratulation, your paper entitled: "**River Water Quality Model Software**", which was presented in the International Conference of Interdisciplinary Studies for Cultural Heritage (ISCH) has been accepted as one of the best 20 papers.

The paper will be published in Sampurasun ISCH e-journal within the period of June 4th , 2016 up to December 4th , 2017.

Kindly Please enrich your paper with the cultural heritage theme and send to **isch2015@unpas.ac.id** and **yucesp@unpas.ac.id** within one week after this announcement.

Thank you and best regards.

Very truly yours,

Yuce Sariningsih

Editor in Chief of Sampurasun e-Journal
Pasundan University

The 1st International Conference on Interdisciplinary Studies for Cultural Heritage (ISCH)

http://isch.unpas.ac.id

isch2015@unpas.ac.id

Appendix 4.

The International Conference of Collaboration Research entitled "Study on Urban Environmental Management of Indonesian Cities Considering Applicability of 'Kitakyushu Model' as Japanese Advanced Eco-model City"

CERTIFICATE OF PARTICIPATION

The International Conference of Collaboration Research entitled
"Study on Urban Environmental Management of Indonesian Cities Considering Applicability of 'Kitakyushu Model' as Japanese Advanced Eco-model City"

Would like to certify

Yonik Meilawati Yustiani

As presenter

Kitakyushu- Japan, 5 June 2015
Graduate School of Environmental Engineering
The University of Kitakyushu, JAPAN

Prof. MATSUMOTO Toru

Collaboration between: and

CERTIFICATE OF PARTICIPATION

The International Conference of Collaboration Research entitled
"Study on Urban Environmental Management of Indonesian Cities Considering Applicability of 'Kitakyushu Model' as Japanese Advanced Eco-model City"

Would like to certify

Leony Lidya

As presenter

Kitakyushu- Japan, 5 June 2015
Graduate School of Environmental Engineering
The University of Kitakyushu, JAPAN

Prof. MATSUMOTO Toru

Collaboration between: and

Proceedings of International Seminar on Collaboration Research

Water Quality Modeling of Urban Rivers-Case Study of Cikapundung River, Bandung, Indonesia

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[b]*Department of Informatics Engineering, Pasundan University, Jl. Dr. Setiabudhi 193 Bandung 40153, Indonesia*

Abstract

Cikapundung River is the main river that located in the middle of Bandung City. It has polluted water due to the surrounding condensed houses and domestic-non domestic activity. The changing of the discharge pattern due to the climate uncertainty makes the difficulty to perform the river quality assessment. One method to assess the river water quality is by means of simulation results of a model verified with the measurement data obtained from in the field. Modeling is a method that is easy, inexpensive, and saves time. The use of river quality model is very useful to predict the future condition using kinds of scenarios, so that the river environmental management can be formulated prior to the occurrence of pollution, environmental damage, or other disasters. Modeling of river water quality was introduced by Steeter Phelps equation using oxygen depletion curve equation (oxygen sag curve) which is using coefficients, i.e. deoxygenation rate and reaeration rate. These rates are environmental condition depended values; therefore the specific research to find the suitable rates is needed. Furthermore, to make simulation simpler, the development of software of river water quality model is necessary. The 'KUALA.V01', software to simulate BOD and DO of river water is now being designed enriched with local water characteristic. Laboratory analysis was conducted to obtain the deoxygenation rate. The software was then being tested. The model gave that the value of deoxygenation rate using laboratory analytical methods ranged from 0.01 to 0.37 per day and ultimate BOD ranged between 1.17 to 6.44 mg/L. The software gave reasonable result in its application to simulate the Cikapundung River water quality.

Keywords: BOD decay rate; deoxygenation; urban river water quality

1. Background

Population size is growing rapidly causing the increment of domestic wastewater derived from the municipal activities. It causes the deterioration of water quality directly and indirectly in long term, Purandara [1]. Concering this condition, especially for the surface water quality which is oftenly used as drinking water source, thus its pollution potency need to be modeled.

Recently, the function of rivers located in Bandung City turns into the discharge place of domestic and industrial wastewater. The water quality in Bandung Basin becomes deteriorated, especially in Citarum River. The dominant pollution source is domestic activities. The West Java Environmental Protection Agency estimates that the domestic wastewater was discharged from 3.5 million people directly and indirectly into the urban rivers around Bandung City. The domestic wastewater reaches up to 60% of total wastewater pours into the rivers.

The changing of the discharge pattern due to the climate uncertainty makes the difficulty to perform the river quality assessment. One method of evaluating the quality of river water is using verified model. Modeling is a method that is easy, cheap, and saves time. The use of river quality model is very useful to give prediction of

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conditions in the future, so that the environmental management measures can be formulated by the river immediately prior to the contamination or other disaster. Mathematical formula used in the modeling of marine environmental quality is Streeter Phelps, the formula with coefficients are reaeration and deoxygenation rate or the BOD decay rate. Empirical analysis to determine the coefficient of the deoxygenation rate needs to be conducted in order to obtain the appropriate water quality modeling for urban rivers. The deoxygenation rate coefficient will also describe the characteristics of urban river water contamination. Usually, the use of water quality models takes coefficients based on literature from other countries or Hydroscience formula with a low level of accuracy. Therefore, a study of the deoxygenation rate for rivers in urban areas in Indonesia will be very useful. From the literature edited by Bowie, et.al, [2], it shows that determination of the deoxygenation rate in the laboratory have also suggested by the USEPA (United States Environmental Protection Agency), even though their values can be obtained by total BOD removal rate that takes into account the rate of deposition of BOD. Study of Adewumi [3] said that several ways can be done to analyze the results of laboratory experiments, such as Thomas method, least squares, Fujimoto, Rapid Ratio, Moment, and the Daily Difference.

To support the calculation, the software called 'KUALA.V01' was developed. This software will also be used for the information system tool in order to give uncomplicated access for the users to the river environmental quality information. The deoxygenation rates obtained from the research is used to simulate the water quality of Cikapundung River.

2. Research and Methodology

Rivers selected as the research site is the Cikapundung River. This river passes through the center of the Bandung City. Activity in the city is estimated to represent urban conditions in Indonesia. From the Cikapundung River, water samples were taken at two stations, i.e. the intersection with the Siliwangi Street, representing the upstream area and the the point on Asia Afrika Street, representing the downstream area. Figure 1 shows the sketch of the sampling site on the Cikapundung River. Water samples taken from the water column where were not impaired by sediment. In order to obtain these conditions, the sampling points chosen at the point with sufficient water depth, i.e at least 50cm.

Tests were carried out to determine the deoxygenation rate in the laboratory. Incubation process using BOD bottles, carried out for 10 days in 20oC incubator. Based on APHA [4], DO concentrations were measured every day using the modified Winkler method. Stamer, et.al [5] study showed that based on the methods of the USGS (United State Geological Survey), when the DO reaches a value below 2 mg/L, aeration should be conducted to see a decrease in oxygen concentration on the next day.

Dissolved oxygen was analyzed or defined in 2 ways:

1. *Winkler* titration method

This method is using iodometric titration as its principle. Water samples to be analyzed first being added with $MnCl_2$ solution and then NaOH - KI, MnO_2 precipitate will happen. By adding the H_2SO_4 or HCl will dissolve deposits that occur again and will also free molecular iodine (I_2) which is equivalent to dissolved oxygen. The free iodine is then titrated with standard solution of sodium thiosulfate ($Na_2S_2O_3$) and using the starch solution indicator.

2. Electrochemical method

The method of determining dissolved oxygen in an electrochemical method is a direct way to determine the dissolved oxygen with a DOmeter. Its principle is to use oxygen probe consisting of a cathode and an anode immersed in an electrolyte solution. In the DO meter instrument, probes typically use a cathode of silver (Ag) and anode lead (Pb). Overall, the electrode is coated with a plastic membrane that is semipermeable to oxygen.

DO measurement results for 10 days for each sample point were plotted in graphs for BOD or DO-loss curve versus time. With these charts deoxygenation rate can be calculated by using linearization first order statistical methods to find the relationship between the two inter-related parameters, and determine the regression coefficients. Method of calculation used in determining the value of the deoxygenation rate explained in this study is the method of Thomas. Research conducted by Oke [6] showed that non-linear regression method, least squares, and Thomas are the first choice methods for estimating the parameters BOD.

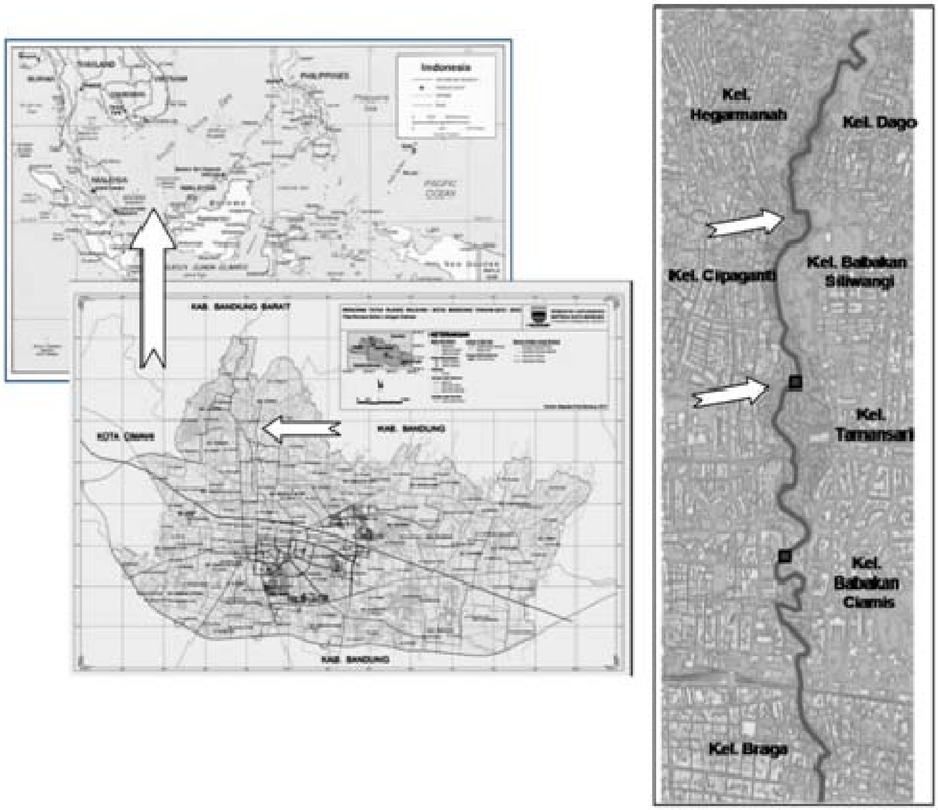

Fig. 1. Sketch of Indonesia, Bandung City, and the Cikapundung River (sampling stations are marked with square symbol).

Thomas method for BOD determination is based on the similarity of two functions, a graphical analysis using the following function [7].

$$\left[ty^{-1}\right]^{1/3} = (2.3kL)^{-1/3} + k^{2/3}\left(3.43L^{1/3}\right)^{-1} t \qquad (1)$$

Where k = BOD decay rate (day^{-1})
L = ultimate BOD (mg/L)
y = BOD uptake in time interval (mg/L)
$[ty^{-1}]^{1/3}$ =can be plot as a function of time (t) t, with slope $k^{2/3}(3{,}43L^{1/3})^{-1}$
$2{,}3kL^{-1/3}$ = intercept point

Slope method introduced by Thomas (1937) gives a constant BOD through least-squares treatment (least squares) to form the basis of the first order reaction equation [8].

$$\frac{dy}{dt} = K_1\left(L_a - y\right) = K_1 L_a - K_1 y \qquad (2)$$

where dy = BOD increment per time unit
K_1 = deoxygenation rate, per day
L_a = first stage ultimate BOD, mg/L
y = actual BOD in time t, mg/L

3. 'KUALA.V01' Software Process and Modeling

In this research, a software of river water quality was developed, named KUALA.V01. Development of the software was started with prototyping process. The prototyping was adopted as software process model and Unified Modeling Language (UML) as modeling language. Prototyping is an evolutionary process model which produces an increasingly more complete software which each iteration. This model used when: 1) objectives defined by customer are general, does not have details like input, processing, and output requirement; 2) developer unsure about the efficiency of algorithms or the form of human computer interaction should take. Prototyping model assists software engineer and customer to better understand what is to be built when requirement are fuzzy.

Prototyping start with communication, between a customer and software engineer to define overall objective, identify requirements and make a boundary. Going ahead, planned quickly and modeling (software layout visible to the customers/end-user) occurs. Quick design leads to prototype construction. Prototype is deployed and evaluated by the customer/user. Feedback from customer/end user will refine requirement and that is how iteration occurs during prototype to satisfy the needs of the customer.

Identifying the user requirements is an important phase to define: 1) Functional requirement - what software must provide to fill the need of the system intended user; 2) Non Functional requirement - a property or quality the system must have like cost, performance, security. Establishing user requirements need intensive communication with customer (the stakeholders), to understand the purposes, problems, needs and prospects/alternative solutions. It begins with data collecting which combine some methods like interview, questionnaire, document study, observation and survey.

There are three types of requirement: 1) Normal requirements - reflect objectives and goals stated for product. If requirement are present in final products, customer is satisfied; 2) Expected Requirements – customer does not explicitly state them. Customer assumes it is implicitly available with the system; 3) Exciting Requirements – Features that go beyond the customer's expectation. In this research, we found that modelling of river water quality is the normal requirement, create various report as expected requirement and online monitoring as exciting requirements.

During meeting with customer, we need to deploy: 1) Functional deployment determines the "value" of each function required of the system; 2) Information deployment identifies data objects and events and also tied with functions; 3) Task deployment examines the behavior of the system; and 4) Value analysis determines the priority of requirements during these 3 deployments. After identified problem and requirements, it continue by modelling using UML. The result of this modelling will be discuss in the next section.

3. Result and Discussion

3.1. BOD Decay Rate

Laboratory treatment results on samples of water of upstream Cikapundung River and downstream Cikapundung River can be seen in Fig. 2 and Fig. 3.

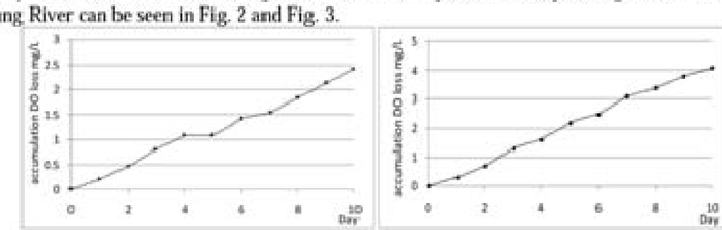

Fig. 2. Accumulation of oxygen consumption (upstream of Cikapundung River).

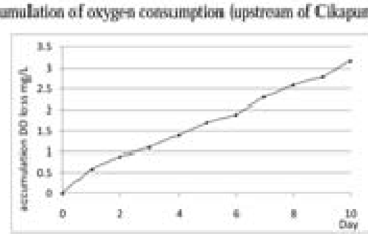

Fig. 3. Accumulation of oxygen consumption (downstream of Cikapundung River).

To obtain the rate of BOD decay/ deoxygenation rate and ultimate BOD in each water sample, method of Thomas with a non-linear least squares was used. Table 1 shows the result for the rate calculation explained the deoxygenation rate and the ultimate BOD for the river.

Sampling and laboratory results on samples of water Cikapundung River can be seen in Table 1. To obtain BOD decay rate and ultimate BOD in each water sample, methods of Thomas (1950) was used with a non-linear least squares. Regression results obtained from the distribution of the data shows the value of the coefficient of determination (R2), which approaches the value 1, indicating a high level of determination.Table 1. shows the results for the BOD decay rate and ultimate BOD for each river.

Table 1. BOD decay rate and BOD ultimate

Sampling point	BOD decay rate (day^{-1})	BOD ultimate (mg/L)	Determination Coeff.
Upstream	0.1622	16.31	0.99
Downstream	0.0233	14.57	0.97

The rate of BOD decay/ deoxygenation range is from 0.0233 to 0.1622 day-1, whereas the ultimate BOD values ranged from 14.57 to 16.31 mg /L.

3.2. Computation Scenario and Result

In this research, quick design style was implemented. Element of software i.e. data, process and interaction was designed without any detailed of it and implement directly to code of source program using visual programming tools Borland Delphi. Part of the complicated work is understanding river water quality formulation and translated the formulation into the river water quality model computation algorithm.

Since the early prototype main scenario of river water quality model and computation algorithm was not changed except the numbers of segment and interaction mode for input and output computation. Its scenario as follow:

1. Input the numbers of segment (maximum 10), in the first prototype just two segments.
2. Input the distance of mix points (X).
3. Input BOD and DO of start point in the first segment (segment 1), L_0 and D_0.
4. Input parameter's values before and after mix point:
   - Q = discharge (m^3/second)
   - K_a = reaeration rate coefficient (day^{-1})
   - K_d = deoxygenation rate coefficient (day^{-1})
   - K_r = total removal rate coefficient (day^{-1})
   - U = average velocity of water flow (m/s)
   - O_{sat} = constant of saturation oxygen
5. Input BOD and DO at mix point (it maybe there is current flows in or flows out, at this point).

Q, U, O_{sat} are taken from measurement while K_a, K_d and K_r are taken from previous research; the value of U, O_{sat}, K_a, K_d and K_r could be the same with the previous value if there is no current flows in or flows out. Figure 2 displayed the input screen of KUALA version 0.1 which enable just for two segments.

Using the 'KUALA.V01', the model gave that the value of deoxygenation rate ranged from 0.01 to 0.37 per day and ultimate BOD ranged between 1.17 to 6.44 mg/L. The software gave reasonable result in its application to simulate the Cikapundung River water quality.

Yustiani [9] give in the previous study that deoxygenation rate value using model calibration process range between 0.03 and 0.95 day-1. This study was conducted for the location of Citarum Hulu River which is situated in the sub-urban area of Bandung City. In the previous study of the River Citepus, Yustiani [10] analized that the BOD ultimate concentration was 7.56 mg/L. In this study, the BOD decay rate was calculated based on Hydroscience equation. Using this equation, the value of decomposition rate was about 1.00 day-1.

Some studies determining the rate of BOD decay have been done in other countries using variety of methods including field studies, the calibration model, and experiments in the laboratory. Bowie et.al [2] wrote that one study that used laboratory tests were Bhargava (1983) with the River Ganga and Yamura (India) as the study area. BOD rate coefficient values resulted in this study were 3.5 to 5.6 day-1 for the River Ganga, and 1.4 day-1 for Yamura River.

Similarly, in the method of determining the rate of BOD explained using a calibration model. Bowie et.al [2] also show other research has been done using this method, among others, by Crain and Malone (1982) for

Gray's Creek River (Louisiana, USA) with the result of 1.44 day-1. In this method, a series of field data should be a reference to the calibration process. The data can be used also in accordance with the terms of such a field study.

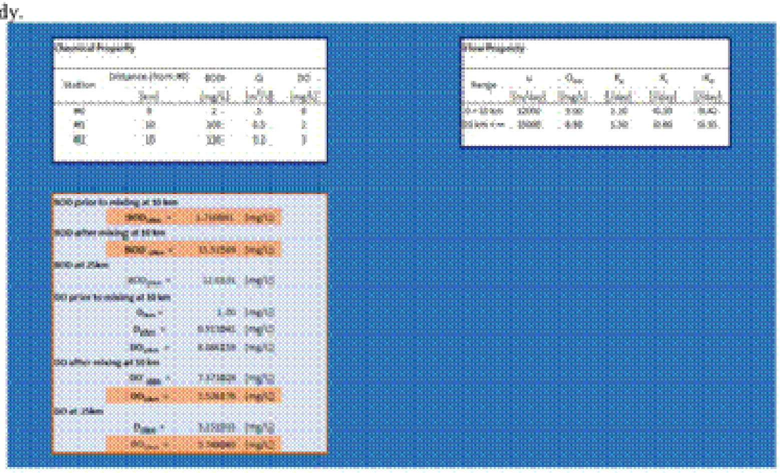

Figure 4. The input screen of Kuala version 0.1

The range of values for the rate of BOD decay of Cikapundung River in this study showed that the activity of microorganisms in the river is relatively low. For comparison, the deoxygenation rate explained for several rivers in other countries are as follows:

- Ravi River (Pakistan) 0,14 – 0,27 day^{-1} [11]
- Swan River (Western Australia) 0,23 day^{-1} [12]
- Gomti River (India) 0,45 day^{-1} [13]

Low figure of deoxygenation rate indicate that microogranism can not decompose the organic substances optimally. This can be caused due to an inhibition of growth and performance of microorganisms such as industrial waste containing heavy metals, high acidity, and others. In addition, medical waste from hospitals or clinics can also be inhibiting the activity of the decomposition of organic matter by microorganisms in the river, especially if the waste contains toxic chemicals or drugs that can kill microogranism.

4. Result and Discussion

The deoxygenation rate range is from 0.0233 to 0.1622 day-1, whereas the ultimate BOD values ranged from 14.57 to 16.31 mg /L. The model gave that the value of deoxygenation rate using laboratory analytical methods ranged from 0.01 to 0.37 per day and ultimate BOD ranged between 1.17 to 6.44 mg/L. The software gave reasonable result in its application to simulate the Cikapundung River water quality. This value of deoxygenation rate shows that microogranism can not optimally decompose the organic substances contained in the rivers, which can be caused to an inhibition of growth and performance of microorganisms such as industrial waste containing heavy metals, high acidity, etc.

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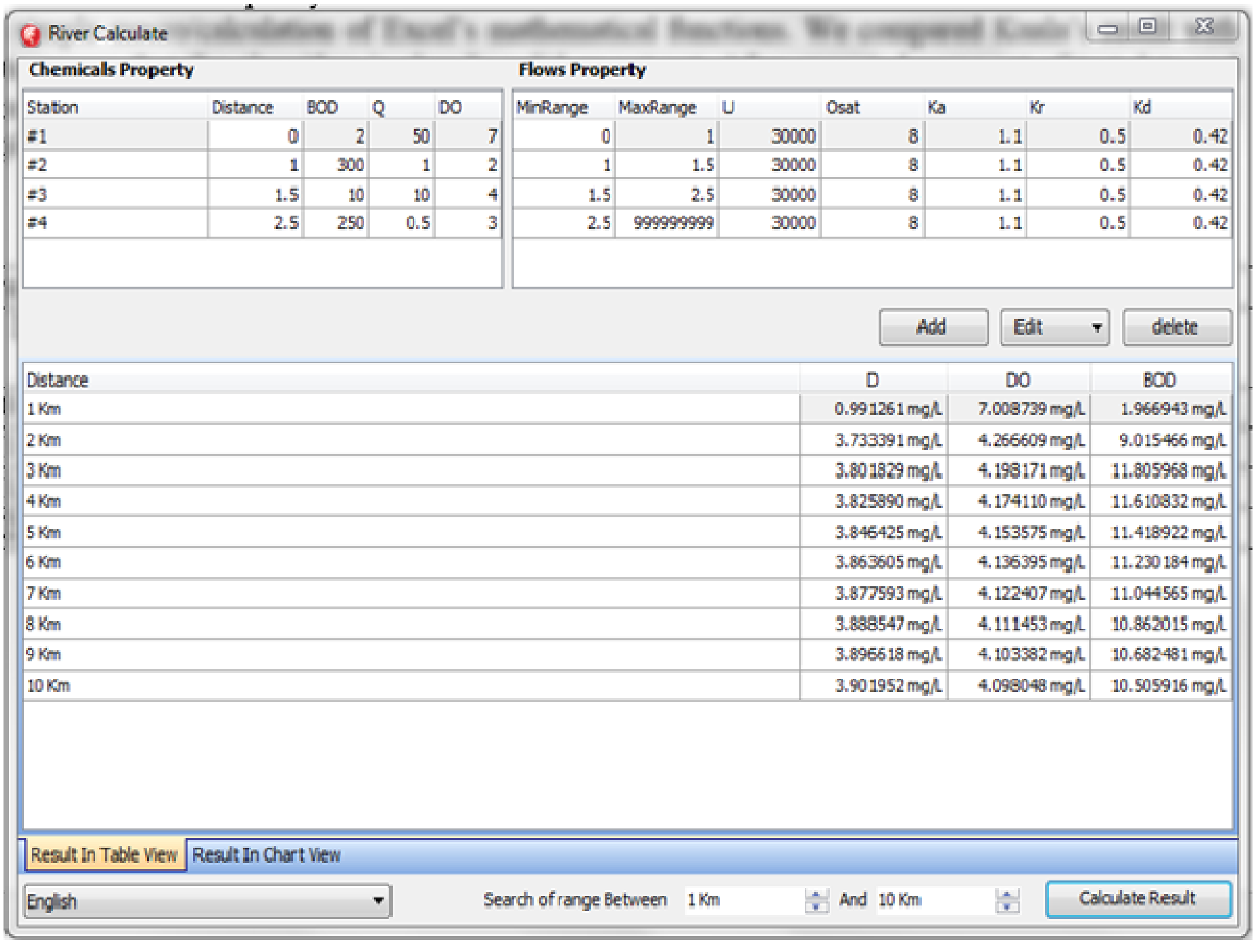
Appendix 5.

Software of KUALA.V01



Station	Distance	BOD	Q	DO
#1	0	2	50	7
#2	1	300	1	2
#3	1.5	10	10	4
#4	2.5	250	0.5	3

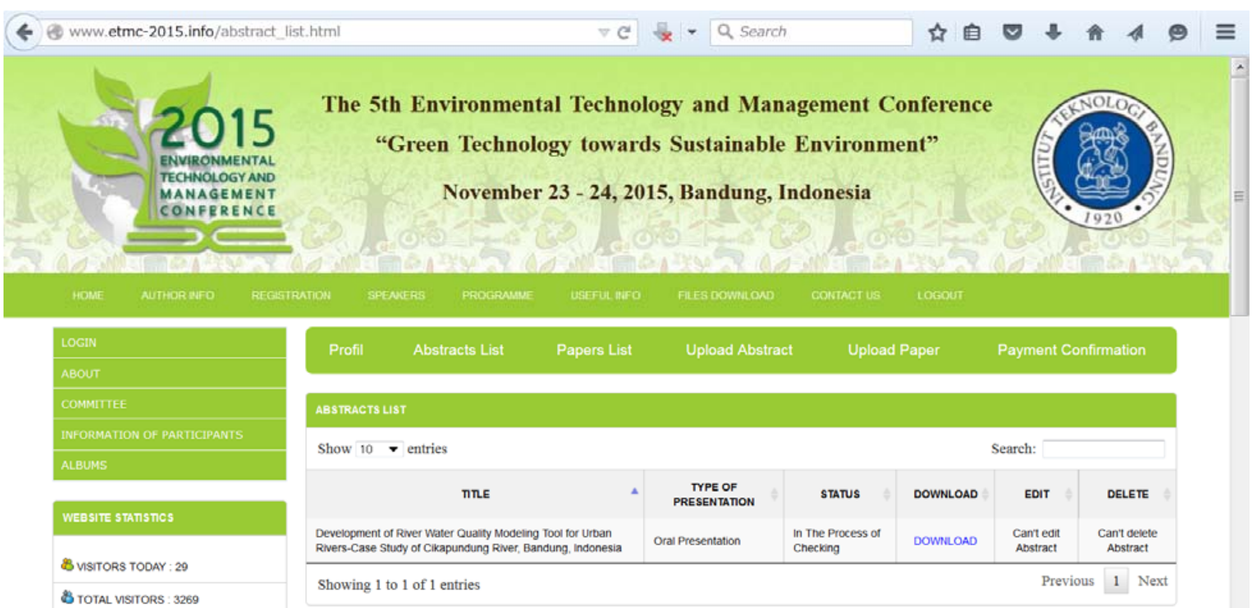
MinRange	MaxRange	U	Osat	Ka	Kr	Kd
0	1	30000	8	1.1	0.5	0.42
1	1.5	30000	8	1.1	0.5	0.42
1.5	2.5	30000	8	1.1	0.5	0.42
2.5	999999999	30000	8	1.1	0.5	0.42

Distance	D	DO	BOD
1 Km	0.991261 mg/L	7.008739 mg/L	1.966943 mg/L
2 Km	3.733391 mg/L	4.266609 mg/L	9.015466 mg/L
3 Km	3.801829 mg/L	4.198171 mg/L	11.805968 mg/L
4 Km	3.825890 mg/L	4.174110 mg/L	11.610832 mg/L
5 Km	3.846425 mg/L	4.153575 mg/L	11.418922 mg/L
6 Km	3.863605 mg/L	4.136395 mg/L	11.230184 mg/L
7 Km	3.877593 mg/L	4.122407 mg/L	11.044565 mg/L
8 Km	3.888547 mg/L	4.111453 mg/L	10.862015 mg/L
9 Km	3.896618 mg/L	4.103382 mg/L	10.682481 mg/L
10 Km	3.901952 mg/L	4.098048 mg/L	10.505916 mg/L

Appendix 6.

Abstract Submission for

The 5th Environmental Technology and Management Conference
“Green Technology towards Sustainable Environment”
November 23 - 24, 2015, Bandung, Indonesia



Dear OP/NR/006,

Based on abstract evaluation, your abstract with title "Development of River Water Quality Modeling Tool for Urban Rivers-Case Study of Cikapundung River, Bandung, Indonesia." is ACCEPTED.

Please submit your full paper no later than October 10th, 2015.

Please note for those who already paid the registration fee, kindly confirm to us through sending an email.

If you need further information, you can visit our website (www.etmc-2015.info).

Thank you for your kind attention.

Warm regards,

--
Secretary ETMC-2015: Emenda Sembiring, PhD
Faculty of Civil and Environmental Engineering ITB
Jalan Ganesa 10 Bandung 40132 – Indonesia
E-mail: etmc@ftsl.itb.ac.id
Phone/Fax +62-22-2502647/+6281214582689/ +62-22-2530704
www.etmc-2015.info

Appendix 7
Selected paper for TELKOMNIKA Journal (indexed by Scopus)

29 Okt 2015

ceie 2015

Dear Yonik Meilawati,

Based on reviewing process, your paper is proposed to publish in a Telkomnika/JPH/JPS Journal (see attachment). Accepted paper will be excluded from the CEIE proceeding.

We are still waiting the acceptance confirmation from the journal.

In case your paper is rejected, we will publish your paper in CEIE proceeding.

Best regards,
CEIE 2015 Committee

Department of Electrical Engineering,

State University of Malang

Appendix 8
Acceptance of paper for ACENS 2016

Asian Conference on Engineering and Natural Sciences

(ACENS 2016)
Fukuoka, Japan
February 01-03, 2016

Acceptance Letter

Paper ID: ACENS-6456
Title: Water Quality Characterization of Bandung City Rivers, Indonesia
Name: Yonik Meilawati Yustiani

Dear **Yonik Meilawati Yustiani**,

We sincerely appreciate your paper submission. On conclusion of the peer-review process, we are pleased to inform you that your paper is accepted for **Oral presentation** at Asian Conference on Engineering and Natural Sciences (ACENS 2016), held at Fukuoka International Congress Center, Fukuoka, Japan. Decisions were made based on a double-blind review process. The exact time and room of your presentation session will be specified in the Conference Program online on http://www.acens-conf.org/ at the end of December 2015.

Please make sure that your manuscripts conform to the writing format which is available on the conference website. Only manuscripts conforming to the format guidelines will be published in the proceedings.

If you have any further questions, please do not hesitate to contact the secretariat of ACENS 2016 by sending your email to acens@acens-conf.org with your **paper ID number** listed above on all communications. Again, congratulations on the acceptance of your paper. On behalf of the Program Committee, we look forward to your full participation in the ACENS 2016 Conference.

Sincerely Yours,
Program Committee of ACENS 2016

Organized by Higher Education Forum
Email: acens@acens-conf.org
Add: F12-1., No.129, Sec.1, Fuxing S. Rd., Taipei, Taiwan

Appendix 9
Abstract Submission for HIC 2016

Dear Dr., Yonik Meilawati Yustiani

Congratulations on the successful submission of your abstract to the
HIC 2016 in Incheon, Korea, August 21-26, 2016.
For your records, please print or save a copy of this email.

Abstract No.	O-239
Paper Title	TOWARDS AN INFORMATION SYSTEM OF MODELING AND MONITORING OF CIKAPUNDUNG RIVER, BANDUNG, INDONESIA
Author	Yonik Meilawati Yustiani

Please use the Abstract ID in all communications about your Abstract.
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abstract / paper management system.

TEL : +82-32-850-5500 | FAX : +82-32-835-4384 | Email : hic2016@inu.ac.kr
Website : www.hic2016.org