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THE ECONOMIC IMPACT OF WATER POLLUTION

Samuel PD Anantadjaya
School of International Business Administration, Faculty of Business & Social Sciences
International University Liaison Indonesia (IULI), BSD City, Serpong, Tangerang, Indonesia
Email: ethan.eryn@gmail.com

Malinda Shella Rahmadani
School of International Business Administration, Faculty of Business and Social Sciences
International University Liaison Indonesia (IULI), BSD City, Serpong, Tangerang, Indonesia
E-mail: malindarahmadani27@gmail.com

Satiri
School of Management, Faculty of Business & Social Sciences
International University Liaison Indonesia (IULI), BSD City, Serpong, Tangerang, Indonesia
Email: satiri@gmail.com

Irma M Nawangwulan
School of Hotel & Tourism Management, Faculty of Business & Social Sciences
International University Liaison Indonesia (IULI), BSD City, Serpong, Tangerang, Indonesia
Email: inawangwulan@gmail.com

Timotius A Rachmat
School of Hotel & Tourism Management, Faculty of Business & Social Sciences
International University Liaison Indonesia (IULI), BSD City, Serpong, Tangerang, Indonesia
Email: timotiusrachmat14@gmail.com

ABSTRACT

Water pollution and its treatment have become the current and considerably urgent matter. The encircled analyses environmentally, clinically, and economically become important for business organizations. The connection between water pollution and its treatment with the affecting stakeholders in its surroundings should be further analyzed, not only because stakeholders hold the responsibility to ensure the cleanliness and sanitation of their responsible watershed, but also due to the fact that water pollution can cause a substantial amount of money that will be poured into water treatment system. This means that citizens of the concerned areas will be affected whether they like it or not. Many countries are attempting to establish environmental policies but simultaneously ensuring that the policies themselves do not hinder economic growth. Governments are attempting to encourage stakeholders to engage in environmental activities and vice versa to ensure that the water supplies are distributed and safe to drink for future generations.

Keywords: water pollution, stakeholders, social, economic, and environmental

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I. INTRODUCTION

Water is considered as a vital essence for a nation's development, a drinking source for nation's population, and the livelihoods that potentially has a profound affect that can take part into making a nation's future greater than ever before in this world. The well-being of people is, undoubtedly, relying on water, at least for the safe drinking water and sanitation (Global Water Partnership, 2013). Water in of itself has been recognized by the UN General Assembly as a human right, in other words, regardless of your status, class, income, and where you live, you have the right to gain access to water (United Nations, 2017). During the consultation in Sweden that was held by the Global Water Partnership, the gathering consultations reported that water is considered as a source of destruction that have the potential to disturb balances; socially, economically and environmentally (Global Water Partnership, 2013).

An example of how stakeholders took part in participating to help improve water pollution is the cleanup of the Onondaga Lake (Duffy, 2017), with the most recent activities were in June 2017 where the community works together to ensure the cleanup progress (Honeywell International, Inc, 2017). Onondaga Lake, a lake that is located in Central New York, was once considered as one of the most polluted lake in history in the 20th century. The lake was once a waterfront resort, with amusement park and an exclusive yacht club (Duffy, 2017). As time flew by, the lake was awash in bacteria and algae due to the loose law on environment. Pollution and sewage from cities end up polluting the lake. As the lake slowly accumulates waste ranging from chemicals to simple trash, such as; plastic bags, and food waste (Immanuel, Hartopo, Anantadjaya, & Saroso, 2013), by the 1940s, water in the lake became so toxic that the government announced

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that lake was unsuitable to be swim in which therefore led to the shutdown of amusement parks, the yacht club and resorts (Chanatry, 2012; Duffy, 2017).

Today, there are more than 60 species living in the lake (Chanatry, 2012). This is because of the extensive and major cleanup haul in the lake that went on for years and is still continuing to maintain its cleanliness; the lake now contains low bacteria counts and high-water clarity (Coin, 2015). This is solely because of engaged stakeholders who believed that it is their responsibility to take care of the lake and its surrounds. The surrounding stakeholders began to take action after realizing the decades of damage that was brought to the lake. Economic, social, and environmental risks have surfaced due to the lack of monitoring systems, in regards to water quality and poor administration of municipal wastewater. Thus, stakeholders need to be able to understand and recognize the dire ongoing issues that the world is facing today and be able to manage and consider this as an important issue to tackle (Global Water Partnership, 2013; Carroll & Buchholtz, 2015). Effects of the respective issues may result in natural climate changes to extreme climate events. Though the issues can be seen as creating local social disruption, it can be viewed, on the other side of the spectrum, as issues that may or already have impacted the economic growth, services and likelihood of countries all around the world (Global Water Partnership, 2013). All in all, different stakeholders have different concerns about the water treatment pollutions and water pollution and treatment itself various in impact on the environmental, social, and economical aspects in this world.

II. LITERATURE REVIEW

II.1. ENVIRONMENTAL IMPACT OF WATER POLLUTION AND TREATMENT

Polluted water has its sides (Kabir, 2014). The polluted water can be used to irrigate farms. However, it can pose as a potential threat for those who lived in, or around the affected area. One of the many reasons why the polluted water is being used is because of the lack of fund for water treatment that is designed for irrigation purposes (Kabir, 2014). This would result in farmers utilizing polluted waters for the sake of saving their expenses

With polluted water being used for crop production, it deteriorates the environmental surroundings and worse, caused water-borne diseases to surface in the concerned region. Kabir (2014) stated that because polluted water "*contains plant nutrients and also organic matter other than high concentration of soluble salts and heavy metals*", it can result into harmful effects that can potentially stay in the concerned areas for decades because of the utilization of polluted water for irrigation purposes. To make matters worse, the water can seep down into the soil, which inevitably have a negative impact on the ground water quality, if it reaches in any ground water reserve areas (Kabir, 2014). Furthermore, due to the polluted water that contains toxic contamination from industrial, agricultural and domestic origin, as well as heat pollution, lakes around the concerned area are being heavily affected (Kabir, 2014).

The most important soil and related ground water contamination are mainly agricultural activities and other activities. The result of utilizing polluted water for irrigation is harmful for consumption, this is due to the evidence of crop contamination that is filled with pathogens, metals,

and sediments. Furthermore, groundwater intrusion occurs due to the inconsiderate municipal and industrial waste dumps that are intruding the freshwater in groundwater reserve, causing freshwater scarcity in the concerned area (Wanninger, 1999; United States Environmental Protection Agency, 2008; Tortajada & Talukdar, 2017). In addition, chemicals waste such as cadmium, copper, lead and zinc are threatening the quality of surface soil through atmospheric deposition (Wanninger, 1999; Kabir, 2014). Due to a widespread of inconsiderate wastrel dumps that are thrown in aquatic systems, there is a major environmental impact of the morality of fishes and marine life organisms due to the contaminations of pesticides that are entering the ecosystems (Kabir, 2014).

Figure 1: Water Withdrawals by Sector 2010

Continent Regions	Total Withdrawal by Sector						Total Water Withdrawal	Total Freshwater Withdrawal	Freshwater Withdrawal as % of IRWR
	Municipal		Industrial		Agricultural				
	km³ per year	%	km³ per year	%	km³ per year	%	km³ per year	km³ per year	
World	**464**	**12**	**768**	**19**	**2,769**	**69**	**4,001**	**3,853**	**9**
Africa	**33**	**15**	**9**	**4**	**184**	**81**	**227**	**220**	**6**
Northern Africa	14	13	3	3	89	84	106	101	215
Sub-Saharan Africa	19	16	6	5	96	79	121	119	3
Americas	**123**	**14**	**321**	**37**	**415**	**48**	**859**	**855**	**4**
Northern America	79	13	289	47	241	40	610	605	10
Central America & Caribbean	8	23	6	18	20	59	33	33	5

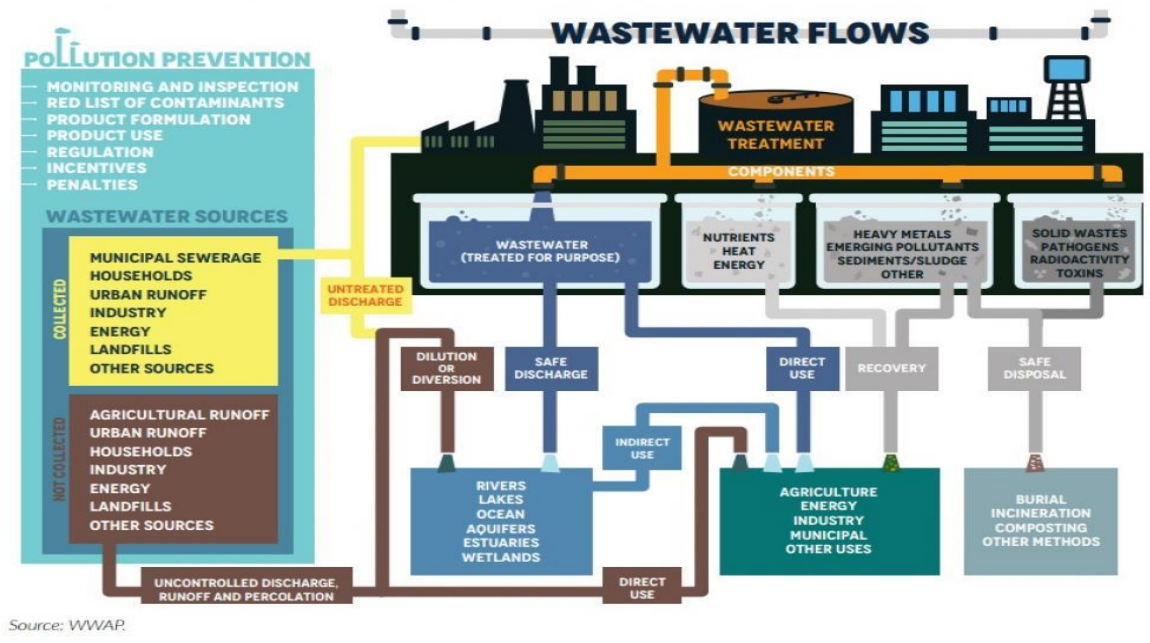
Continent Regions	Total Withdrawal by Sector						Total Water Withdrawal	Total Freshwater Withdrawal	Freshwater Withdrawal as % of IRWR
	Municipal		Industrial		Agricultural				
	km³ per year	%	km³ per year	%	km³ per year	%	km³ per year	km³ per year	
Southern America	36	17	26	12	154	71	216	216	2
Asia	**234**	**9**	**253**	**10**	**2,069**	**81**	**2,556**	**2,421**	**20**
Middle East	25	9	20	7	231	84	276	268	55
Central Asia	7	5	10	7	128	89	145	136	56
Southern & Eastern Asia	202	9	224	10	1,710	80	2,135	2,017	18
Europe	**69**	**21**	**181**	**54**	**84**	**25**	**334**	**332**	**5**
Western & Central Europe	51	21	131	53	66	27	248	246	12
Eastern Europe	18	21	50	58	18	21	86	86	2
Oceania	**5**	**20**	**4**	**15**	**16**	**65**	**25**	**25**	**3**
Australia & New Zealand	5	20	4	15	16	65	25	24	3
Other Pacific Islands	0.03	30	0.01	11	0.05	59	0.1	0.1	0.1

Source: (Food and Agriculture Organization of the United Nations, 2016)

Figure 1 shows the total amount of water withdrawal by sectors. As shown below, the sector that utilized the most water is indeed agricultural activities all over the world. As shown, the sector that consumed and utilized an abundant amount of water is the agricultural sector which is the case for majority countries in the world. Although wastewater is harmful, it can possibly be

treated as an alternative resource (Down to Earth, 2017). This is because wastewater can be seen and considered as an alternative cost-efficient and sustainable source of energy due to the nutrients, organic and organic minerals that are found in the polluted water that are filled with residues from the fertilizers. Furthermore, there are available technologies that can help with the process of sludge/bio-solid treatment process that can be conveniently built-in the wastewater treatment facilities. In addition, there are other technological innovation that are being in process, such as; the development to recover nitrogen and phosphorus from the wastewater (Down to Earth, 2017).

Figure 2: Wastewater Flow System



Source: (Down to Earth, 2017)

Additionally, if the wastewater treatment facilities in the concerned areas are not functioning well, flooding may occur, thus, it is important for wastewater treatment facilities to

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examine the environmental sustainability in the surrounding area of the facilities. If the facilities are not being well-maintained, if it suffers breakdowns, it may result in flooding of land area in the surrounding regions (Concerned Erin Citizens, 2014). A prime example happened in January 2009 in Halifax, Canada. Because of the local area power outage, the Halifax Wastewater Treatment Facility has suffered damages from wastewater flood, despite the fact that construction of the facility had just been completed in February of 2008. The failure at the designated facility has resulted in wastewater being dumped and re-routed into the Halifax Harbor until further notice (Anguish, 2009). It did cost approximately $54.7 million to fix the Halifax Wastewater Treatment plant after the malfunction that caused raw sewage to flood the building and seriously caused substantial damages (CBC News, 2011). When settling in an area that is near a wastewater treatment facility, residents' awareness must be improved on all possible implications (Concerned Erin Citizens, 2014). At the first level, the condition of the aquatic environment may well be alarming, and influence the economic losses to the society (Zhang, 2014). If the level of dissolved oxygen in the water is less than 5 ppm[1], or a pH levels of less than 6.5, aquatic animals may unable to breathe and survive (Michigan Technological University, 2018). The incident on wastewater treatment facility due to the power outage mirrors the required public trust in the banking industry (Siahaan & Anantadjaya, 2013). When people put their money into the banking systems, this denotes the level of trust that any maintenance works are scheduled regularly to make sure that the banking systems are always ready to handle transactions.

[1] The term "ppm" in this context is referring to "parts per million", and "pH" denotes the "power of hydrogen".

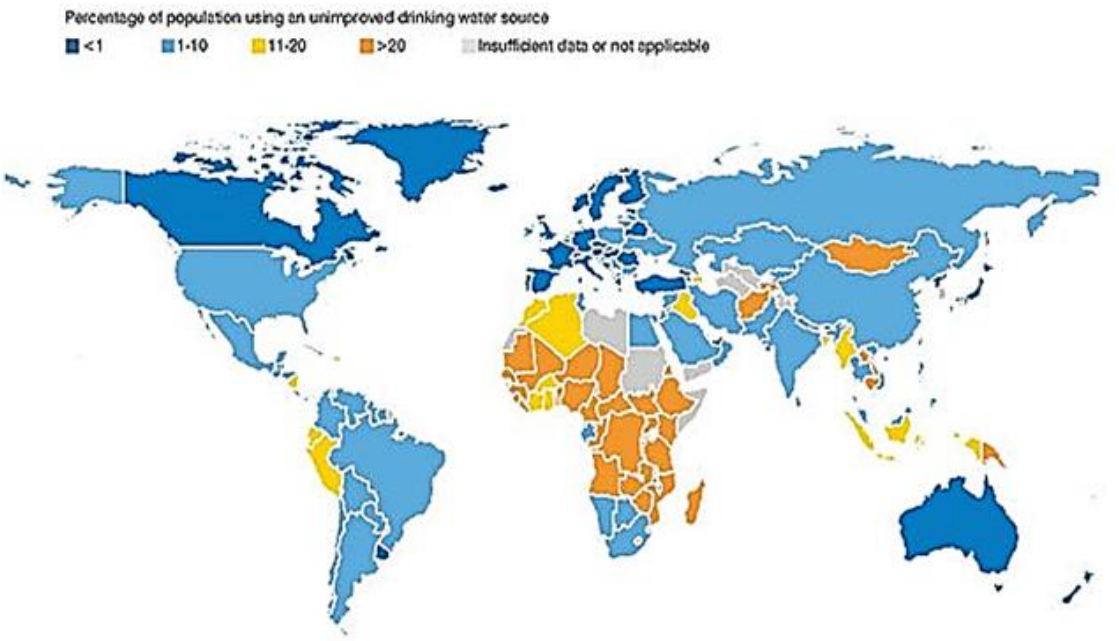
II.2. HEALTH IMPACT OF WATER POLLUTION AND TREATMENT

It is well-known that clean water is an absolute essential part of living a healthy life. Thus, it is a basic need for all human beings to have access to adequate supply of clean water. Unfortunately, it has been observed that about 663 million people are not getting access to their basic essential needs for water around the world (Edugreen, 2007; Slaymaker & Bain, 2017). Providing the people with safe and clean drinking water is an important issue for the local government. Hence, the government needs to take action such as investing in low cost equipment so people can use them to test the quality of water before drinking (Hitzfeld, Hoger, & Dietrich, 2000; Slaymaker & Bain, 2017). Based on the research by the United Nation Food and Agriculture Organization, UNESCO-IHE Institute for Water Education, World Water Council and Water Footprint Network, the required fresh/clean water ranges from 1 bathtub[2] full of water to produce 1 cup of coffee to 16,000 bathtubs full of water to build a medium house (Miller & Spoolman, 2016). For water-deficient countries, the tendency will be importing products than attempting to manufacture those products domestically (Miller & Spoolman, 2016) as those products contain virtual water[3]. Countries' policies should be catering to such conditions (Carroll & Buchholtz, 2015).

[2] One full bathtub is equivalent to 151 liters, or 40 gallons (Miller & Spoolman, 2016).

[3] The term "virtual water" refers to the indirectly consumed fresh water in the forms of various products (Miller & Spoolman, 2016).

Figure 3: Percentage of Population Using an Unimproved Drinking Water Source



Source: (Slaymaker & Bain, 2017)

Severe water pollution is threatening human health all throughout the world (Kabir, 2014). For decades, human activities have caused continuous damage to the water resources. As a result, waterways are being dangerously contaminated with industrial discharges and pesticides due to fallouts, runoff erosions, and drainages (Kabir, 2014). There are toxic blue-green algae (also known as cyanobacteria) that can be found in drinking water and water used for recreational activities. This can potentially pose a hazard to humans. Unfortunately, this toxic substance is not being treated fully, but rather at a local level for sometimes even be neglected to be treated. Not only is these toxic algae pose a danger to humans, but also to both wild and domestic animals alike. The algae are found accumulating along the shores of ponds and lakes. If this were not treated

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properly, it can consequentially cause the presence of bacteria such as Escherichia coli (E. coli) (Hitzfeld, Hoger, & Dietrich, 2000; Slaymaker & Bain, 2017). In many places, the groundwater may be contaminated by the containers people use to carry and store water as those containers contain bacteria and traces of E. coli (Slaymaker & Bain, 2017).

Besides the fact that freshwater is being threatened by poor management and over exploitation, freshwater is also vulnerable to the growing ecological degradation that are occurring all around the world. Many developed countries are experiencing the disposal of chemicals into their water resources while the developing nations are experiencing problems with agricultural run-offs. In Asian urban areas, for instance, water pollution is mainly caused by the phenomena of rapid urban development, poor enforcement of regulations, and the rapidly growth of unplanned settlements that lack running sewage systems (Abeygunawardane, Dayawansa, & Pathmarajha, 2011).

The unfortunate fact is that some water pollution effects are recognized immediately, whereas others seldom show up immediately and instead take months or even years before they show signs of effects (Kabir, 2014). Water pollution has a heavy impact on the food chain. In other words, the higher the toxic chemical climbs up the food chain, the more dangerous and harmful the chemical can be for the organisms sitting on the top of the food chain. This can inevitably result in infectious diseases forming from the contaminated water such as typhoid and cholera. This is called microbial water pollution (Kabir, 2014). There are plenty of health problems that arise due

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to the consumption of polluted water. This includes diarrhea, skin lesions, negative affect of blood circulation and damage to the body's nervous system (Kabir, 2014).

An ongoing as well as a primary health concern that is caused by water treatment facilities are airborne hazards. This is due to the abundant of chemicals and harmful organisms that are being discharged from the wastewater treatment facilities into the air, thus, posing health risk of respiratory and gastrointestinal infections, depressions, damage to the nervous system, eye irritations, and possible poisoning for those who are in the surrounding regions (Concerned Erin Citizens, 2014).

II.3. ECONOMIC IMPACT OF WATER USAGE AND TREATMENT

The economic crises in recent years have provided an important opportunity to promote water's vital role in human's lives. There is a rushed need to respond to the continuously decreasing supply of water (Moss, 2017). Unfortunately, projections of future water scarcity are numerous but it is rather difficult to measure just how much water usage human uses and to predict water availability for future use. Hence, it is quite the obstacle to correctly calibrate factors such as how does water usage plays a role in the economic growth of a country (Katz, 2010). For example, according to the World Commission on Water Use for the 21st Century (Miller & Spoolman, 2016), a relatively large area in the Northern African continent, the natural capital degradation has reached a rather stressful stage in comparison to the low-level of stress in Southern African region, South America, Canada, and a large region in the Western and Northern Australia.

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For sure, this stressful situation of the freshwater availability forces organizations to constantly search for alternatives. The search leads to higher cost of production, undoubtedly.

According to Moss (2017), there are many politicians, who do not seem to consider regulating pollution in water as a dire situation. This is due to the perceived risks of investing in any water-related projects, thus, ultimately reducing any investment for new capital and/or maintenance for treatment facilities. This is due to impractical approaches to cost recovery. As a result, especially in less developed countries, people are not getting access to basic sanitation and clean water to survive. According to the United Nation Development Programme (UNDP) Human Development Report for 2006, countries in sub-Saharan will require annual investments of roughly $7 billion annually to reach its goals on water sanitation (Moss, 2017).

Ultimately, if water sanitation problem is not addressed, there will be heavy prices to pay such as an increase loss of jobs for farmers. Additionally, industry will face shortages and individuals will inevitably feel the consequences onto their standard of living (Moss, 2017). The construction and implementation of water treatment plants can affect the financial conditions of people who live in the concerned areas. The results would not only be an increase to tax rates, but rather a significant depreciation in property values that are situated in the surrounding neighborhood (Concerned Erin Citizens, 2014). Additionally, it is quite costly just to maintain the cleanliness of the water treatment. According to the US Department of Defense, the total spending had reached about US$30 billion to remove groundwater pollution in its facilities, just in the last few decades (Walton, 2012).

Table 1: Supply and Demand Pressures on Water Availability and Use

Demand Pressures	Impacts of Water Stress	Supply Pressures
Population Growth • Increased urban use • Increased demand for food **Economic Growth** • Increased urban water use • Increased industrial water use • More water-intensive diets **Energy Demand** • Use of food crops and crop land for biofuel **Climate Change** • Increase crop ET requirement **Policy/Regulation** • Deteriorating infrastructure (lack of investment in water) • Higher environmental standards	Localized ground water overdraft Pressures on ecosystem Economic/political conflict Risk for potential growth!	**Spatial/temporal mismatch** between supply and demand **More expensive supply curve** for new waters **Continued water quality deterioration** **Climate change pressures** • Increasing variability • Extreme events jeopardize infrastructure and water supply reliability • Declining renewable water resources (in some cases)

Source: (Ringler, 2012)

Moss (2017) stated that agriculture, which is the biggest user of water, will be the sector that will have the heaviest impact of all due to a lack of water reduces yields. This will inevitably affect the supply and demand of food, thus, affecting the trades among countries. Hence, the manufacturing sector in countries will highly be at risk, especially for the water dependent inputs, because of the increase in price of water and the limited resource of it. Ironically enough, agricultural activities contributed as one of the biggest contributors of water pollution. The result of nitrogen, that comes from manure and fertilizers in agriculture, being washed-off costs US residents approximately $157 billion a year due to the damages it caused in both the environment and human health (Schechinger, 2015). Thus, businesses are trying to increase efficiency in their

use of water. In return, the stakeholders should continuously encourage their local and state politicians to take legislative actions in recognizing and promoting water conservation (Moss, 2017).

II.4. WATER POLLUTION TREATMENT AND ITS STAKEHOLDERS

Having an engaged stakeholder taking part in a water treatment process is very productive. The initiatives that motivates the stakeholders' involvement effort to make changes would often centers around a specific issue. This can be seen as protesting for a regulation in water quality violation to prevent harmful pollutant from entering the waterways (United States Environmental Protection Agency, 2013). The total maximum daily load (TMDL), or a cleanup plan for waters, can be defined as the maximum value of pollutant that is allowed to enter water while still being able to pass the standards to be considered clean water quality. Thus, many watershed groups were formed due to many violations of the TMDL that are occurring the bodies of water around the world (United States Environmental Protection Agency, 2017).

Looking from the groups of stakeholders, it becomes interesting to note the interests of each of the groups about the water pollution and any implications to them. Since society mirrors the macro-environment, it interlinks sub-segments in social, technological, economic and political (Carroll & Buchholtz, 2015). The social environment emphasizes on demographics, lifestyles, culture and social values. From this angle, the wastewater treatment poses an important condition to the society as a way to improve lifestyle, for instance. The economic environment concentrates on the nature and direction of the stage of the economy. For sure, the water pollution in a certain

area will definitely disturb the nature and direction of the economy of the country. The technological environment directs the possible technological-based advancements in the society. In the area where water pollution occurs, certainly alternative solutions toward water treatment becomes eminent. Political environment will likely follow with the policies and laws toward clean water act. Different spectrums on the programs of corporate social responsibilities (CSR) may likely be activated across individuals, organizations and government to ensure the clean water project (Carroll & Buchholtz, 2015). As an additional consideration, Russell & Taylor III (2014) proposed the concepts on organizational capital, information capital, human capital, risk, service, distribution, and products to be internally contemplated along with the interests to and implications of water pollution.

Figure 4: Groups of Stakeholders

Source: (Carroll & Buchholtz, 2015)

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When there is no specific source of the pollutant that is invading the body of water, stakeholder participation is crucial. The Environmental Protection Agency, or better known as EPA (United States Environmental Protection Agency, 2013) believed that stakeholders' involvement is crucial. Thus, stakeholders are beneficial and invaluable when trying to review the water quality criteria, identifying and determining the source of pollutant that are entering waterways, creating and developing strategies to reduce the TMDL, and implementing the respective strategies.

The EPA (2013) stated that the effect of stakeholders' involvement has a positive impact in identifying citizens' values and concerns regarding the environment. This inevitably develop some kind of consensus among the citizens that believes in changes that are occurring in the environment, thus, creating a movement, grassroots organizations, and activist that demand changes to be made. With that said, this will provide and enable efficient and effective possible solutions through an open and inclusive process that includes a diverse range of people, who are pursuing a common agenda (United States Environmental Protection Agency, 2013). Approximately 70% of the cities and communities that are situated in and around the Santa Ana watershed in Southern California were considered disadvantaged (Bureau of Reclamation, 2013). In 2009, the Santa Ana Watershed Project Authority (SAWPA) developed its Integrated Watershed Plan. The plan was created by going to communities that are in disadvantaged and engage with them in order to fulfill the goal of stakeholder involvement to resolve the environmental injustice.

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As a result, many environmental issues were identified in the early stage of the process (United States Environmental Protection Agency, 2013);

- The presence of localized groundwater contamination from previous industrial activities
- Many smaller-sized water companies in lower-income communities lack the financial resources to upgrade the technology required in the water treatment facilities.
- The presence of language barriers and low educational level residents puts many communities at a disadvantage when trying to provide for reliable and factual information regarding any watershed problems (this is due to the high population of Spanish linguist and other immigrant communities).

SAWPA discovered that many residents that are situated in and around the Santa Ana watershed are living in fear of drinking contaminated water. Furthermore, the level of fear ingrained in the communities is so high that many residents were consistently purchasing large bottles of water simply to do basic and essential needs, such as; cooking and drinking water. Thus, the process of integrated and initiating stakeholders' involvement enables SAWPA to identify and address the issue of perceived unsafe water to the residents, hence, families can be informed correctly regarding water consumption. Spending scarce funds to protect themselves from a perceived risk is a key environmental justice issue (United States Environmental Protection Agency, 2013). Stakeholders' contributions are to be recognized so their productivity can gradually increase. In addition, an engaged stakeholders' involvement can increase the likelihood of identifying any potential environmental justice in the surround regions of the watershed (United States Environmental Protection Agency, 2013).

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Regardless of the reasons for conducting any kinds of watershed management activities, involving stakeholders can be very beneficial. Stakeholders' processes often contribute to the reality check for scientific efforts (United States Environmental Protection Agency, 2013). This means that stakeholders often seek to synthesize among competing issues; ecological, technical, social, cultural, political and economic concerns through a process that helps to define what they can and cannot do; know their strengths and weaknesses. The contribution that stakeholders make an effort to protect and understand the watershed management inevitably gave more attention to other factors beyond the watershed itself such as how concerned land is used, what type of vegetative or other cover it has, and how it is managed (United States Environmental Protection Agency, 2013). Thus, in order to receive the desirable outcome requires the involvement of all stakeholders in the surrounding and concerned areas such as the landowners, developers, farmers, urban governments, homeowners, recreational groups and other constituents (United States Environmental Protection Agency, 2013).

II.5. COST-BENEFIT ANALYSIS OF WASTEWATER TREATMENT PLANTS

The cost measurement in implementing water treatment systems is very complex. Incremental cost measurement for water supply and water treatment systems need to be systematically reconsidered for areas not having access. Water treatment systems take two types of costs into account; investment costs and recurrent costs. Investment costs are those that account and cover for the planning construction, housing alternation in surrounding areas as well as the protection of water sources and the educational trainings of employees at the water treatment

facilities. On the other hand, recurrent costs are costs that are used to maintain and operated the water treatment facilities This includes the cost for replacements of parts and any ongoing protection activities that are monitoring the water sources (Hutton & Haller, 2004).

The benefits are inevitably far more advantageous than the costs in terms of healthcare. A large majority of diseases that are contracted is in relation with water-related issues. Cholera, typhoid, malaria, and dengue are all illnesses pertaining to that of water. Water treatment will significantly reduce the amount of threats induced by water-borne, water-washed, and water-dispersed sickness, as they are deemed to be highly infectious (Hutton & Haller, 2004).

Cost-benefit analysis (CBA) is a tool that is utilized to calculate the estimation of the overall benefits and costs of investment (Punttila, 2014). In CBA all the impact that are deemed relevant (both in present and future) will be converted to monetary terms benefits, and costs (Punttila, 2014). This is what capital budgeting is all about, which may be encircling around financing cost, life-cycle costing, replacement cost, and historical cost (Industrial Economics, Inc, 1998). The sum of those figures make-up the cost basis of the assets, which will be depreciated as time progresses. At the end, the total of those figures represents the discounted benefits, costs, and net present values. This will give information on how effective the water protection measures are in the long run (Punttila, 2014).

There are seven steps in cost-benefit analysis (Holquist, 2013; Sartori, et al., 2014): (1) description of the condition to determine the cause of the problem and the circumstances

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surrounding the event, including specifying the program or policy changes that occurred and the current status quo, (2) set framework and objectives, (3) assimilation of the project, which means to choose a plausible solution and project to execute, (4) technical workability & environmental sustainability to determine how long the project can last and whether or not it will have some sort of impact in the environment surrounding the project, (5) financial analysis to analyze the financial situation of the solution, perhaps, by discounting costs and benefits to obtain present values, which means to convert future costs and benefits into present value, (6) economic analysis take into account the opportunity costs of the resources employed and measure the monetary values and benefits of the project, and (7) recommendation to provide assessments on all of the results, determine the amount of possible risks the solution and project will cause and how to reduce them.

To achieve such a goal in developing a wastewater treatment, an activity-based costing appears appropriate as it attempts to allocate costs to processes based on activity. In this case, resources are tied into activities as well as to cost objects. Examples of resources include; labor, time, and capital, which have the monetary implications to make-up the cost structure of the wastewater treatment project. An example of the activity-based costing in mirroring the wastewater treatment project may be structured as follows;

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Table 2: An Example on Budgeting Calculations Concerning the Preliminary Inspection

(Based on the Activity-Based Costing)

Activities	**Required Resources**	**Potential Cost Basis**	**Cost Allocation**		
			Unit Cost (hours)	**Rate**[4] (US$)	**Proposed Cost**[5] (US$)
Pre-Inspection	Initial Assessment (including clerical time for proposals, presentation & lobbying)	Labor & Time	15	7	105
	Initial Inspection (including traveling to/from site, inspection of site, sampling & analysis)	Labor & Time	25	10	250
	Review by Inspector	Labor & Time	10	15	150
	Administration Work (including cost calculation, presentation, project financing)	Labor & Time	20	7	140
Post-Inspection	Managerial Review	Labor & Time	5	20	100
	Data Verification	Labor & Time	10	7	70
				Total Preliminary Inspection	**815**

Source: (Industrial Economics, Inc, 1998), modified

[4] Using the middle rate of Bank Indonesia, which is the Central Bank of the Republic of Indonesia, at Rp. 13,386/US$1 as of July 4, 2017 at 1:24 PM (kursdolar.net, 2017)

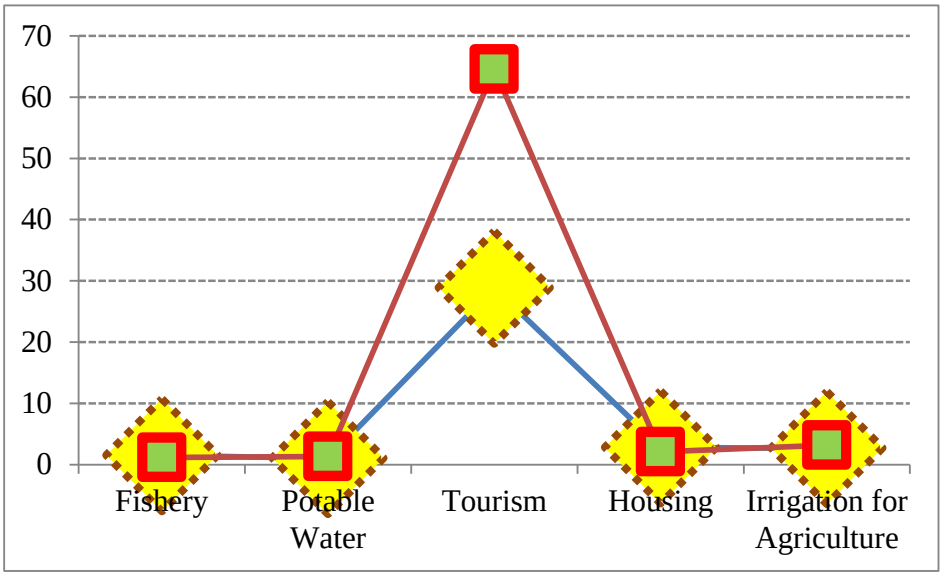
[5] This assumes the averages of the required personnel in handling the various activities. Ideally, the average should be calculated in details by separating chargeable hours for managers, inspectors, clerks, lab technicians, administrative staff, and supporting staff.

In addition to the above suppositional example, there are additional budget to be considered, such as; hardware and software requirement on the wastewater treatment, the potential MIS/IT supports, and expert systems, long-distance and local calls (Industrial Economics, Inc, 1998), whose values are relatively large and may become unfeasible for certain industries or communities.

III. CONCLUSION AND FINDINGS

Not only has water pollution and its treatments have been effectively causing consequences environmentally, socially, and economically, but it has a direct impact to workers' productivities at work. From the potential declining productivity alone, this can potentially cause many organizations millions of dollars in response to the ever-changing environment.

Figure 5: Economic Losses Due to Water Pollution



Source: (Zhang, 2014)

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The potential economic losses, as shown below, also portray troubling conditions. On one side, the increasing flux of tourism is beneficial for the country's economic growth (Zhang, 2014). However, the fact stated that the ever-increasing tourism results in the higher level of water pollution. This is the reason why Graff-Zivin and Neidell (2012) claimed that in general, protecting the environment is typically part of a tax on the labor market and the economy. There is a large amount of evidence that the ozone concentration links environmental problems, especially pollution, with health issues, and the workers' productivity. The presence of heat and sunlight meets with the mixtures between nitrogen oxides (NO_x) and volatile organic chemicals (VOC) influences the earth ozone (Graff-Zivin & Neidell, 2012). Hence, since health in of itself is widely considered as an important asset of human capital, efforts need to be made in order to reduce pollution. This can be seen as a plausible investment and even more, can be viewed as a tool to promote the economic development and growth of a country (Graff-Zivin & Neidell, 2012). Additionally, pollution not only will have an effect on the health of the residents of the concerned areas, but it can consequentially have a substantial amount of monetary value being put to water treatment projects and ultimately the ones who will end up being charged for the treatments are the citizens themselves. Aside from the costs of installing the water treatment and the relevant maintenance costs on the water treatment, the contributing costs from other sources of water pollution should also be heavily considered. Such considerations should be compared to potential benefits, including cost-savings on the environmental clean-ups, tax levies, workers' productivity, societal indulgence. Undoubtedly, managerial audit and financial audit may have to be in-placed to ensure the good governance of the public officers and residents.

Ultimately, it comes down to the stakeholder's personal values (Setio & Anantadjaya, 2014) whether or not they are willing to contribute in ensuring the sanitation of the water systems. In the view of the fact that conclusively means if stakeholders are not maintaining the stability and cleanliness of the water facilities, they are the one who are effected the most from financially, economically, clinically, and environmentally.

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