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Cibodas Biosphere Reserve-Ciliwung River Basin: Role And Problems Related To Eco-DRR Management In Indonesia

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Abstract
Floods are serious hazard in Indonesia. A number of 118 flood disasters were recorded between 1980 and 2010. In the beginning of January 2014, during two weeks, the Capital City of Indonesia, Jakarta, and outlying areas have experienced continued rains causing river overflows and inundation. Thousands of houses, buildings, and roads were flooded. Approximately 134,662 persons or 38,672 households in 100 urban villages were directly affected by the flood. At least 62,819 persons were displaced and sheltered in 253 displacement centers. Telephone lines and electricity networks were disrupted. Floodwaters blocked some major roads. Flood water levels varied from 0.2 m up to 1.2 m and were at around 2 m at the river banks. Flood disaster as an environmental hazard are influenced by many factors including change in climate, and socio economic development. Prolonged and intense rainfall, an increasing amount of runoff, and human activities are considered to cause flooding in this country. The section of Ciliwung in Jakarta is heavily polluted. Informal settlements or slums flourished on the banks of Ciliwung, increasing the amount of waste and reducing the surface area of the river. Some canals were completely blocked by slums and people created informal gardens inside by drying the canals. Water maintenance and ecological awareness are minimal. With many of the original forest converted into settlements within the watershed area, flooding is experienced annually. The Cibodas Biosphere Reserve includes Gede and Pangrango Mounts National Park and Botanical Garden. It is an upstream area to the city of Jakarta and has played an important role to conserve water and control flooding of Ciliwung River Jakarta. Ciliwung, the main river flows into a densely populated area in Jakarta. The catchment area is around 337 km^2 with 110 km length of river. The average annual rainfall is 2,500 mm. Ecosystem-based disaster risk reduction (Eco-DRR) is very needed to be implemented in the Biosphere Reserve integrated management, i.e.: in the ecosystem of mountain forests, includes vegetation on hillsides; wetlands, riverbank coastal and dry land ecosystems. It will emphasis on investments in sustainable development, especially in the prevention phases or conservation.

INTRODUCTION

Indonesian Profile

Indonesia is a tropical archipelago country, comprising thousands of islands. The country has around 5,200 km lenght, 17 thousands islands, located between 5° North and 10° South of Equator, with 24-33°average temperature (Indonesian Geospacial Information Agency: www.bakosurtanal.go.id). The population is estimated at over 252 million people, making it the world's fourth most populous country. The Indonesian economy is the world's 16th largest by nominal GDP. Despite its large population and densely populated

regions, Indonesia has vast areas of wilderness that support the world's second highest level of biodiversity. The country has abundant natural resources, yet poverty remains widespread. The iIndonesian Economy has grown strongly since 2010. GDP real growth rate was 5.3% in 2013, 6.2% in 2012, and 6.5% (2011 est.), with GDP - per capita (PPP) at US$5,200 (2013 est.), US$5,000 (2012 est.), and US$4,800 (2011 est.) (Index Mundi, Indonesia Economy Profile 2014). Indonesia and the Philippines. including some of the most dynamic and rapidly improving economies in terms of competitiveness (Busso *et al.,* 2012). However, the Indonesian Performance Index ranks Indonesia 112 of 178 countries. It is far behind the developed countries EPI, with the top 10 rank are remain dominated by a number of European countries (Performance Index. Yale University. http://epi.yale.edu).

Indonesian Biodiversity

Indonesia is known as a country with a megadiversity of biological species as well as acenter for world biodiversity. Indonesia has 10% of world's flowering plant species, 12% of world's mammal species, 16% of world's reptile and amphibian species, 17% of world's bird species, 25% of world's fish species, 15% of world's insect species. Indonesia's forest and marine harbor a vast biodiversity: Almost 30,000 plants of herbal medicine; Appr. 7,000 species known and have been used for medical purpose; About 250 species used in the traditional; herbal medicine, Jamu, industries (National Development Planning Agency of Indonesia, 2014).

Problem statement: flooding in Jakarta

Indonesia is known as one of the most vulnerable countries to flooding (National Development Planning Agency of Indonesia, 2006), which is its most frequently occurring hazard with 118 flood events in the period between 1980 and 2010; and 66 flood events in the period between 2000 and 2010 (Center for Excellence in Disaster Management and Humanitarian, 2011).

As recently as January 2014, Jakarta (population: 9 million) and outlying areas experienced a large flooding event which lasted for two weeks, after continued rains caused river overflows and inundation. The Provincial Agency for Disaster Management (BPBD) DKI Jakarta reported that approximately 134,662 persons or 38,672 households in 100 urban villages were directly affected by current floods. Twelve casualties were recorded. At least 62,819 persons were displaced and sheltered in 253 displacement centers. Floodwaters blocked some major roads. Flood water levels varied from 0,2 m up to 1,2 m and around 2 m at the river bank. National response was mobilized. The Government of Indonesia indicated that it has the capacity to respond to both short and longer term needs created by the floods and also welcomed technical assistance from the international community in the country, particularly for relief aid logistic management.

Ciliwung river basin

Ciliwung river flows from the Puncak highlands to the south of the city, across the city northwards towards the Java Sea; the Ciliwung river, divides the city into the western and eastern principalities (Figure 1). Other rivers include the Pesanggrahan, and Sunter high sea tides. Other contributing factors include clogged sewage pipes and waterways that service an increasing population, in addition to deforestation near rapidly urbanizing Bogor and Depok in Jakarta's hinterland. It has a catchment area of 476 km^2. The Ciliwung river has its source at Mount Mandalawangi in Bogor Regency with the highest peak at 3,002 m. The river flows in a northern direction passing several active volcanoes (Mount Salak, Mount Kendeng, and Mount Halimun), crosses two main cities (Bogor and Jakarta) before flowing into the Java Sea through the Jakarta Bay. The main tributaries in the upper catchment area are the Ciesek and Ciluar rivers with respective lengths 9,7 km and 21,0 km, with catchment areas of 27,15 km^2 and 35,25 km^2 respectively. The 17,2 km length of the upstream area has

a very steep slope 0,08 %, the 25,4 km length in the middle-reach has a slope of 0,01 % and the downstream, 55 km in length, has a flat slope of 0,0018 %. Mean annual rainfall reaches 3,125 mm, with mean annual discharge of 16 m^3/s as measured at Ciliwung Ratujaya observation station (231 km^2) (Subagiono and Tanaka (2010)). With such topographical, geological and hydrological features the Ciliwung river is often overflowing and inundating parts of Jakarta, including intense flooding in 2013 and 2014. The population along the Ciliwung river basin reaches 4,088 million (Census 2000) which can be regarded as the most densely populated area.

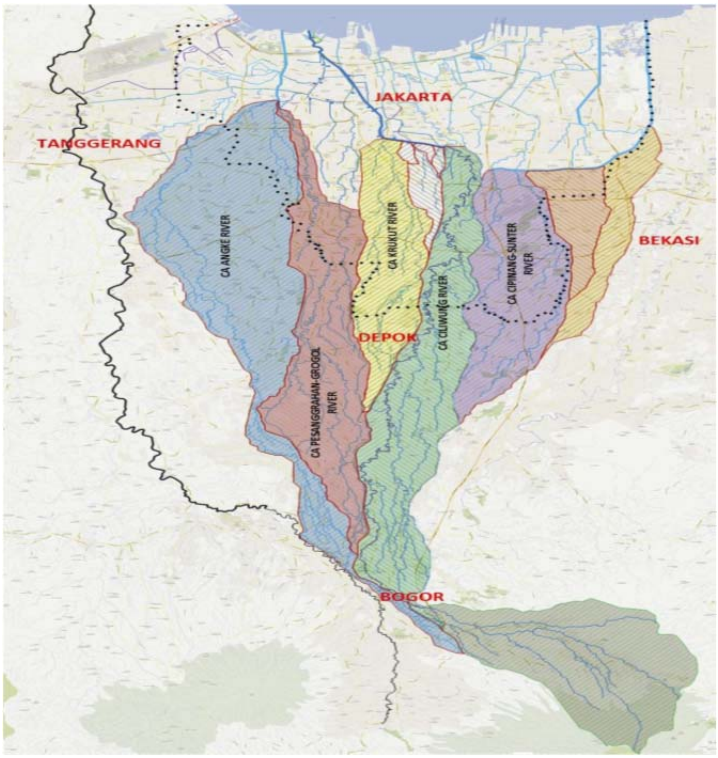

Figure 1. Ciliwung River Basin, Indonesia (Source: Pemda DKI Jakarta, 2013)

Cibodas Biosphere Reserve-Mounts Gede Pangrango National Park

Mount Gede Pangrango National Park is a national park in West Java, Indonesia. The park is centred on two volcanoes—Mount Gede and Mount Pangrango—and is 150 km² in area. It evolved from already existing conservation areas, such as Cibodas Botanical Gardens, Cimungkat Nature Reserve, Situgunung Recreational Park and Mount Gede Pangrango Nature Reserve, and has been the site of important biological and conservation research over the last century. In 1977 UNESCO declared it part of the World Network of Biosphere Reserves (www.dephut.go.id).

Topography and ecology

Mount Gede (2,958 m) and Pangrango (3,019 m) are twin volcanoes. The two summits are connected by a high saddle known as Kandang Badak (2,400 m). The mountain slopes are very steep and are cut into rapidly flowing stream, which carve deep valleys and long ridges. Lower and upper montane and subalpine forests are within the park and have been well

studied. To the north of Mount Gede is a field of Javanese Edelweiss (*Anaphalis javanica*). The park contains a large number of species known to occur only within its boundaries, a result of an intensive amount of research over many years (www.dephut.go.id).

Cibodas Biosphere Reserve

Biosphere reserve is a concept of site management to harmonize the needs for biodiversity conservation, socio-economic development & logistic support, the concept created by the UNESCO Man and the Biosphere Program in order to promote a balanced relationship between human and the nature. Main Characteristics of Biosphere reserves: Achieving the three interconnected functions: conservation, development and logistic support. Since 1972 Indonesia Implement the program, for which the Indonesian Institute of Science (LIPI) is a national focal point Cibodas Biosphere Reserve: Maintenance of ecosystem diversity and establishment of beautiful landscape to serve millions of people (Purwanto, 2014) (Figure 2).

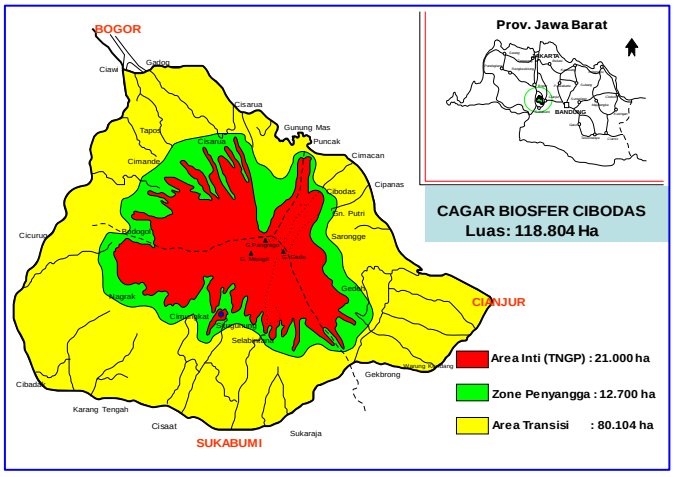

Figure 2. Cibodas Biosphere Reserve, Indonesia (Source: J. Purwanto-MAB & Herry Subagiadi-Cibodas National Park)

This paper would like to answer the following questions: (1) why flooding regularly occurs on an almost annualbasis in such megapolis city as Jakarta? (2) what driving factors aggravate the flood disaster in this area? (3) what steps can be taken to prepare for worsening floods? (4) how to solve or reduce the flood and its impact?

METHODS

Our paper was written according to observation in the field, discussion, and literature review. Observation was carried out in the check point area of Ciliwung river basin, in the upstream, modle stream, aand donstream. Disscusion was consudted trhough Forum Group Disscusion with stakeholders (Government, Universities, Social Communities, Private Sectors). Study was started with Scientific Workshop Including the 9th meeting of the Expert Working Group on Measuring Vulnerability, Development Pathways for Urban and Rural Coastal Zones organised by United Nations University (UNU), the Indonesian Institute of Sciences (LIPI), International Center for Interdisciplinary and Advanced Research (ICIAR), the Bogor Botanical Garden, and held in Indonesia, 12 - 16 July 2012. This was followed by First International Workshop '*Climate and Societal Change in Coastal Areas in Indonesia and*

South East Asia' February 19-22, 2014, Jakarta, Indonesia, Organized by UNU, Franzius Institute, LIPI ICIAR.

In 2013, the United Nations Environmental Programme (UNEP) and Center for Natural Resources and Development (CNRD) based at the Cologne University for Applied Sciences (CUAS), Germany jointly developed a master's module "Disasters, Ecosystems and Risk Reduction", which is currently being implemented in a number of universities around the world. The course is structured in four main blocks: (1) it linkages between ecosystems, disaster risk reduction, and resilience; (2) it linkages between climate change, disasters and ecosystem-based adaptation; (3) ecosystem management approaches/tools in reducing disaster risk and adapting to climate change impact; and (4) mainstreaming Eco-DRR/CCA into development policy, plans and strategies (UNISDR, 2013).

To continue this programme, PEDRR/CNRD/LIPI/UNORCID organized an International Science-Policy Workshop conducted in Bogor, Indonesia, 16-18 June 2014 , and a Global Training of Instructors Ecosystem-based Disaster Risk Reduction and Climate Change Adaptation (Eco-DRR/CCA) 19-21 June, 2014, at the same venue . The course module, Teaching module, and Case study and exercise had already been prepared (Nehren *et al.* 2013; Nehren *et al.* 2014a and 2014b).

We use ecosystem services (provision, supporting, regulation and cultural fungtions) approach to know how far Eco-DRR has already be impelemented in the Ciliwung river basin management (Renaud *et al*., 2013; Estrella & Saalismaa, 2013; Sudmeier-Rieux and Ash, 2009; Sudmeier-Rieux *et al*., 2013)

RESULTS

Jakarta Flooding: Natural and social driving factors

Major flooding in Jakarta, occured in 1621, 1654 and 1918, than in 1976, 1996, 2002, 2007 and 2013 (Pemda DKI Jakarta, 2013). Jakarta is probably the best example of how challenging it is to attempt to lower the disaster risk of flooding. Jakarta Metropolitan City as the capital of the Republic Indonesia is the country's economic power house. However, it is very prone to flood disasters from annual floods and five-year inundation. Ciliwung and 12 other rivers estuary to Jakarta Bay (Figure 3).

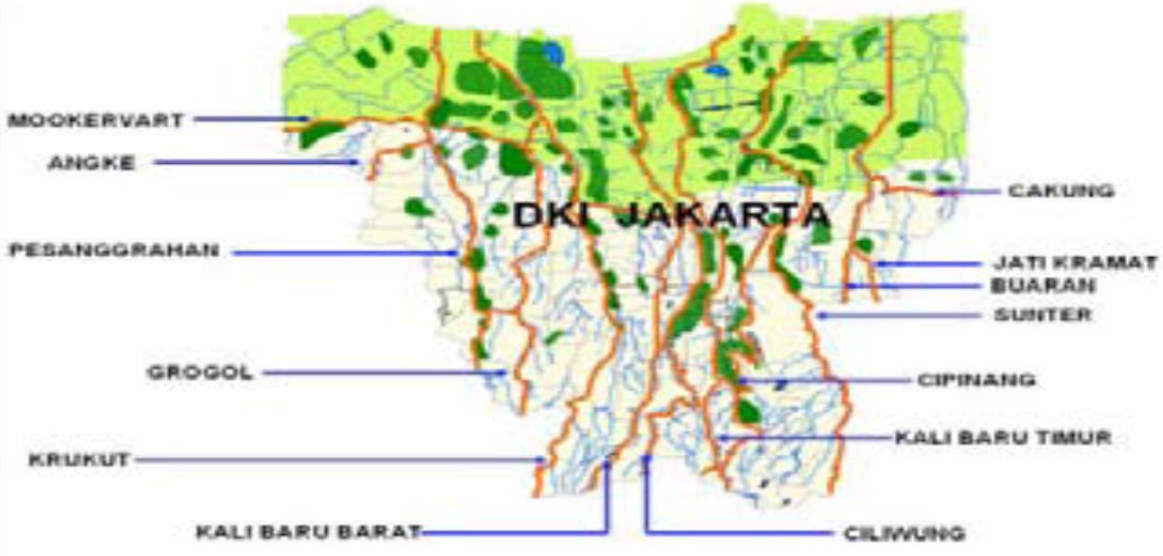

Figure 3. Jakarta's 13 rivers (Source: MercyCorps In: ADPC, Asian Disaster Preparedness Center, 2010)

1. Increasing population pressure. The capital city of Jakarta (DKI Jakarta), as the core of Jabodetabek, is home to nearly 9.6 million people, according to the 2010 census, a sharp increase from 8.4 million in 2000, with a growth rate of 1.40 percent per year. The population of Greater Jakarta Metropolitan Area, comprised of DKI Jakarta, Bogor, Depok, Tangerang and Bekasi (Jabodetabek), reached 27.9 million according to the 2010 national census, with a growth rate of 3.6 percent per annum over the period 2000-2010 (BPS Stastitics of Indonesia, 2011; Tommy Firman, 2011).
2. Uncontrolled construction. The economic growth of Jakarta was accompanied by the uncontrolled construction of high buildings that cemented the downstream area thereby reducing infiltration of surface water into the ground.
3. Ground water extraction, the weight of the built-up area pressing upon the land, as well as subsidence due to geologic processes.
4. Land subsidence (10 cm/year or more) of areas already under above sea level lead to an autonomous increase of flood risk. The area of the Jakarta Special District is 662 km^2 of land area and 6,977 km^2 of sea area. Jakarta lies in a low, flat basin, averaging 7 metres (23 ft) above sea level; In 2010, Jakarta has reached 58% are under mean sea level, which means it is prone to flooding from upstream and high tides. Land subsidence. During 36 years, land subsidence in north Jakarta area has reached 4 m (1974 to 2010) (Pemda DKI Jakarta, 2013).
5. Excessive rainfall and flash floods along the rivers systems that pass through the mainland, inundated some the Jakarta mainland area and paralyzed life in many places.
6. Part of the reason has to do with geography. Indonesia is in the tropics, stretching from 6°08' N latitude to 11°15' S latitude. It gets year-round rainfall from the warm water surrounding the world's largest archipelago, with additional rainfall coming from climate phenomena such as the Asian monsoon, the Australian monsoon, the Inter-Tropical Convergence Zone, and the El Niño/La Niña Southern Oscillation (ADPC, 2000).
7. In the monsoon season, any coastal inundation is often aggravated by waves that could reach up to 2 to 4 m during storms. Other influences on inundation include sea level rise, land subsidence, and high tide during full moon (locally called *rob*).
8. Jakarta is the estuary of the 13 rivers. The total area of Jakarta is 661 km^2, which is traversed by 13 rivers that pass in 2 provinces and that rivers have an catchment area area of 850 km^2. The city's southern and eastern sections consist of lake and swamp land with a total area of 121.49 hectares (in 2006) used as a water reserve. Its 27 water systems are comprised of 13 rivers, drains and canals that collects surface run-off exits into Jakarta Bay through Jakarta's 35-km coast.
9. Changes in land use (for residential and industrial). The rapid rate of population growth in Jakarta and buffer zones must be balanced with the rate of residential growth. Of the vast amount of land up will certainly affect the rate of surface runoff.
10. The other part of the potential for disaster comes from the vulnerability of settlements located in high-risk areas.
11. Waterways have also been clogged by solid waste from riverbank communities both from within Jakarta and the upstream provinces of Bogor, Depok and Cianjur.
12. Illegal setlement at the river bank and catchment area. In some rivers there has been narrowed and sedimentation so that the capacity is reduced.
13. Causes – rainfall & climate change. The long rainfall records show that statements about climate change being the cause of the floods problems cannot be proven with the current available data.

Flood assessments, and the East Canal Flood Project had already designed in 1918 by a Dutch engineer, Herman van Breen to form a semi-circular system with the West Canal for

accommodating the runoff from the 13 major rivers (Pemda DKI Jakarta. 2013). Then a Master Plan for Drainage and Flood Control of Jakarta developed in 1973.

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Cibodas Biosphere Reserve

*Potential of National Park (*van Steenis, 2006; Forpela, 2006; IUCN, 2009)

1. The Indonesian national park Gunung Gede Pangrango protects watersheds which supply Indonesia's capital Jakarta with its freshwater;
2. Gunung Gede Pangrango National Park protects valuable examples of primary rain forest in West Java, with submontane and montane tropical rain forest covering the most extensive area. It includes two twinned volcanoes and mountainous rain forests with many Javan endemic species.
3. Some the main rivers flowing from Gunung Gede National Park eventually contribute to the Ciliwung River, the Citarum River and the Kali Angke River, Jakarta's main water suppliers.
4. Mount Gede Pangrango National Park area has a lot of potential, particularly as a supplier for fresh water.
5. Jakarta's urban water supply comes mainly from the Ciliwung River and the Jatiluhur reservoir on Citarum River, located about 65 km southeast of Jakarta located within Gunung Gede Pangrango National Park.
6. Generates 4.341 billion Rupiah (roughly USD$430,000) per year for drinking water and local agricultural purposes
7. The source of 3 river/watershed areas including Cimandiri, Ciliwung, and Citarum, and the largest source of raw water for Greater Jakarta.
8. Regulates water flow and water supplies, improves water quality, reduces erosion, and mitigates flood disasters
9. Primary forest area with high biodiversity value: 260 bird species (home to 57% of all birds from Java and Bali), 103 mammal species, 4 primates (Propela)
10. It has been estimated that the 60 or more rivers flowing from the park provide water worth US$1.5 billion for domestic and agricultural uses.
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*Problems of National Park (*van Steenis, 2006; Forpela, 2006; IUCN, 2009)

1. This valuable water source has been threatened by unsustainable environmental practices by farmers and local land stewards, causing erosion, a depleted water source, and reduced water quality.
2. The impact of various human activities on the core area is growing due to tourism development and increasing population density in the surrounding areas. Current levels of deforestation result in flooding equal to 21,000 trucks with 5,000 liter capacity (Forpela).
3. Land Use Changes, some legal and illegal encroachments
4. Water Level Fluctuation (water level fluctuation ratio more than 100)
5. Water Quality polluted from upstream to downstream (chemical agriculture practice, solid waste from garbage and cattle etc)
6. Land degradation is causing erosion and sedimentation (steep slopes, land clearing, runoff and erosion increasing).
7. Social conflict (occupation of conservation area for any activities at times conflicting with revegetation government program, trees adoption etc).

Management of National Park

Management of Cibodas Biosphere Reserve, Gede Pangrango National Park consisted of: Increased commitment among stakeholders in the Cibodas Biosphere Reserve Area;

Formulated Re-Zoning of CBR; Developed Integrated Management Plan of CBR; Management guideline for Core area, Buffer and transition zone; Established Institutional arrangement of CBR; Inprove Core Area Management Guidelines; and develop Buffer Zone and Transition Area Management Guideline (Purwanto, 2014).

Integrated Management Ciliwung River Basin

Some national policies have been delivered to publics, are:

1. Government distribute Indonesian Healthy Cards and Indonesian Smart Cards to the low economic people, to insure that they will get health services and have a chance to study;
2. A new Precident, Joko Widodo leads his cabinet with new paradigm 'work-work and work', and direct inspection, or check on the spot to some government programs and policies;
3. Government merge State Minister of Environment and State Minister of Forestry, that it is hoped to give a good implication to protect and conserve the natural resources (water, forest, flora and fauna);
4. Government introduced State Minister of Marine that its task is more empazise to protect and use the natural resources in the sea, and develop fisheries;
5. Government has program of food reliance in the three year future.
6. To support his programme, Government will change people subsidies, from premium subsidize to productive subsidize (agriculture and marine programme).

Related to regional policies, the Jakarta Governor has implemented some programs, are:

1. Normalization of rivers and water reservoirs. It is included dredging of sediment, cleaning garbage, moving illegal settlement in the side of river and reservoirs;
2. Develop a great sea wall in the North of Jakarta Bay to protect the city from sea water. Though, it is debatable, because of its impact to habitate change and biodiversity lost.
3. Jakarta Regional Government developes coordination with other sorounding regional government. For example: assist funding for Bogor regional government for regreening the degraded area, and move illegal settlement in the Ciliwung catchment area.
4. Develop some dams and small reservoir to flood control and water conservation.
5. It has been developed in some years ago a biophory to conserve water and organic fertilizer process in family scale;
6. Monitoring water quality a long Ciliwung river already carried out by Minister of Environment, and monitoring biodiversity status in the Ciliwung river basin by Research Center for Biology, the Indonesian Institute of Sciences (LIPI);
7. Some non government organizations and people communities already participated to protect Ciliwung River;
8. Ciliwung Restoration Program, and Ciliwung water treatment.
9. Early warning system has already been implemented, to monitor the rainfall and water level in the upper area, and send it to the middle and downstream areas.

CONCLUSIONS

Flood disasters threat Jakarta and its sorounding area, and took place almost every year, that have a serious impact to the social, economic and environmental problems. The problems caused by some complicated and interrelated aspects, such as social , economics,

environment. Some programs and efforts related to Eco-DRR has already been done by the national and regional government to integrate Ciliwung river basin management. Eventhough, it often works sectorally and partially, and has not achieve an optimum target yet. Cibodas Biosphere Reserve-Gede Pangrango National Park that the location in the catchment area of Ciliwung, has important role in the integrated water resource management. It is not only has the main fuction to conserve flora and fauna diversity in the core area, but also more important to develop program related to community development in the buffer zone and transition area. Coordination and impelementation are a weak point of Eco-DRR development program in Indonesia. To implement a good program needs a strong leader, discipline, consistency, and implementation of law inforcement.

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