Study on Implementation of
Integrated Spatial Plan for
The Mamminasata Metropolitan Area

SECTOR STUDY (3)

# ENVIRONMENTAL STUDY

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# 1. PRESENT ENVIRONMENTAL CONDITION

## 1.1. Natural Environment

### 1) Physical Condition

(1) Topography and Geology

(i) Topography

The Study area is located in the southern part of South Sulawesi, encompassing Makassar city, Maros regency, Gowa regency and Takalar regency. The mountain ranges extend to the east of Study area and the Makassar strait unfolds on the west side with many coral reefs and islands. The plain located between the mountain area and the strait is almost flat. 5 major rivers, Maros, Tallo, Jeneberang, Gamaniti and Pappa river are running down in the Mamminasata area.

Topographic conditions are classified into 5 types. Flat area has the widest land coverage (59.42% or 139,285.53 ha). Flat area is mostly found in Makassar city, Takalar regency and downstream of Maros regency. Steep slope area covers only 1,388 ha or 0.59% of the total land. Slightly steep area extends to the east of Gowa regency. The topographic condition is summarized in the following table.

**Table 1.1: Topographic Characteristic of Study Area**

| No. | Slope (%) | Topography | Area (ha) | Ratio (%) |
|---|---|---|---|---|
| 1. | 0 – 8 | Flat | 139,285.53 | 59.42 |
| 2. | 9 -15 | Slightly slope | 19,845.55 | 8.47 |
| 3. | 16 – 25 | Slightly steep | 10,012.53 | 4.27 |
| 4. | 26 – 40 | Steep | 1,388.70 | 0.59 |
| 5. | > 40 | Very steep | 63,877.68 | 27.25 |

A greater part of the plain has gentle undulation ranging from 5 to 40 m in height. A marine terrace, which is generally a component of the coastal plain, is not distributed. Laterites and soils cover the basement rocks in thin layer, and outcrops of basement rocks are observed everywhere. The flat plain is presumed to be a peneplain formed by lateral erosion of rivers.

The flat land between Makassar city and Takalar is an old flood plain of the Jeneberang river formed in an age of the Late Quaternary. In the vicinities of river mouths and along the seacoast, small sandbars and swamps are distributed. Gowa regency is almost covered with hills and mountains, while Maros regency consists in the flat and mountainous land.

(ii) Geology

The basement rocks in Mamminasata are composed of the following formations:

- Lagi Volcanic (propylitized volcanic rocks)
- Tonasa Formation (limestone, marl)
- Camba Formation (sedimentary rocks, volcanic rocks)
- Baturape-Cindako Volcanic (basaltic volcanic rocks)
- Intrusive Rocks (dolerite, diorite, basalt, etc.)
- Quaternary sediments (old flood plain deposit, etc.)

The Lagi Volcanics is the oldest rock exposed in the Study area. It is a propylitized volcanic rock formed at Paleocene, and found in a limited area in the upstream of the Maros river. The Tonasa Formation is the second oldest rock consisting of limestone and marl. It is observed around the right tributary (Bantimurung river) and the middle reaches of Maros river (mainly limestone), and the peneplain lying along the coast between Takalar and Jeneponto (mainly marl interbedded with thin limestone), with more than 1,000 m in thickness. In the Bantimurung area and part of the middle reaches of Maros river, many calcareous cavities are developed in this formation. Rainfall in the mountain area may be stored once in these cavities, and then flow out the rivers. Therefore, rivers have a general tendency that their flow does not rapidly increase even with heavy rain. The Tonasa Formation along the south coast between Takalar and Jeneponto is different from the one distributed around Maros river basin. It is mainly composed of soft marl, with less calcareous caves. Under such a geological condition, river flow is influenced by rainfall intensity.

The Camba Formation is sedimentary rocks consisting of tuffaceous sandstone interbedded with tuff, siltstone and volcanic rocks. The Baturape-Cindako Volcanics formed at Pliocene is basaltic volcanic rock consisting of lava and pyroclastic rock interbedded with tuff and sandstone. It is distributed to overlie the Camba Formation around Cindako and Baturape mountains. The Camba Formation and the Baturape-Cindako Volcanics are widely distributed in the mountainous areas and peneplains. These stratums have low porosities and their permcability is small. They have low capacity for reserving water.

The intrusive rocks are distributed within the host-rock formed in an age from the Eocene to Pliocene. The rocks range from basalt through dolerite, diorite, gabbro to diabase. In general, all rocks are hard and less permeable. However, in some cases, basalt dike shows high permeability due to many open cracks.

(2) Soil Condition

Physiographic condition in Mamminasata shows that soil, are quite various. According to the land system map published by ReProT (1990), Mamminasata has 4 soil types; i.e., (i) Entisol, (ii) Inceptisol, (iii) Mollisol, and (iv) Ultisol.

The following table illustrates the type of soil in Mamminasata based on the existing

Soil Map (LPT, Bogor, 1968). As seen in the table, Inceptisol covers the widest area (163,200 ha) while Entisol has the smallest coverage (only 8,780 ha or 3.75% of total width).

**Table 1.2: Soil Types in Study Area**

| No. | Type of soil | Area (ha) | Ratio (%) |
|---|---|---|---|
| 1. | Entisol | 8,779 | 3.75 |
| 2. | Inceptisol | 163,200 | 69.63 |
| 3. | Molisol | 28,164 | 12.01 |
| 4. | Ultisol | 34,266 | 14.62 |
| | Total | 234,409 | 100.00 |

Source: Analysis results with GIS

The main constituent of the Quaternary sediments in Mamminasata is the old flood-plain deposit of the Jeneberang river. The deposits range from clay to sands, gravels and boulders. Since the Jeneberang river course was frequently changed, flood plain deposits are widely distributed from the south of Makassar city to the neighborhood of Takalar. Other Quaternary sediments are sand and gravel on river terraces, mud in swamps, and other.

(3) Groundwater

Excellent aquifer of groundwater is found widely. The alluvial plain and limestone mountainous area are promising for groundwater resources. Especially, the new underground-river is found out recently in Bantimurung area and it is expected for the future resource of domestic water supply.

In Makassar city, shallow groundwater in the sandbar could be used. However, as the result of rapid urbanization, water is being contaminated gradually. The residential people in rural areas utilize practically the shallow groundwater for daily use. These wells are hand dug wells. On the other hand, saline (brackish) water is found in Takalar and the coastal region, and the deterioration of groundwater is noticeable.

Groundwater has been utilized for irrigation of paddy field and cultivation of vegetables until the completion of the irrigation system.

**(PDAM's groundwater well in Takalar)**

**(watering for healthy vegetables)**

**Table 1.3: Results of Groundwater Quality Analysis in Study Area (rainy season)**

| Parameters | National Standard for Drinking Water (No.907-2002) | Unit | Well Water (ground water quality) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2006/2/11 | | | | | | | | | | | |
| | | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| | | | Maros Regency (MW.1) | Maros Regency (MW.2) | Maros Regency (MW.3) | Maros Regency (MW.4) | Gowa Regency (GW.1) | Gowa Regency (GW.2) | Gowa Regency (GW.3) | Gowa Regency (GW.4) | Takalar Regency (TaW.1) | Takalar Regency (TaW.2) | Takalar Regency (TaW.3) | Takalar Regency (TaW.4) |
| **Physical :** | | | | | | | | | | | | | | |
| Temperature | ±3℃ | ℃ | 29.5 | 28.4 | 29.5 | 28.6 | 28.4 | 29.9 | 29.3 | 28.3 | 29.0 | 30.5 | 30.8 | 29.5 |
| Color | 15 | TCU | 1 | 1 | 5 | 1 | 1 | 1 | 1 | 1 | 3 | 1 | 2 | 5 |
| Total Suspended Solid (TSS) | 1,000 | mg/l | 5.53 | 5.53 | 4.78 | 4.86 | 6.45 | 6.05 | 7.1 | 6.56 | 6.45 | 4.25 | 5.27 | 5.35 |
| **Chemical** | | | | | | | | | | | | | | |
| pH | 6.5-8.5 | - | 7.1 | 6.8 | 6.9 | 6.8 | 5.5 | 6.0 | 5.4 | 6.3 | 6.5 | 6.4 | 6.6 | 6.9 |
| $BOD_5$ | (-) | mg/l | 1.41 | 0.76 | 1.08 | 0.93 | 0.78 | 1.50 | 1.27 | 0.87 | 0.90 | 1.09 | 0.89 | 1.06 |
| COD | (-) | mg/l | 4.95 | 1.96 | 2.79 | 1.97 | 1.93 | 4.09 | 4.37 | 2.01 | 2.01 | 3.05 | 1.24 | 2.39 |
| Disolved Oxigen (DO) | (-) | mg/l | 6.2 | 6.2 | 6.35 | 6.24 | 5.1 | 5.1 | 5.0 | 6.31 | 6.2 | 6.30 | 6.15 | 6.1 |
| Phosphorus (P) | (-) | mg/l | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt |
| Nitrate ($NO_3$-N) | 50 | mg/l | 0.22 | 22 | 0.23 | 0 | 0.43 | 0.25 | 0.45 | 0.31 | 0.29 | 0.15 | 0.24 | 0.022 |
| Amonium ($NH_3$-N) | 1.5 | mg/l | 0.008 | 0.008 | 0.013 | 0.007 | 0.021 | 0.021 | 0.20 | 0.021 | 0.009 | 0.006 | 0.014 | 0.09 |
| Arsenic (As) | 0.01 | mg/l | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt |
| Cadmium (Cd ) | 0.003 | mg/l | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt |
| Chromium ($Cr^{6+}$ ) | 0.05 | mg/l | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt |
| Lead (Pb) | 0.01 | mg/l | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt |
| Mercury (Hg) | 0.001 | mg/l | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt |
| Mineral oil | (-) | mg/l | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt |
| Detergent | 0.05 | mg/l | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt |
| Phenol compounds | (-) | mg/l | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt | tt |
| **Bacteriology :** | | | | | | | | | | | | | | |
| Fecal Coliform | 0 | MPN/100ml | 1 | 2 | 2 | 2 | 3 | 2 | 4 | 1 | 15 | 0 | 1 | 2 |
| Total Coliforms | 0 | MPN/100ml | 20 | 20 | 45 | 35 | 50 | 50 | 20 | 30 | 100 | 10 | 25 | 30 |

Source : Mamminasata JICA study team data Year 2006

### (4) Flora and Fauna

The biodiversity of Sulawesi island is remarkable. A lot of endemic species of flora and fauna are found in the mountainous region, especially in *Bantimurung* and *Bulusaraung* National Park of Maros regency.

As a world class butterfly valley, Bantimurung National Park should be conserved. A survey conducted by Hasanuddin University registered 270 species of butterflies (according to another report, only 143 species are still alive). Butterflies may decrease by the environmental deterioration, use of insecticides and illegal collection in the sanctuary.

**(Graphium androcles)**

The estuary of the Tallo River is an inundation area with fish and shrimp ponds. The inhabitants living in the scattered areas in the estuary form their own community groups. Their life style is self sufficient with minimum loads on the environment. The estuary has maintained an abundant natural environment with mangroves and nipah palms.

The endemic flora and fauna are scarcely found in the other areas, i.e. urban, cultivation and hilly areas near the residence.

In the Makassar strait, a number of small islands are scattered, where the good natural and/or precious aquatic environmental condition have been kept. These

islands can be accessed only by boat, and have the genuine coral reefs that never been touched by human beings.

**（park in Makassar city）**

**（coral sea around island）**

(5) Landscape

The widest area of landscape categories in Mamminasata is flat plain compassed of flood plain of Maros, Tallo and Jeneberang river. The village and surrounding green area is scattered like islands among the paddy fields. Such rivers run meandering among the pastoral landscape.

Landscape of the Bantinurung region in Maros is worthy of mentioning. This mountainous area is formed by limestone, with precipitous rocky mountains. The waterfalls and caves are scattered, e.g., Bantinurung Waterfall and Dreaming Cave.

**Limestone mountain area in Bantimurung region**

### 2) Conservation of Natural Resources

Natural resources cover (i) designated natural conservation areas, (ii) forestry area in the upper river basin, and (iii) small islands and limited coastal zone. These conservation areas should be preserved in Mamminasata.

(1) Designated Natural Conservation Areas

Four natural conservation areas in Mamminasata are listed on the following table and figure.

**Table 1.4: Summary of Conservation Areas in Study Area**

| No | Name of Conservation Area | Administrative Location | Size (ha) | Decree for establishment |
|---|---|---|---|---|
| 1 | Bantimurung and Bulusaraung National Park (*Taman Nasional*) | Maros regency. Pangkep regency | 43,750 | Decree of the Minister of Forestry No. 398/Menhut-II/ 2004 |
| 2 | Komara Wildlife Reserve (*Suaka Margawatwa*) | Takalar regency | 2,972 | Decree of the Minister of Forestry No 147/Kpts-II/1987<br>Decree of the Minister of Forestry No. 911/Kpts-II/1999 |
| 3 | Malino Recreational Park (*Taman Wisata Alam*) | Gowa regency | 3,500 | Decree of the Minister of Forestry No 420/Kpts-II/1991 |
| 4 | Komara Hunting Game Reserve (*Taman Buru*) | Takalar regency | 9,780 | Decree of the Minister of Forestry No. 147/Kpts-II/1987<br>Decree of the Minister of Forestry decree No. 237/Kpts-II/1997 |

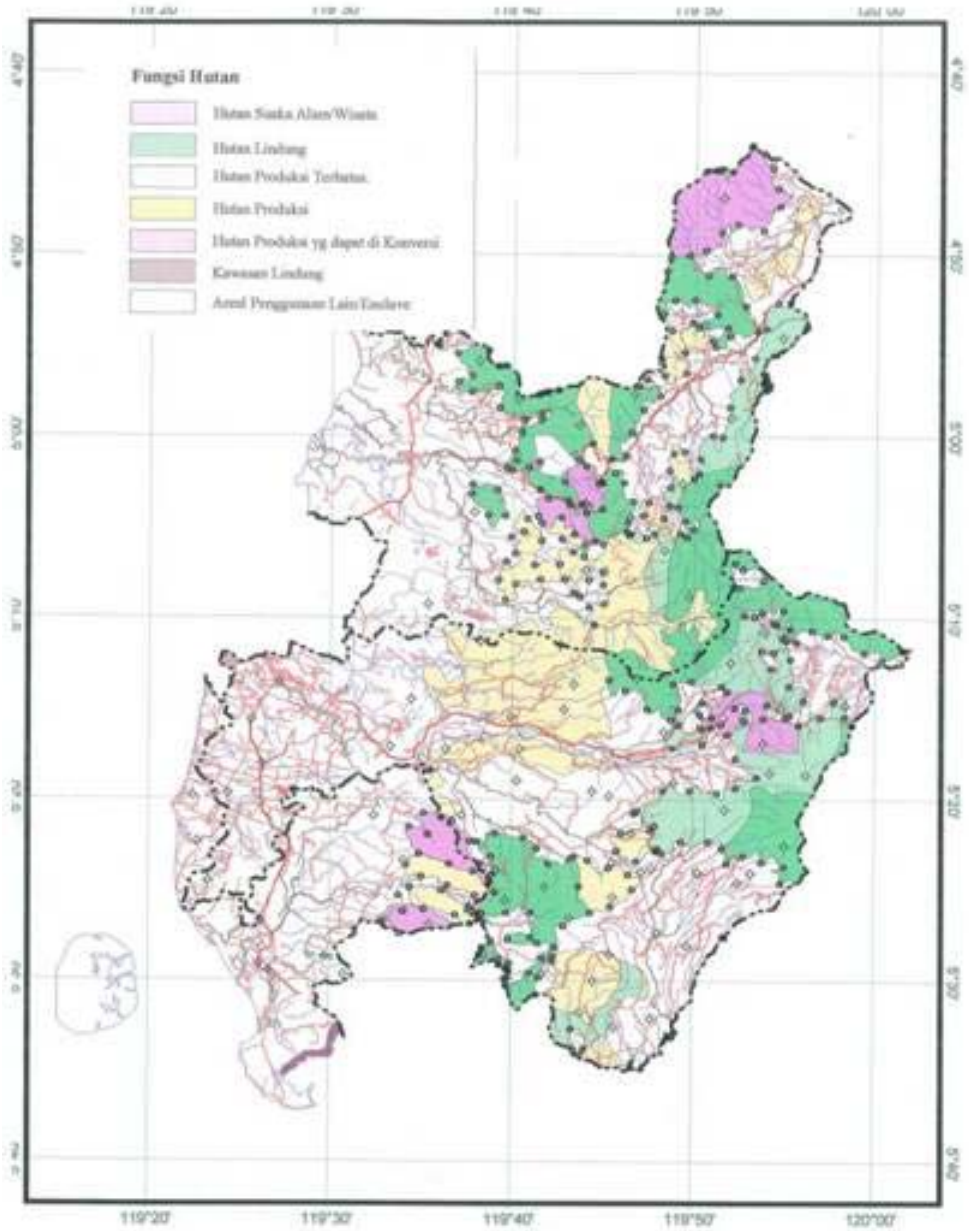

Source: The Nature Conservancy
Note: This is not latest data, but as of January 2004.
Bantimurung Nature Reserve (Cagar Alam) is combined into Bantimurung – Bulusaraung National Park (Taman Nasional).

**Figure 1.1: Location of Conservation Areas in Mamminasata**

Among these conservation areas, *Bantimurung* and *Bulusaraung* National Park was established, combining the *Bantimurung* Nature Reserve and surrounding forestry areas in 2004. According to BKSDA South Sulawesi I, over 150 species of butterfly and many species of fireflies inhabit in this area. Eco-tourism development could be expected in the conservation areas.

(2) Forestry Area in Upper River Basin

The central government designates and/or stipulates forest areas to be retained as permanent forest under the Law No.41-1999. Distribution of such conservation and protection forests is shown in the following figure.




Source: BPKH

**Figure 1.2: Distribution map of Conservation and Protection Forestry Areas in the Study Area**

(3) Small Islands and Coastal Zone

There are many coral islands to the northwest of Makassar city and west of Takalar regency in the Makassar strait. The coral reefs spread around the islands and nurse the aquatic ecosystem, various fish species, mollusks, crustacean, sea grass. These small islands draw attention as marine tourism resources, i.e. diving spots and swimming beaches. Likewise, the coastal zone has a high biodiversity potencies covering mangrove ecosystem, aquatic species mining materials and minerals. In Takalar, the mangrove plantation is advanced actively.

## 1.2. Social Environment

### 1) General Social Condition

Inhabitants of Makassar account for 14% of the total population of the province. In general Makassar provides better social services, Maros, on the other hand, has the higher poverty rate both in percentage and numbers among four regencies. Takalar shows the lowest rate of life expectancy, mean years of schooling, per capita expenditure, household expenditure for education and health. Takalar shows a poverty rate of 15.8%, better than the average rate of South Sulawesi, but significantly lower than Maros and Gowa. Social indicators in Mamminasata are reproduced in the following table.

**Table 1.5: Social Indications in Mamminasata**

(2002)

| Province District | | South Sulawesi | Makassar | Maros | Gowa | Takalar |
|---|---|---|---|---|---|---|
| Total population | 2003 | 8,213,864 | 1,145,406 | 286,260 | 552,293 | 240,578 |
| | 2002 | 7,960,991 | 1,127,785 | 278,833 | 528,313 | 232,681 |
| Proportion of population (%) | Female | 48.9 | 50.4 | 50.9 | 49.8 | 53.2 |
| | Male | 51.1 | 49.6 | 49.1 | 50.2 | 46.8 |
| Life Expectancy (years) | Female | 65.1 | 73.8 | 71.4 | 72.4 | 68.8 |
| | Male | 61.4 | 69.9 | 67.4 | 68.4 | 64.9 |
| Adult Literacy Rate (%) | Female | 91.6 | 92.8 | 76.9 | 73.4 | 75.9 |
| | Male | 94.9 | 96.7 | 82.1 | 78.1 | 82.0 |
| Mean Years of Schooling (Years) | Female | 7.0 | 9.8 | 5.4 | 5.9 | 5.4 |
| | Male | 7.7 | 10.8 | 6.2 | 6.7 | 6.0 |
| Per Capita Expenditure | Total (Rupiah/Month) | 153,000 | 242,100 | 146,300 | 135,700 | 133,800 |
| | Food (% of total) | 66,1 | 54,7 | 70,4 | 68,9 | 71,4 |
| Household Expenditure % for | Education | 2,01 | 5,12 | 1,19 | 1,62 | 0,81 |
| | Health | 1,64 | 1,71 | 1,86 | 1,35 | 1,64 |
| | Health and Education | 3,64 | 6,83 | 3,06 | 2,96 | 2,45 |
| Poverty line (Rupiah Capital/Month) | | 91,937 | 103,381 | 98,228 | 86,457 | 90,993 |
| Poverty | Number of poor people | 1,309,200 | 63,400 | 67,900 | 107,400 | 37,800 |
| | Poverty rate (%) | 15.9 | 5.6 | 23.7 | 19.6 | 15.8 |

Data source: BPS and BAPPENAS

### 2) Ethnicity, Language and Religion

As the administrative, commercial, and educational center of the Eastern Indonesia, Makassar has the multi-ethnic population. While the lingua franca is Indonesian, many regional languages are widely used. Most of them belong to the South Sulawesi stock. Makassar was the center of the old Makassarese kingdom of Gowa, and the Makassarese still form the largest ethnic group. Since the 1980s, specialists have considered Makasar (Makassarese) to be a language family, rather than a single language. The largest member of this family is Makasar, which is widely spoken in Makassar, Gowa, Maros and Takalar. The predominant dialect is Gowa (Lakiung). The Turatea dialect is also widely used in Makassar, partly because most becak drivers hail from Takalar regency where this dialect is spoken.

Bugis is also widely spoken in Makassar. The other language families in Mamminasata are Mandar and Sa'dan Toraja. There is a sizable Toraja community in Makassar, as well as smaller communities of Mandar speakers. However, their language loyalty is not so high as the Bugis and Makassar communities. The population of Javanese in Maros, Gowa and Takalar has significantly contributed to the ethnic diversity in Mamminasata.

**Table 1.6: Population by ethnicity**

(year 2000)

| MUNICIPALITY/ REGENCY | Ethnics | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Bugis | Makassar | Toraja | Mandar | Luwu | Jawa | Duri | Selayar | Others | Total |
| Makkasar | 354,105 | 468,772 | 64,994 | 16,748 | 4,062 | 54,112 | 6,448 | 7,985 | 122,793 | **1,100,019** |
| Maros | 149,030 | 107,721 | 2,901 | 560 | 123 | 5,423 | 106 | 62 | 6,190 | 272,116 |
| Gowa | 13,410 | 110,084 | 879 | 582 | 102 | 3,534 | 53 | 380 | 6,854 | 135,878 |
| Takalar | 1,984 | 221,813 | 174 | 134 | 144 | 1,082 | 12 | 28 | 4,347 | 229,718 |

Source: BPS, 2003

Most inhabitants in Mamminasata are Moslem. About 10% of the Makassar population is Christian, but in other region, the Christian is less than 5% of the population.

**Table 1.7: Population by Religion in Mamminasata**

| | Moslem | Protestant | Catholic | Hindu | Buddhist | Others | Total |
|---|---|---|---|---|---|---|---|
| Makassar | 1,020,279 | 60,946 | 47,125 | 7,898 | 17,438 | 0 | 1,153,686 |
| Maros | 286,720 | 1,736 | 829 | 38 | 7 | 50 | 289,373 |
| Gowa | 522,215 | 2,403 | 1,413 | 120 | 235 | 0 | 526,386 |
| Takalarl | 229,447 | 129 | 98 | 5 | 34 | 5 | 229,718 |

## 1.3. Extent of Environmental Pollution

The Mamminasata Metropolitan area faces such environmental pollution as (i) water pollution, (ii) air pollution, and (iii) solid waste problems, as well as (iv) lack of environmental awareness. Existing condition of water and air pollution is discussed herein, and the solid waste problem is discussed separately in Sector Study Report on Solid Waste Management.

**(Stuck drainage canal where solid waste is dumped)**

**(Solid waste flowing into main canal)**

**(Dark water of drainage canal where solid wastes are floating and emitting offensive odor)**

### 1) Water Pollution

The Mamminasata Metropolitan Area expands over the Jeneberang River basin and Tallo River basin. The water quality analysis of these rivers has been executed by the South Sulawesi BAPEDALDA in 2004 [1]. According to the analysis, several constituents exceed the water quality standard value; TSS, Fe, Mn, Zn, Cd, Mg, $KMnO_4$, $H_2S$, $Cl^-$, $SO_4$, $NH_3$, $NO_2$, BOD, COD, Mineral oil, Fecal-Coliform and Total-Coliforms, as observed in the following tables.

The analysis indicates serious water quality deterioration caused by domestic wastewater, agricultural activities, and agro-processing industry in Mamminasata. The pictures show the scenery we can see everywhere in Mamminasata, particularly in Makassar. Solid waste is dumped into drainage canals and floating on the water surface. Moreover, industrial wastewater is discharged into canals without any treatment.

[1] Refer to the "Report on Water, Ocean, Soil and Air Quality Analysis in South Sulawesi Province, 2004 by BAPEDALDA, South Sulawesi.

## Table 1.8 (1): Results of Water Quality Analysis in Jeneberang River (dry season)

| Parameters | Governmental Regulations No.82-2001 | | | | Unit | Jeneberang River | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 2004/5/27 | 2004/5/31 | 2004/5/27 | | | |
| | | | | | | 41 | 42 | 43 | 44 | 45 | 46 |
| | Class I | Class II | Class III | Class IV | | Drawbridge of Countryside of Lonjok Boko (SJ. I ) | Bridge of Lebong River (SJ. II ) | Meeting point of Lebong River and Jeneberang River (SJ.III) | Bili-Bili Dam (SJ.IV) | Bridge Sungguminasa (SJ. V ) | Benten Somba Opu (SJ.VI) |
| **Physical :** | | | | | | | | | | | |
| Temperature | ±3℃ | ±3℃ | ±3℃ | ±5℃ | ℃ | 33 | 27 | 35 | 35 | 34 | 31 |
| Turbidity | | | | | NTU | | | | | | |
| Total Dissolved Solids (TDS) | 1,000 | 1,000 | 1,000 | 2,000 | mg/l | 71 | 245 | 329 | 546 | 546 | 1,982 |
| Total Suspended Solid (TSS) | 50 | 50 | 400 | 400 | mg/l | 128 | 145 | 2,482 | 29 | 29 | 39 |
| **Chemical** | | | | | | | | | | | |
| pH | 6-9 | 6-9 | 6-9 | 5-9 | - | 7.69 | 7.92 | 7.92 | 7.64 | 7.75 | 7.86 |
| Iron ( Fe ) | 0.3 | - | - | - | mg/l | - | 6.6 | 4.7 | 3.76 | 2.94 | 2.56 |
| Mangan ( Mn ) | 0.1 | - | - | - | mg/l | - | 0.13 | 0.68 | 0.31 | 0.38 | 0.2 |
| Barium (Ba) | 1 | - | - | - | mg/l | - | - | - | - | - | - |
| Cupper ( Cu) | 0.02 | 0.02 | 0.02 | 0.20 | mg/l | TT | TT | 0.07 | TT | TT | TT |
| Zinc (Zn) | 0.05 | 0.05 | 0.05 | 2.00 | mg/l | TT | 0.09 | 0.16 | 0.12 | TT | TT |
| Chromium ( $Cr^{6+}$ ) | 0.05 | 0.05 | 0.05 | 1.00 | mg/l | - | - | - | - | - | - |
| Total Chromium (Cr) | | | | | mg/l | TT | TT | TT | 0.28 | TT | TT |
| Cadmium (Cd ) | 0.010 | 0.010 | 0.010 | 0.010 | mg/l | 0.007 | 0.006 | 0.009 | 0.004 | 0.004 | 0.007 |
| Mercury (Hg) | 0.001 | 0.002 | 0.002 | 0.005 | mg/l | - | - | - | - | - | - |
| Lead (Pb) | 0.030 | 0.030 | 0.030 | 1.000 | mg/l | 0.004 | TT | TT | TT | TT | TT |
| Magnesium (Mg) | | | | | mg/l | TT | TT | 4.64 | TT | TT | 11.07 |
| Calcium (Ca) | | | | | mg/l | 1.05 | TT | 5.55 | TT | TT | 11.3 |
| Slenium (Se) | 0.01 | 0.05 | 0.05 | 0.05 | mg/l | - | - | - | - | - | - |
| Nickel (Ni) | | | | | mg/l | TT | 0.18 | TT | TT | TT | TT |
| Cobalt (Co) | 0.2 | 0.2 | 0.2 | 0.2 | mg/l | - | - | - | - | - | - |
| Organic matter ($KMnO_4$ ) | 10 | - | - | - | mg/l | 1.9 | 9.6 | 5.69 | 3.8 | 6.95 | 9.16 |
| Hydrogen Sulphine ($H_2S^-$ ) | 0.002 | 0.002 | 0.002 | - | mg/l | 0.001 | 0.03 | 0.01 | 0.12 | 0.27 | 0.001 |
| Chlouride ($Cl^-$) | 600 | - | - | - | mg/l | 0.49 | 0.98 | 0.98 | 0.98 | 1.96 | 987.5 |
| Sulphate ($SO_4$) | 400 | - | - | - | mg/l | 4.95 | TT | 73.95 | TT | TT | 73.95 |
| Amonium ($NH_3$-N) | 0.5 | - | - | - | mg/l | 0.03 | 0.39 | 0.21 | 0.74 | 1.08 | 0.13 |
| Nitrate ($NO_3$-N) | 10 | 10 | 20 | 20 | mg/l | TT | TT | 4.42 | 1.15 | 1.06 | 1.66 |
| Nitrite ($NO_2$-N) | 0.06 | 0.06 | 0.06 | - | mg/l | 0.001 | 0.025 | 0.03 | 0.62 | 0.63 | 0.013 |
| $BOD_5$ | 2 | 3 | 6 | 12 | mg/l | 2.01 | 8.44 | 1.74 | 1.18 | 0.9 | 1.25 |
| COD | 10 | 25 | 50 | 100 | mg/l | 3.2 | 13.3 | 3.0 | 3.0 | 4.0 | 3.8 |
| Detergent | 0.2 | 0.2 | 0.2 | - | mg/l | TT | TT | TT | TT | TT | TT |
| Mineral oil | 1 | 1 | 1 | - | mg/l | TT | TT | 17 | 34 | 7 | 36 |
| **Bacteriology :** | | | | - | | | | | | | |
| Fecal Coliform | 100 | 1,000 | 2,000 | 2,000 | MPN/100ml | - | - | - | - | - | - |
| Total Coliforms | 1,000 | 5,000 | 10,000 | 10,000 | MPN/100ml | 1,100 | 900 | 700 | 1,100 | 1,700 | - |

Notes: Exceeding the standard

Source:

*Hasil Pengujian Kuakitas Air, Laut Tanah dan Udara di Provinsi Sulawesi Selatan Tahun 2004* (Testing Result of Water, Sea Water, Land and Air Quality of South Sulawesi Year 2004) BAPEDALDA South Sulawesi

## Table 1.8 (2): Results of Water Quality Analysis in Jeneberang River (rainy season)

| Parameters | Governmental Regulations No.82-2001 | | | | Unit | Jeneberang River | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 2004/12/8 | | | | | |
| | | | | | | 41 | 42 | 43-1 | 44 | 45 | 46 |
| | Class I | Class II | Class III | Class IV | | Drawbridge of Countryside of Lonjok Boko (SJ.1) | Bridge of Lebong River (SJ.2) | ±500m at the Encounter of Jeneberang body at Bili-bili Dam (SJ.3) | Bili-Bili Dam (SJ.4) | Bridge Sungguminasa (SJ.5) | Benteng Somba Opu (SJ.6) |
| **Physical :** | | | | | | | | | | | |
| Temperature | ±3℃ | ±3℃ | ±3℃ | ±5℃ | ℃ | 28 | 25 | 30 | 31 | 28 | 27 |
| Total Dissolved Solids (TDS) | 1,000 | 1,000 | 1,000 | 2,000 | mg/l | 95 | 101 | 124 | 124 | 123 | 214 |
| Total Suspended Solid (TSS) | 50 | 50 | 400 | 400 | mg/l | 61 | 178 | 687 | 528 | 454 | 111 |
| **Chemical** | | | | | | | | | | | |
| pH | 6-9 | 6-9 | 6-9 | 5-9 | - | 7.64 | 7.37 | 7.27 | 7.9 | 7.45 | 7.48 |
| Iron ( Fe ) | 0.300 | - | - | - | mg/l | 0.42 | 0.22 | 3.84 | 1.84 | 2.04 | 1.87 |
| Mangan ( Mn ) | 0.100 | - | - | - | mg/l | 0.008 | 0.008 | 0.516 | 0.181 | 0.105 | 0.096 |
| Barium (Ba) | 1.000 | - | - | - | mg/l | - | - | - | - | - | - |
| Cupper ( Cu) | 0.02 | 0.02 | 0.02 | 0.2 | mg/l | TT | TT | TT | TT | TT | TT |
| Zinc (Zn) | 0.05 | 0.05 | 0.05 | 2.0 | mg/l | 0.089 | 0.053 | 0.123 | 0.072 | 0.054 | 0.087 |
| Chromium ( $Cr^{6+}$ ) | 0.05 | 0.05 | 0.05 | 1.0 | mg/l | - | - | - | - | - | - |
| Total Chromium (Cr) | | | | | mg/l | TT | TT | TT | TT | TT | TT |
| Cadmium (Cd ) | 0.01 | 0.01 | 0.01 | 0.01 | mg/l | TT | TT | TT | 0.003 | TT | 0.001 |
| Mercury (Hg) | 0.001 | 0.002 | 0.002 | 0.005 | mg/l | - | - | - | - | - | - |
| Lead (Pb) | 0.03 | 0.03 | 0.03 | 1.00 | mg/l | TT | TT | TT | TT | 0.258 | 0.139 |
| Nickel (Ni) | | | | | mg/l | 0.340 | 0.669 | 0.647 | 0.519 | 0.463 | 0.365 |
| Cobalt (Co) | 0.2 | 0.2 | 0.2 | 0.2 | mg/l | - | - | - | - | - | - |
| Organic matter ($KMnO_4$ ) | 10 | - | - | - | mg/l | 5.37 | 6.64 | 6.32 | 5.06 | 3.16 | 5.37 |
| Hydrogen Sulphine ($H_2S^-$ ) | 0.002 | 0.002 | 0.002 | - | mg/l | 0.009 | 0.001 | 0.016 | 0.07 | 0.044 | 0.027 |
| Disolved Oxigen (DO) | 6 | 4 | 3 | 0 | mg/l | 7.75 | 8.57 | 7.34 | 8.16 | 7.14 | 7.14 |
| Chlouride ($Cl^-$) | 600 | - | - | - | mg/l | TT | 1.94 | 1.94 | 1.94 | 3.88 | 50.44 |
| Sulphate ($SO_4$) | 400 | - | - | - | mg/l | 2 | 2 | 12 | 13 | 17 | 20 |
| Amonium ($NH_3$-N) | 1 | - | - | - | mg/l | 0.08 | 0.20 | 0.29 | 0.09 | 0.11 | 0.13 |
| Nitrate ($NO_3$-N) | 10 | 10 | 20 | 20 | mg/l | 0.702 | 0.318 | 1.167 | 0.577 | 1.007 | 0.715 |
| Nitrite ($NO_2$-N) | 0 | 0 | 0 | - | mg/l | 0.050 | 0.032 | 0.098 | 0.078 | 0.144 | 0.065 |
| $BOD_5$ | 2 | 3 | 6 | 12 | mg/l | 0.81 | 3.88 | 2.24 | 2.86 | 1.44 | 3.06 |
| COD | 10 | 25 | 50 | 100 | mg/l | 6.0 | 7.0 | 7.2 | 6.50 | 4.0 | 6.30 |
| Detergent | 0 | 0 | 0 | - | mg/l | - | - | - | - | - | - |
| Metil blue active compounds | | | | | mg/l | TT | TT | TT | TT | 0.03 | TT |
| Phenol compounds | 0.001 | 0.001 | 0.001 | - | mg/l | - | - | - | - | - | - |
| Mineral oil | 1.0 | 1.0 | 1.0 | - | mg/l | TT | TT | TT | TT | TT | TT |
| **Bacteriology :** | | | | - | | | | | | | |
| Fecal Coliform | 100 | 1,000 | 2,000 | 2,000 | MPN/100ml | 700 | 3,300 | 50 | 3,400 | 1,100 | 50 |
| Total Coliforms | 1,000 | 5,000 | 10,000 | 10,000 | MPN/100ml | 1,400 | 2,400,000 | 80 | 2,400,000 | 1,700 | 1,100 |

Notes: Exceeding the standard

Source:
*Hasil Pengujian Kuakitas Air di Provinsi Sulawesi Selatan Tahun 2004* (Testing Result of Water Quality of South Sulawesi Year 2004) BAPEDALDA South Sulawesi

## Table 1.9 (1): Results of Water Quality Analysis in Tallo River (dry season)

| Parameters | Governmental Regulations No.82-2001 | | | | Unit | Jeneberang River | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 2004/12/8 | | | | | |
| | | | | | | 41 | 42 | 43-1 | 44 | 45 | 46 |
| | Class I | Class II | Class III | Class IV | | Drawbridge of Countryside of Lonjok Boko (SJ.1) | Bridge of Lebong River (SJ.2) | ±500m at the Encounter of Jeneberang body at Bili-bili Dam (SJ.3) | Bili-Bili Dam (SJ.4) | Bridge Sungguminasa (SJ.5) | Benteng Somba Opu (SJ.6) |
| **Physical :** | | | | | | | | | | | |
| Temperature | ±3℃ | ±3℃ | ±3℃ | ±5℃ | ℃ | 28 | 25 | 30 | 31 | 28 | 27 |
| Total Dissolved Solids (TDS) | 1,000 | 1,000 | 1,000 | 2,000 | mg/l | 95 | 101 | 124 | 124 | 123 | 214 |
| Total Suspended Solid (TSS) | 50 | 50 | 400 | 400 | mg/l | 61 | 178 | 687 | 528 | 454 | 111 |
| **Chemical** | | | | | | | | | | | |
| pH | 6-9 | 6-9 | 6-9 | 5-9 | - | 7.64 | 7.37 | 7.27 | 7.9 | 7.45 | 7.48 |
| Iron ( Fe ) | 0.300 | - | - | - | mg/l | 0.42 | 0.22 | 3.84 | 1.84 | 2.04 | 1.87 |
| Mangan ( Mn ) | 0.100 | - | - | - | mg/l | 0.008 | 0.008 | 0.516 | 0.181 | 0.105 | 0.096 |
| Barium (Ba) | 1.000 | - | - | - | mg/l | - | - | - | - | - | - |
| Cupper ( Cu) | 0.02 | 0.02 | 0.02 | 0.2 | mg/l | TT | TT | TT | TT | TT | TT |
| Zinc (Zn) | 0.05 | 0.05 | 0.05 | 2.0 | mg/l | 0.089 | 0.053 | 0.123 | 0.072 | 0.054 | 0.087 |
| Chromium ( $Cr^{6+}$ ) | 0.05 | 0.05 | 0.05 | 1.0 | mg/l | - | - | - | - | - | - |
| Total Chromium (Cr) | | | | | mg/l | TT | TT | TT | TT | TT | TT |
| Cadmium (Cd ) | 0.01 | 0.01 | 0.01 | 0.01 | mg/l | TT | TT | TT | 0.003 | TT | 0.001 |
| Mercury (Hg) | 0.001 | 0.002 | 0.002 | 0.005 | mg/l | - | - | - | - | - | - |
| Lead (Pb) | 0.03 | 0.03 | 0.03 | 1.00 | mg/l | TT | TT | TT | TT | 0.258 | 0.139 |
| Nickel (Ni) | | | | | mg/l | 0.340 | 0.669 | 0.647 | 0.519 | 0.463 | 0.365 |
| Cobalt (Co) | 0.2 | 0.2 | 0.2 | 0.2 | mg/l | - | - | - | - | - | - |
| Organic matter ($KMnO_4$ ) | 10 | - | - | - | mg/l | 5.37 | 6.64 | 6.32 | 5.06 | 3.16 | 5.37 |
| Hydrogen Sulphine ($H_2S^-$ ) | 0.002 | 0.002 | 0.002 | - | mg/l | 0.009 | 0.001 | 0.016 | 0.07 | 0.044 | 0.027 |
| Disolved Oxigen (DO) | 6 | 4 | 3 | 0 | mg/l | 7.75 | 8.57 | 7.34 | 8.16 | 7.14 | 7.14 |
| Chlouride ($Cl^-$) | 600 | - | - | - | mg/l | TT | 1.94 | 1.94 | 1.94 | 3.88 | 50.44 |
| Sulphate ($SO_4$) | 400 | - | - | - | mg/l | 2 | 2 | 12 | 13 | 17 | 20 |
| Amonium ($NH_3$-N) | 1 | - | - | - | mg/l | 0.08 | 0.20 | 0.29 | 0.09 | 0.11 | 0.13 |
| Nitrate ($NO_3$-N) | 10 | 10 | 20 | 20 | mg/l | 0.702 | 0.318 | 1.167 | 0.577 | 1.007 | 0.715 |
| Nitrite ($NO_2$-N) | 0 | 0 | 0 | - | mg/l | 0.050 | 0.032 | 0.098 | 0.078 | 0.144 | 0.065 |
| $BOD_5$ | 2 | 3 | 6 | 12 | mg/l | 0.81 | 3.88 | 2.24 | 2.86 | 1.44 | 3.06 |
| COD | 10 | 25 | 50 | 100 | mg/l | 6.0 | 7.0 | 7.2 | 6.50 | 4.0 | 6.30 |
| Detergent | 0 | 0 | 0 | - | mg/l | - | - | - | - | - | - |
| Metil blue active compounds | | | | | mg/l | TT | TT | TT | TT | 0.03 | TT |
| Phenol compounds | 0.001 | 0.001 | 0.001 | - | mg/l | - | - | - | - | - | - |
| Mineral oil | 1.0 | 1.0 | 1.0 | - | mg/l | TT | TT | TT | TT | TT | TT |
| **Bacteriology :** | | | | - | | | | | | | |
| Fecal Coliform | 100 | 1,000 | 2,000 | 2,000 | MPN/100ml | 700 | 3,300 | 50 | 3,400 | 1,100 | 50 |
| Total Coliforms | 1,000 | 5,000 | 10,000 | 10,000 | MPN/100ml | 1,400 | 2,400,000 | 80 | 2,400,000 | 1,700 | 1,100 |

Notes: Exceeding the standard

Source:
*Hasil Pengujian Kuakitas Air di Provinsi Sulawesi Selatan Tahun 2004* (Testing Result of Water Quality of South Sulawesi Year 2004) BAPEDALDA South Sulawesi

**Table 1.9 (2): Results of Water Quality Analysis in Tallo River (rainy season)**

| Parameters | Governmental Regulations No.82-2001 | | | | Unit | Tallo River | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 2004/12/10 | | | | | |
| | | | | | | 35-1 | 36-1 | 37-1 | 38 | 39-1 | 40 |
| | Class I | Class II | Class III | Class IV | | River Upstream of Pacelekang of Desa Bolangi (ST.1) | ± 100m from the Domestic Septictank, Makassar City (ST.2) | Creek of Maros Regency, ± 800m from Tallo Bridge (ST.3) | Tello Bridge (Tallo River) (ST.4) | Creek which Passes Makassar Industrial Estates, ±100m from Tallo Bridge (ST.5) | Tallo Toll Bridge (ST.6) |
| **Physical :** | | | | | | | | | | | |
| Temperature | ±3℃ | ±3℃ | ±3℃ | ±5℃ | ℃ | 28 | 29 | 30 | 30 | 31 | 31 |
| Total Dissolved Solids (TDS) | 1,000 | 1,000 | 1,000 | 2,000 | mg/l | 125 | 266 | 233 | 605 | 546 | |
| Total Suspended Solid (TSS) | 50 | 50 | 400 | 400 | mg/l | 227 | 149 | 410 | 163 | 171 | 601 |
| **Chemical** | | | | | | | | | | | |
| pH | 6-9 | 6-9 | 6-9 | 5-9 | - | 7.15 | 7.08 | 7.23 | 6.96 | 7.02 | 8.58 |
| Iron ( Fe ) | 0.300 | - | - | - | mg/l | 0.22 | 1.09 | 3.19 | 0.58 | 0.63 | 0.26 |
| Mangan ( Mn ) | 0.100 | - | - | - | mg/l | 0.168 | 0.129 | 0.25 | 0.27 | 0.23 | 0.10 |
| Barium (Ba) | 1.000 | - | - | - | mg/l | - | - | - | - | - | - |
| Cupper ( Cu) | 0.02 | 0.02 | 0.02 | 0.2 | mg/l | TT | TT | TT | TT | TT | TT |
| Zinc (Zn) | 0.05 | 0.05 | 0.05 | 2.0 | mg/l | 0.089 | 0.096 | 0.064 | 0.061 | 0.188 | 0.095 |
| Chromium ( $Cr^{6+}$ ) | 0.05 | 0.05 | 0.05 | 1.0 | mg/l | - | - | - | - | - | - |
| Total Chromium (Cr) | | | | | mg/l | TT | TT | TT | TT | TT | TT |
| Cadmium (Cd ) | 0.01 | 0.01 | 0.01 | 0.01 | mg/l | TT | 0.021 | 0.021 | 0.004 | 0.001 | 0.194 |
| Mercury (Hg) | 0.001 | 0.002 | 0.002 | 0.005 | mg/l | - | - | - | - | - | - |
| Lead (Pb) | 0.03 | 0.03 | 0.03 | 1.00 | mg/l | TT | TT | TT | TT | 0.207 | 0.260 |
| Nickel (Ni) | | | | | mg/l | 0.129 | 0.330 | 0.445 | 0.410 | 0.307 | 0.482 |
| Cobalt (Co) | 0.2 | 0.2 | 0.2 | 0.2 | mg/l | - | - | - | - | - | - |
| Organic matter ($KMnO_4$ ) | 10 | - | - | - | mg/l | 9.976 | 9.796 | 4.108 | 8.22 | 8.53 | 19.28 |
| Hydrogen Sulphine ($H_2S^-$ ) | 0.002 | 0.002 | 0.002 | - | mg/l | 0.063 | 0.086 | 0.018 | 0.004 | 0.009 | 0.006 |
| Disolved Oxigen (DO) | 6 | 4 | 3 | 0 | mg/l | 6.53 | 6.12 | 5.92 | 3.88 | 7.75 | 2.8 |
| Chlouride ($Cl^-$) | 600 | - | - | - | mg/l | TT | 3.88 | 70.80 | 225.08 | 605.2 | 7,022.2 |
| Sulphate ($SO_4$) | 400 | - | - | - | mg/l | 8 | TT | 19 | 43 | 38 | 1,000 |
| Amonium ($NH_3$-N) | 1 | - | - | - | mg/l | 0.27 | 0.26 | 0.49 | 0.88 | 0.91 | 2.36 |
| Nitrate ($NO_3$-N) | 10 | 10 | 20 | 20 | mg/l | 1.337 | 1.194 | 0.474 | 0.416 | 0.427 | 0.245 |
| Nitrite ($NO_2$-N) | 0 | 0 | 0 | - | mg/l | 0.281 | 0.276 | 0.112 | 0.152 | 0.123 | 0.038 |
| $BOD_5$ | 2 | 3 | 6 | 12 | mg/l | 1.43 | 1.43 | 0.616 | 3.056 | 4.07 | 5.33 |
| COD | 10 | 25 | 50 | 100 | mg/l | 10.0 | 10.0 | 5.20 | 9.50 | 9.8 | 20.0 |
| Detergent | 0 | 0 | 0 | - | mg/l | - | - | - | - | - | - |
| Metil blue active compounds | | | | | mg/l | TT | TT | 0.016 | 0.244 | 0.105 | 0.494 |
| Phenol compounds | 0.001 | 0.001 | 0.001 | - | mg/l | - | - | - | - | - | - |
| Mineral oil | 1.0 | 1.0 | 1.0 | - | mg/l | TT | TT | TT | TT | TT | TT |
| **Bacteriology :** | | | | - | | | | | | | |
| Fecal Coliform | 100 | 1,000 | 2,000 | 2,000 | MPN/100ml | 17,000 | 1,700 | 700 | 20 | 700 | 1,100 |
| Total Coliforms | 1,000 | 5,000 | 10,000 | 10,000 | MPN/100ml | 540,000 | 79,000 | 1,700 | 700 | 2,200 | 2,200 |

Notes: Exceeding the standard
Source:
*Hasil Pengujian Kuakitas Air di Provinsi Sulawesi Selatan Tahun 2004* (Testing Result of Water Quality of South Sulawesi Year 2004) BAPEDALDA South Sulawesi

The following table shows the results of water quality analysis of canals in Makassar city in 2004[2]. Quality of sea water around the Study area has also been analyzed as shown in the following table.

[2] Refer to the "Quality study of waste water at some canal/river in Makassar city 2004

## Table 1.10: Water Quality Analysis of Canals in Makassar

| Parameters | Governmental Regulations No.82-2001 | | | | Unit | Makassar City 2004/ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1 | 2 | 3 | 4 | 5 | 6 |
| | Class I | Class II | Class III | Class IV | | Tallo River (Toll bridge) | Pannampu street | Urip Sumoharjo street | AP. Pettarani street | Saddang river street | Jongaya street |
| **Physical :** | | | | | | | | | | | |
| Odor | | - | - | - | - | no smell | smell | smell | smell | smell | smell |
| Taste | | - | - | - | - | taste | taste | taste | taste | taste | taste |
| Temperature | ±3℃ | ±3℃ | ±3℃ | ±5℃ | ℃ | 29.4 | 27.6 | 29.6 | 30.5 | 27.3 | 27.2 |
| Color | - | - | - | - | TCU | 55 | 154 | 27 | 421 | 12 | 22 |
| Turbidity | - | - | - | - | NTU | 8 | 27 | 4 | 72 | 39 | 60 |
| Total Dissolved Solids (TDS) | 1,000 | 1,000 | 1,000 | 2,000 | mg/l | 8,850 | 1,640 | 13,400 | 475 | 322 | 491 |
| **Chemical** | | | | | | | | | | | |
| pH | 6-9 | 6-9 | 6-9 | 5-9 | - | 6.867 | 7.129 | 7.382 | 6.894 | 7.045 | 7.03 |
| Iron ( Fe ) | 0.3 | - | - | - | mg/l | 0.359 | 0.728 | 0.099 | 0.106 | 0.135 | 0.133 |
| Mangan ( Mn ) | 0.1 | - | - | - | mg/l | 0.776 | 1.2171 | 0.2399 | 0.272 | 0.5061 | 0.43 |
| Zinc (Zn) | 0.05 | 0.05 | 0.05 | 2.0 | mg/l | 0.182 | tt | tt | 0.074 | tt | 0.03 |
| Chromium ( $Cr^{6+}$ ) | 0.05 | 0.05 | 0.05 | 1.0 | mg/l | tt | tt | tt | tt | tt | tt |
| Cadmium (Cd ) | 0.01 | 0.01 | 0.01 | 0.01 | mg/l | 0.0041 | tt | 0.0622 | 0.0317 | tt | tt |
| Calcium Carbonate ($CaCO_3$) | 500 | - | - | - | mg/l | 2,662.13 | 600.48 | 3,823.05 | 460.37 | 400.32 | 256.20 |
| Chlouride ($Cl^-$) | 600 | - | - | - | mg/l | 5,636.55 | 1,616.52 | 9,146.10 | 184.34 | 170.16 | 184.34 |
| Mercury (Hg) | 0.001 | 0.002 | 0.002 | 0.005 | mg/l | tt | tt | tt | tt | 0.0002 | 0.0003 |
| Lead (Pb) | 0.03 | 0.03 | 0.03 | 1.00 | mg/l | 0.0166 | 0.0174 | 0.0099 | 0.0106 | 0.0161 | 0.02 |
| Arsenic (As) | 0.1 | 1.0 | 1.0 | 1.0 | mg/l | tt | tt | tt | tt | tt | tt |
| Cyanide ($CN^-$) | 0.02 | 0.02 | 0.02 | - | mg/l | tt | tt | tt | tt | tt | tt |
| Sulphate ($SO_4$) | 400 | - | - | - | mg/l | 39.4 | 71.3 | 236 | 998.8 | 287.7 | 381.70 |
| Flourine ($F^-$) | 0.5 | 1.5 | 1.5 | - | mg/l | tt | 1.0112 | tt | 2.454 | 0.697 | 1.7305 |
| Nitrate ($NO_3$-N) | 10 | 10 | 20 | 20 | mg/l | 0.5 | 3.4 | 2.5 | 23.9 | 2.9 | 14.9 |
| Nitrite ($NO_2$-N) | 0.06 | 0.06 | 0.06 | - | mg/l | 0.02 | 0.026 | 0.059 | 0.098 | 0.05 | 0.091 |
| $BOD_5$ | 2 | 3 | 6 | 12 | mg/l | 144.3 | 620.0 | 43.7 | 369.4 | 260.0 | 120.0 |
| COD | 10 | 25 | 50 | 100 | mg/l | 280 | 1,702 | 126 | 1,346 | 480 | 225 |
| Detergent | 0.2 | 0.2 | 0.2 | - | mg/l | 1.1 | 1.02 | 1.95 | 1.48 | 1.05 | 0.33 |
| Disolved Oxigen (DO) | 6 | 4 | 3 | - | mg/l | 5.6 | 0 | 1.5 | 0 | 0 | 0 |
| Organic matter ($kMnO_4$ ) | 10 | - | - | - | mg/l | 13.588 | 158 | 50.56 | 66.36 | 53.72 | 37.92 |

Notes: Exceeding the standard
Source:
*Kajian kualitas limbah cair pada beberapa titik kanal/sungai di Kota Makassar* (Quality study of waste water at some canal/river in Makassar city), BTKL Makassar 2004

## Table 1.11: Sea Water Quality Analysis around Mamminasta

| Parameters | Ministry of Environment Decree No.51-2004 | | | Unit | Marine Life | | Marine Tourism | | | Harbor / Seaport | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| | Marine Life | Marine Tourism | Harbor / Seaport | | Estuary of Tallo River | Estuary of Jeneberang River | Around Losari Beach | Around Senggol Market in Pare-pare | Estuary of Sumpang Minangae in Pare-pare | Around Soekarno Hatta Seaport | Paotere Port | Cappa Ujung Port in Pare-pare |
| | | | | | 6-Jul-04 | | | 11-Sep-04 | | 6-Jul-04 | | 11-Sep-04 |
| **Physical :** | | | | | | | | | | | | |
| Temperature | natural | natural | natural | ℃ | 29.0 | 27.8 | 28.9 | 30.0 | 31.0 | 29.0 | 29.0 | 31.0 |
| Total Dissolved Solids (TDS) | - | - | - | mg/l | 43,801 | 65,973 | 846,347 | 38,947 | 37,064 | 44,296 | 61,901 | 41,589 |
| Total Suspended Solid (TSS) | coral:20 | 20 | 80 | mg/l | 333 | 332 | 370 | 137 | 144 | 474 | 281 | 280 |
| | mangrove:80 | | | | | | | | | | | |
| | seaweed:20 | | | | | | | | | | | |
| **Chemical** | | | | | | | | | | | | |
| pH | 7-8.5 | 7-8.5 | 6.5-8.5 | - | 8.16 | 7.73 | 8.27 | 7.96 | 7.89 | 8.13 | 8.08 | 7.89 |
| Iron ( Fe ) | - | - | - | mg/l | 1.033 | 0.726 | 0.744 | TT | TT | 0.808 | 0.726 | 0.744 |
| Mangan ( Mn ) | - | - | - | mg/l | TT | TT | TT | 0.182 | 0.215 | TT | TT | 0.197 |
| Cupper (Cu) | 0.008 | 0.050 | 0.050 | mg/l | 0.191 | 0.148 | 0.183 | TT | TT | 0.251 | 0.103 | TT |
| Zinc (Zn) | 0.050 | 0.095 | 0.100 | mg/l | 0.184 | TT | TT | 0.119 | 0.199 | TT | TT | 0.186 |
| Chromium ( Cr ) | - | - | - | mg/l | TT | TT | TT | 0.177 | 0.130 | TT | TT | 0.132 |
| Chromium ( $Cr^{6+}$ ) | 0.005 | 0.002 | - | mg/l | | | | | | | | |
| Cadmium (Cd ) | 0.001 | 0.002 | 0.010 | mg/l | 0.006 | 0.002 | TT | 0.070 | 0.046 | TT | TT | 0.008 |
| Mercury (Hg) | 0.001 | 0.002 | 0.003 | mg/l | | | | | | | | |
| Lead (Pb) | 0.008 | 0.005 | 0.050 | mg/l | | | | | | | | |
| Nickel (Ni) | 0.050 | 0.075 | - | mg/l | 0.174 | 0.681 | 0.719 | 0.805 | 0.772 | 0.463 | 0.706 | 0.892 |
| Cobalt (Co) | - | - | - | mg/l | | | | | | | | |
| Disolved Oxigen (DO) | >5 | >5 | - | mg/l | 6.2 | 6.1 | 6.6 | 5.8 | 5.9 | 5.9 | 6.9 | 5.4 |
| Nitrate ($NO_3$-N) | 0.008 | 0.008 | - | mg/l | 0.4 | 0.2 | 0.3 | TT | TT | 0.2 | 0.1 | TT |
| Nitrite ($NO_2$-N) | - | - | - | mg/l | 0.004 | 0.005 | 0.003 | TT | TT | 0.009 | 0.003 | TT |
| $BOD_5$ | 20 | 10 | - | mg/l | 23.0 | 20.0 | 29.9 | 67.4 | 52.2 | 32.5 | 60.0 | 67.4 |
| COD | - | - | - | mg/l | 52.0 | 44.0 | 59.0 | 102.8 | 102.8 | 61.0 | 110.0 | 102.8 |
| **Bacteriology :** | | | | | | | | | | | | |
| Fecal Coliform | - | 200 | - | /100ml | | | | | | | | |
| Total Coliforms | 1,000 | 1,000 | 1,000 | /100ml | | | | | | | | |

Notes: Exceeding the standard
Source:
*Hasil Pengujian Kuakitas Air, Laut Tanah dan Udara di Provinsi Sulawesi Selatan Tahun 2004* (Testing Result of Water, Sea Water, Land and Air Quality of South Sulawesi Year 2004) BAPEDALDA South Sulawesi

The field observations make it clear that the main pollution sources are solid waste generated from households and small-middle scale factories.

The environmental authorities, BAPEDALDA and can inspect such activities and identify pollution source. However, they do not have enough budget for the environmental improvement activities, and have little knowledge how to make an action for protecting further deterioration.

**(Losari beach where solid waste are floating)**

**(Discharged wastewater from *tempe* industry)**

## 2) Air Pollution

South Sulawesi BAPEDALDA and Makassar BAPEDALDA have been monitoring ambient air quality since 2001. The following table shows the ambient air quality in Makassar surveyed at 7 stations along the main streets in 2004. The survey reveals that the concentration of $PM_{10}$ exceeds the standard value, as well as TSP and lead (Pb). These parameters indicate that air pollution is caused mainly by emission gas from motor vehicles and dust. It is therefore necessary to control traffic volume and promote afforestation activities in urban area in order to absorb gases.

**(Traffic condition in Makassar Municipality (1))**

**(Traffic condition at intersection)industry)**

**Table 1.12: Analysis Result of Ambient Air Quality along the Streets (2004)**

| | NO. | $SO_2$ μ g/Nm3 | CO μ g/Nm3 | $NO_2$ μ g/Nm3 | $O_3$ μ g/Nm3 | $PM_{10}$ μ g/Nm3 | TSP μ g/Nm3 | Pb μ g/Nm3 | Nox μ g/m3 | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| analysis result *1) | 1 Karebosi | 116.27 | - | 17.55 | 109.68 | 204.20 | 188.19 | 1.78 | 10.34 | 15-Jul-04 |
| | 2 Stadion Matoangin | 125.73 | - | 1.41 | 83.47 | 191.06 | 219.08 | 1.37 | 6.22 | 16-Jul-04 |
| | 3 Hertasning (Lapangan) | 120.84 | - | 7.60 | 148.07 | 174.28 | 196.40 | 1.11 | 3.94 | 21-Jul-04 |
| | 4 Depan Kantor Keuangan | 107.65 | - | 7.36 | 63.09 | 178.90 | 179.17 | 2.15 | 3.64 | 12-Jun-04 |
| | 5 Pasar Sentral Depan NV Haji Kalla | 129.52 | - | 24.30 | 105.60 | 394.34 | 380.05 | 2.21 | 26.38 | 11-Jun-04 |
| | 6 PT. Berdikari (Pelabuhan) | 112.43 | - | 39.15 | 55.13 | 276.40 | 205.87 | 1.05 | 25.90 | 13-Jun-04 |
| | 7 KIMA | 98.76 | - | 62.12 | 68.33 | 308.63 | 291.18 | 1.62 | 29.96 | 27-May-04 |
| National standard for ambient air quality *2) | | | | | | | | | | |
| measured duration | 1 hour | 900 | 30,000 | 400 | 235 | - | - | - | - | |
| | 24 hours | 365 | 10,000 | 150 | - | 150 | 230 | 2 | 92.5*4) | |
| | 1 year | 60 | - | 100 | 50 | - | 90 | 1 | - | |
| Local standard for ambient air quality *3) | | | | | | | | | | |
| measured duration | 1 hour | 900 | 30,000 | 400 | 230 | - | - | - | - | |
| | 24 hours | 360 | 10,000 | 150 | - | 150 | 230 | 2 | 92.5*5) | |
| | 1 year | 60 | - | 100 | 50 | - | 90 | 1 | - | |

Notes: Exceeding the standard
Source:
*1) "*Hasil pemeriksaan kualitas udara KOTA MAKASSAR tahun 2004* (Examination Result of Makassar city Year 2004 )" : → 24 hours survey
*2) Government Regulation regarding Control of Air Pollution No.41-1999
*3) Governor's Regulation of South Sulawesi Province No. 14-2003
*4) Governor's Dgree of the Minister for Environment concerning Guidekines for Establishment of Environmental Quality Standards No.2-1988
*5) Governor's Dgree of South Sulawesi Province No.465-1995

### 3) Lace of Environmental Awareness

Environmental awareness of all stakeholders in Mamminasata appears to be quite low and insufficient causing the above mentioned environmental problems. Most of the local people in Mamminasata do not take care of the amenity and the environment in their surrounding area. Solid waste is scattered here and there, and stocked in canals. The environmental awareness of the people in Mamminasata should be seriously addressed.

## 1.4. Legislation and Institutional Settings

### 1) Legislations related to the Environment

(1) Environmental Standard

The central government stipulates the limitation value of water quality, ambient air quality and noise level. For instance, the Government Regulations No. 82/2001 regarding Water Pollution Control stipulates the physical, chemical and bacteriological value for every water type. On the other hand, South Sulawesi provincial government stipulates the standard value under the Governor's Decree No. 14/2003 for i) environmental water quality, ii) discharged wastewater quality, iii) ambient air quality, iv) industrial emission gas quality, v) noise, and vi) vibration. The provincial standard is the lowest administrative level, and there is no more additional regulation regarding the environmental quality standard.

(2) Natural Conservation Area

Natural conservation areas are defined under the "Forest Consensus Land Use Plan, 1985" (*Tata Guna Hutan Kesepakatan:* TGHK). Those natural conservation areas are under control of the *BKSDA Selawesi Selatan I* (Natural Resources Conservation Office, South Sulawesi I).

(3) Conservation and Protection Forestry Area

The central government designates and/or stipulates a certain forest area to be retained as permanent forest under the Law No.41-1999 regarding Forestry.

(4) Environmental Impact Assessment

The Governor Decree No. 494/VII/2003 stipulates the type and activity of plans for EIA (AMDAL), as well as the environmental management (UKL) and environmental monitoring (UPL), in addition to the Decree of State Minister for the Environment No. 17/2001. The legislations are therefore set in a generally acceptable manner. However, they have not been always observed by the stakeholders in Mamminasata.

The Decree of Ministry of Living Environment No. 40/2000 provides the responsibility and relationship of Central Government and Regency/City in assessing the environmental impacts. If one project is located and/or will have impacts on more than one province, then the EIA will be conducted by the central government.

**2) Regional Authorities related to the Environment**

In Mamminasata, the authorities listed in the following table are in charge of the environmental issues.

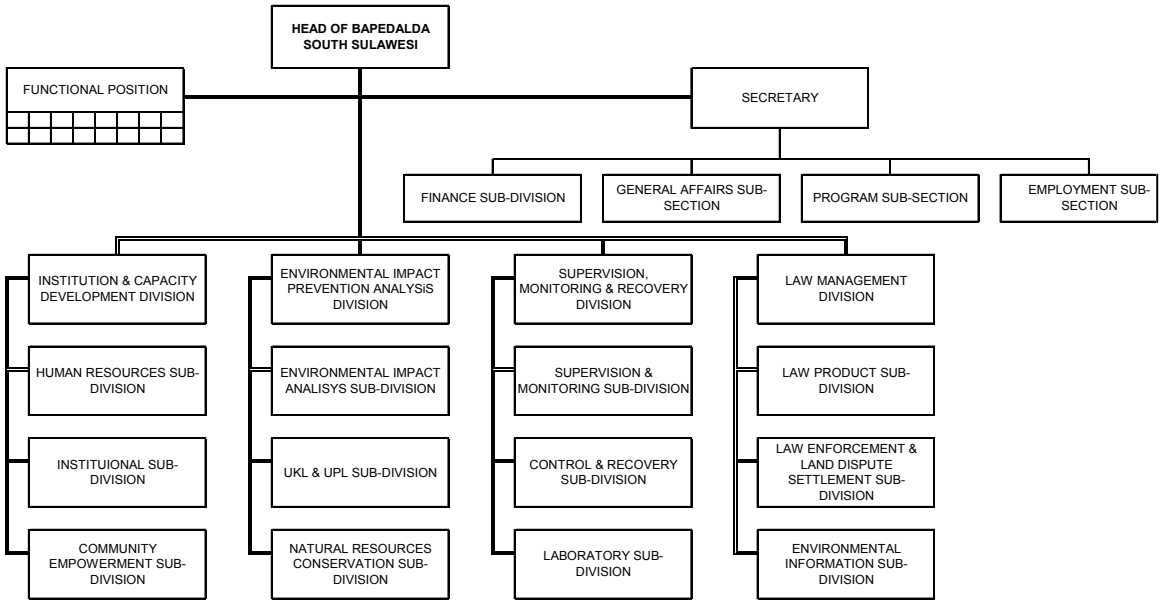
**Table 1.13: Regional Environmental Authorities in Mamminasata**

| Category | Regional Level | Name of authorities |
|---|---|---|
| Environmental Impact Management Agency | Provincial | South Sulawesi BAPEDALDA (Bapedalda Proopinsi) |
| | Makassar Municipality | Makassar Municipality *BAPEDALDA* (Bapedalda Kota Makassar) |
| | Maros regency | Maros Regency *BAPEDALDA* (Bapedalda Kab. Maros) |
| | Gowa regency | Environmental Impact Management Office of Gowa Regency (Gowa Regency *Kantor Pegendalilan Dampak Lingkungan*) |
| | Takalar regency | Spatial Planning, Environment and Cleansing Department of Takalar Regency (Takalar Regency *DINAS Tata Ruang, Lingkungan Hidup dan Kebersihan* ) |
| | National | ASDEP: |
| | Provincial | BAPPEDA of South Sulawesi Province |
| Forestry Organization | National | Balai KSDA Selawesi Selatan I: Natural Resources Conservation Office, South Sulawesi I (*Balai Konservasi Sumber Daya Alam*) |
| | Provincial | DINAS Forestry of South Sulawesi Province (*DINAS Kehutanan Propinsi Sulawesi Selatan*) |
| | | BPDAS |
| | | Balai Pemantapan Kawasan Hutan |
| | | DINAS Agriculture and Forestry of Takalar Regency (*DINAS Pertanian dan Kehutanan, Kabupaten Takalar*) |
| | | Forestry Department Kabupaten Maros |
| Research center | university | Environmental Study Center , Hassanudin University |
| | | Environmental Study Center , Universitas Negeri Akassar DR. Ardi, Director of the Center |

Source: JICA Study Team

(1) South Sulawesi *BAPEDALDA*

The South Sulawesi BAPEDALDA, established under the Governor Decree No. 22-2001 and 180/2004, was launched in 2001. It is organized in the following manner.




Source: Decree of Governor of South Sulawesi, Number : 22-2001 (BAPEDALDA)

**Figure 1.3: Organization Structural Chart of the BAPEDALDA of South Sulawesi Province**

The provincial Bapedalda has duties to assist the Governor in terms of environmental impact management. Bapedalda has the following functions:

(i) Formulate environmental impact management plan,

(ii) Undertake environmental coordination and management,

(iii) Undertake monitoring and control towards the environment condition,

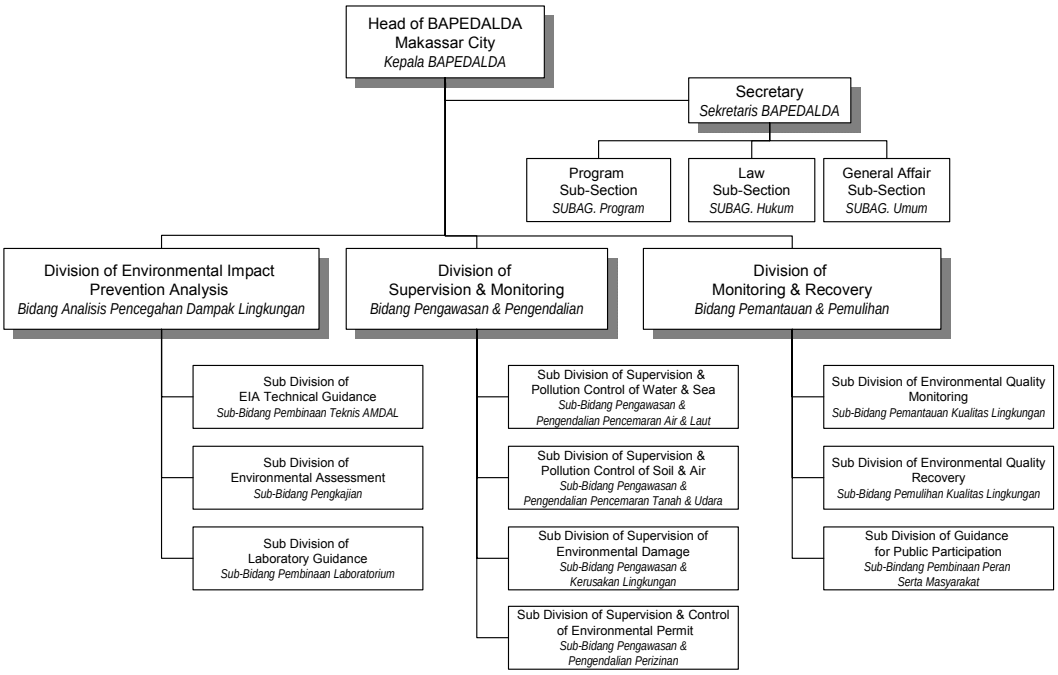
(iv) Formulate environment management policy,

(v) Evaluate and approve EIA document for cross – regency activities, and

(vi) Socialization and capacity building for the environment.

(2) Makassar *BAPEDALDA*

The Makassar BAPEDALDA is organized as shown in the following diagram.

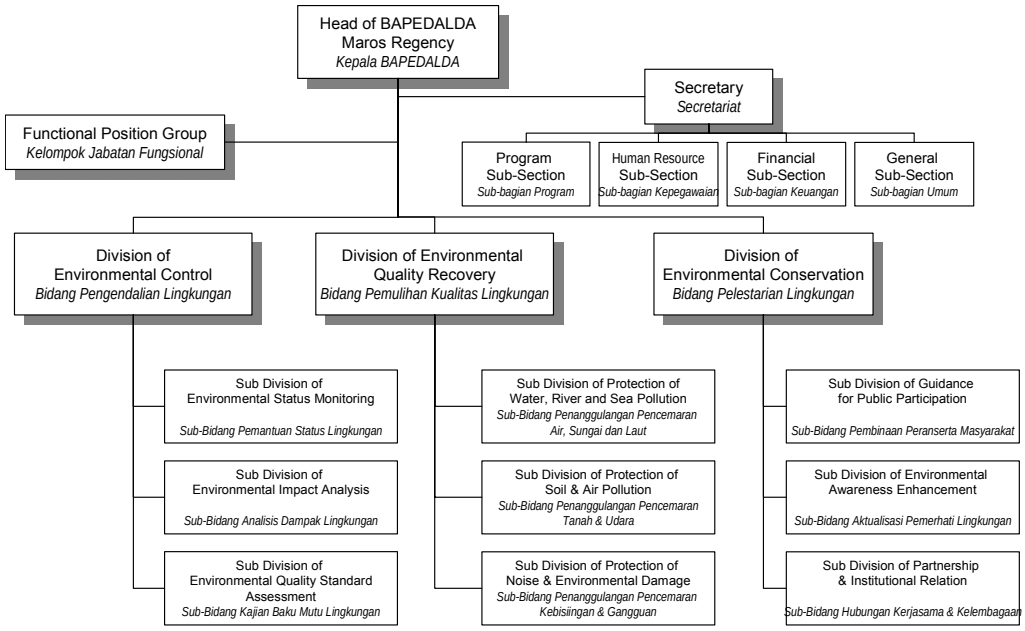



Source: Decree of Mayor of Makassar City, No. 15/ 2000

**Figure 1.4: Organization of Makassar BAPEDALDA**

(3) Maros Regency *BAPEDALDA*

The BAPEDALDA in Maros regency is organized as follows.




Source: Regulation of Maros Regency No. 26 – 2000 regarding Establishment, Organizational and Administration of Technical Institute of Governmental Scope area, Maros Regency.

**Figure 1.5: Organization of Maros BAPEDALDA**

### 3) Forestry Organizations

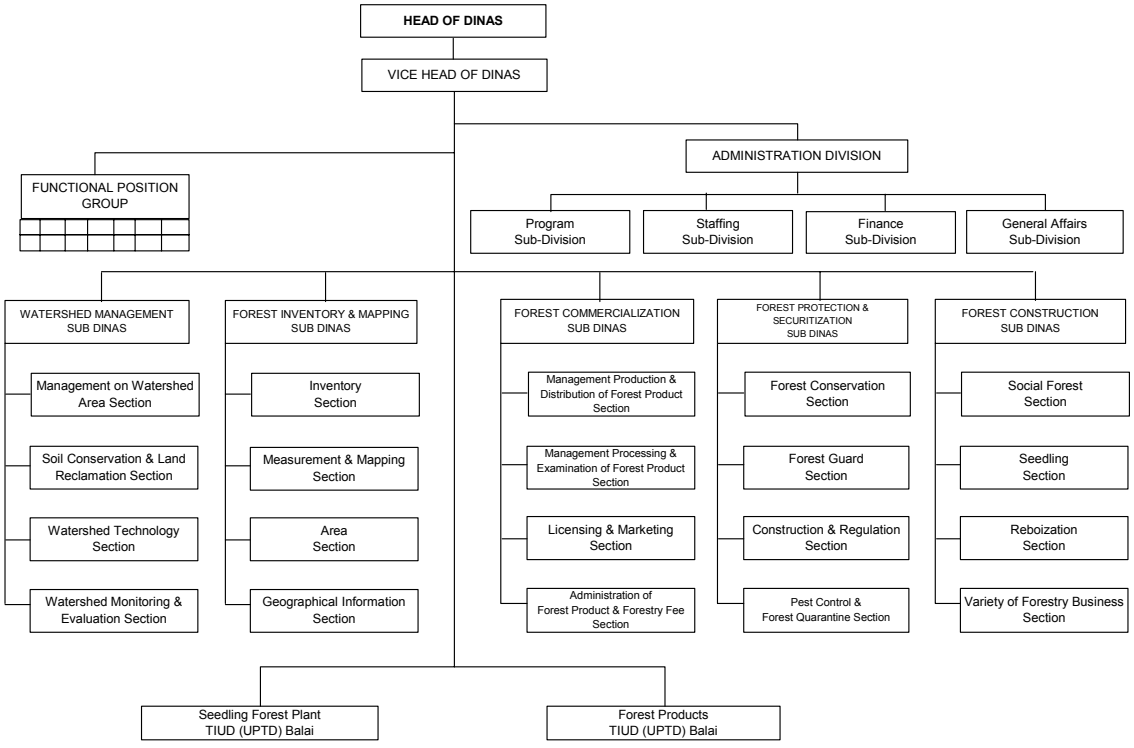
(1) Natural Resources Conservation Office, South Sulawesi I (BKSDA)

This organization is a regional office of the Ministry of Forestry. BKSDA is in charge of monitoring and evaluating the flora and fauna and the conservation area. It has two regional offices. Region I covers among Takalar, Gowa, Bantaeng, Jeneponto, Bulukumba, Sinjai. Region II covers Maros, Makassar, Pangkep, Barru, Soppeng, Wajo and Bone. BKSDA issues annual report on the status of conservation in the area and submits it to the central office. This report is open to the people.

BKSADA consists in 125 staff distributed to 3 offices, i.e., Makassar office (44 persons at the main office), Takalar office (22), and Maros office (54). The total staff is not enough to cover all the Mamminasata area. Lack of equipment is another problem for field operations.

(2) DINAS Forestry of South Sulawesi Province

The Dinas Forestry is organized as shown in the following diagram.




Source: Regulation of South Sulawesi Province, Number: 13 2001, DINAS Forestry of South Sulawesi Province

**Figure 1.6: Organization Structural of DINAS Forestry of South Sulawesi Province**

The monitoring of the environmental condition has not been duly executed by the respective authorities, causing the environmental deterioration in Mamminasata. It appears that the institutional reinforcement should be implemented under the strong initiative of the provincial leaders, collaborating with the people and communities in Mamminasata.

# 2. ENVIRONMENTAL IMPROVEMENT STRATEGIES

## 2.1. Basic Approach and Strategy

### 1) Existing Plan in Mamminasata

The South Sulawesi province and Makassar have their own environmental management strategies and plans. However, the other regencies have not clearly defined the strategy for environmental conservation and management, saying that they have faced little environmental problems up to now.

| The Ministry of Environment's 2001-2004 conservation strategy |
|---|
| a) Implementing sustainable development policies and coordinating them at the national level,<br>b) Empowering individuals and groups to involve in sustainable development decision making for the public's interest, and encourage individuals and the community to utilize the empowerment results and information,<br>c) Improving regional capacity in implementing good environmental governance,<br>d) Propelling compliance on policy and law through legal instruments and other kinds of instruments,<br>e) Improving efforts of sustainable development through steps of prevention and pollution prevention supported by efforts in harmonizing the three pillars of activities; economy, social and environment, and<br>f) Promoting sustainable development at the global and regional levels while still taking account of the national interest. |

Source: "Strategic Plan and Work Program/ Ministry of the Environment 2001-2004" Ministry of the Environment, April 2002

| Strategy Plan of BAPEDALDA Makassar Municipality 2001-2005 |
|---|
| a) Environmental awareness enhancement for all stakeholders, including individuals and local communities,<br>b) Motivating communities' initiative and creativity, and<br>c) Synergic partnership among all stakeholders and all levels of the communities. |

Source: "Strategy Plan of BAPEDALDA Makassar Municipality 2001-2005" BAPEDALDA Makassar, April 2002

### 2) Basic Approach and Strategy

The main issues to be addressed in Mamminasata are (i) water pollution in land, ocean and coastal area, (ii) air pollution, (iii) solid waste management, and (iv) lack of environmental awareness. In order to solve those issues and formulate a "Clean and Environment-Friendly Metropolitan Area", the environmental strategies are proposed as follows:

| Environmental Policy for the Formulation of Eco-Friendly Metropolitan Area |
|---|
| 1) Raising public awareness for environment in order to understand "Eco-Friendly",<br>2) Improving efforts for pollution prevention harmonized among the whole stakeholders, such as individuals, local community, governmental authorities, and private sectors,<br>3) Establishment of the Recycling–based Metropolitan through useless minimizations and effective utilities of resources,<br>4) Promoting nature restoration through improvement of urban environment,<br>5) Promoting global environmental activities as a pioneer in Indonesia, such as Clean Development Mechanism (CDM) and Rationalization of Energy Use,<br>6) Conserving the limited natural resources in the Bantimurung National Reserves and Maritime Zone including small islands,<br>"Eco-Friendly" must be considered to be minimization of the environmental load. |

## 2.2. Environmental Awareness

### 1) Promotion of Public Awareness

The Mamminasata area has a large biodiversity, and the protection/reserved areas have been designated to preserve such a biodiversity. The Bantinurung and Puttunuang National Park in Maros, for instance, is famous for butterfly. Maros and Gowa regencies have large forests of different species. The coastal zone in Takalar is full of mangroves.

**(Lamproptera meges ennuis)**

Despite the fauna and flora endowed in Mamminasata, the people are unaware of how important and valuable is the biodiversity and how it should be protected for sustainable development in Mamminasata for the generations to come. As pointed out in the foregoing Section, the Mamminasata people have been developing land and water resources with less attention to the protection of the environment. Water in the region has been polluted

to the extent critical for maintaining healthy life and garbage has been disposed of everywhere without consciousness about the pollution. In Makassar, trees along the historical avenues have been cut for expansion of the residential areas and road development.

Makassar City has put a campaign to create a "Clean City"; however the citizens are paying less attention yet to the protection of the urban environment and amenity. Residential areas have been developed, sprawling without proper plans to protect the amenity and enhance the living environment. The green area in Makassar has decreased to the level of 2.4% of the municipal land area.

The mind of the environmental protection through 'Reduce, Reuse and Recycle" (RRR) has not been well disseminated to the people in Mamminasata. According to the public awareness survey on the solid waste management for the Mamminasata spatial plan, about 72% of the surveyed people responded that they have a mind to reduce garbage but the volume of solid waste has been increasing year by year. Nearly 23% of the surveyed people are unconscious about the garbage reduction at all.

To create a "Clean Metropolitan Area" in Mamminasata, the environment awareness should be drawn to the following three points:

(i) Biodiversity and natural resources, particularly in the national parks, swampy areas in river estuaries, mangroves along the coastal zone, and nipah palm along riversides.
(ii) Green planting, particularly through reforestation, mangrove plantation, roadside green spaces, alley and school planting
(iii) Urban amenity improvement, particularly, solid waste management inclusive of separate collection, canal cleaning, RRR promotion,

In order to raise the environmental awareness, it is needed that some targets are set in a form easily attainable by the ordinary citizens to their daily lives without changing their life style. Once the people become interested in attaining such targets, they should be provided with knowledge, technologies and information on good practices so that they can maintain such actions with more confidence. In this context, three key words are proposed to enhance the environmental awareness of the people in Mamminasata.

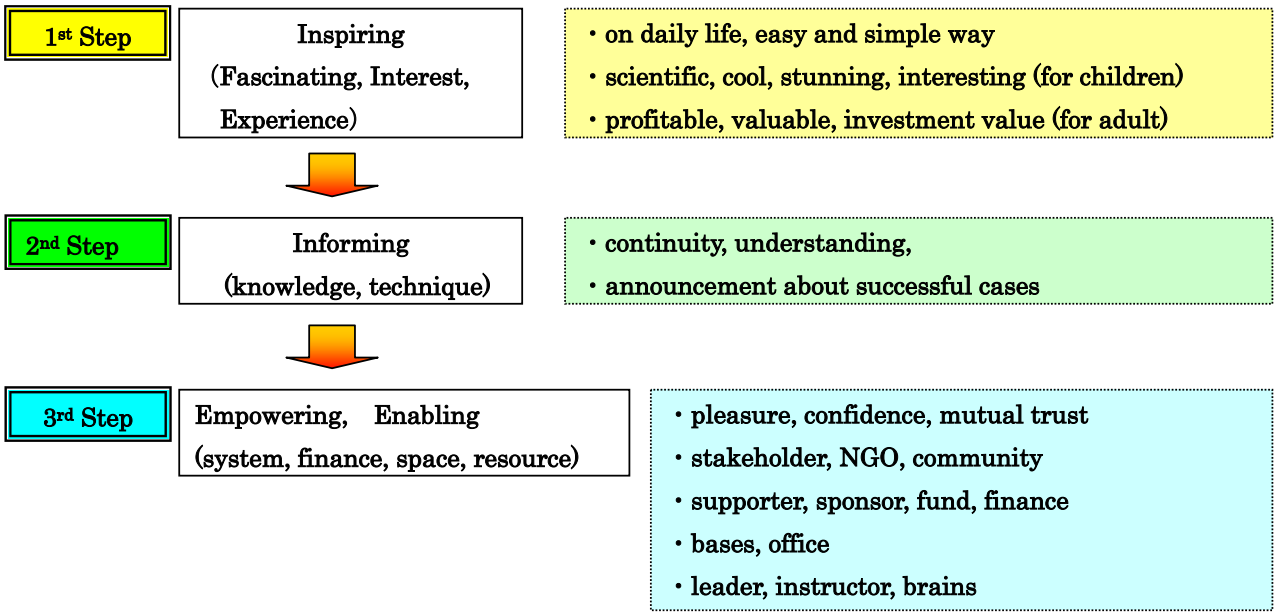



**Figure 2.1: Key Words for Enhancement of Environmental Awareness**

The above key words can be sought one by one or together in parallel. In either case, implementation of improvement projects requires core talent and its supporting brains. It is therefore important to discover and foster the talent. In addition, the project implementation requires certain funds even if labor is provided at no cost. Moreover, if the projects do not generate any earnings, they would reduce the motivation of the stakeholders. It is therefore desirable for them to have business-like systems that generate income to meet the personnel and other necessary expenses.

**"Inspiring"** is the first step. Citizens in Mamminasata are required to understand the environmental resources, natural endowment, cultural and historical heritages, and they are guided to become proud of them. They will then start realizing the importance of gradual change into a more environment-friendly life. It is important for them to understand that the change will eventually lead to the cost reduction in daily life. Some examples to inspire motivations to the introductory actions are:

○,1 "Garbage is Resource" or "Garbage is not Waste", showing the value of garbage and value of recycling.

○,2 "Save Water" and "Save Energy", showing how to avoid wasteful use and save water, energy and other resource.

○,3 "Discover the value of Nature", showing the value and inspiring motivation to respect such a value.

If you show the citizens "here is such a good resource" or "it is so valuable", then they would be interested in such activities. For instance, a simple mark on the old trees along the streets around the Karebosi Square that these trees are "Protected Tree", the citizen would understand the significance of preserving the valuable green in Makassar. If you invite the citizens to evaluate and rank the "Most Valuable Tree" in the town, they would have better understanding and respect the value of green in their life.

**(Large Tree in Karebosi Square)**

**(Large Tree in Karebosi Square)**

**"Informing"** is the second step. The citizens are requested to learn how to continue environmental awareness, joining the activities to know "best practice" in the world and how to disseminate knowledge and technologies.

① Disseminate "how good it is" or "how harmful it is", showing the good example in Indonesia and the world.

② Disseminate a good example "how to reserve" or "how to restore" the environment, showing the results of reservation and restoring.

③ Disseminate a good example "we can do this" or "we can continue this", showing how your can participation in realizing the environment-friendly town.

If you show the citizen "how harmful is it" to have polluted water in ditches, drains and canals in the city, showing how many cases of diseases have happened under such conditions, they would be motivated to prevent such diseases by cleaning the ditches and other sources of water-born diseases. If you show on a board "how many trees have been saved" by recycling used paper, the citizens will enhance their understanding on resource saving.

**"Empowering"** is the last step. The public and academic sector is required to support the continuation of the environment protection activities by providing necessary knowledge and technical support, basic infrastructure and, if inevitable, any financial support.

① Promote environmental education at primary and secondary level, through not

only classroom teaching but also practices in the field.

② Promote environment-related business (e.g., recycling industry, organic farming), showing how it would contribute to the society and how it could be financially sustainable.

③ Set up an "Environment Group" in each society (e.g., public offices, universities, schools, enterprises, and communities) so that it would lead the society in promoting and getting support for the environment protection activities.

An example is the Hasanuddin University learning in dirty classrooms and atmosphere in the campus. The Faculty of Environment and students interested in the environment protection would better take an initiative to obtain ISO14000, it would have a significant impact to many students in the campus. Such an initiative will start with "let's do it on our own" or "environment-friendly campus is our pride". If they get a certificate of ISO14000, they would disseminate it to their offices employed after graduation.

In fact, it is laborious to get a certificate of ISO14000. It is therefore suggested that the Mamminasata's Original Environmental Guideline is established on the model of ISO14000 for schools, hotels, restaurants, shopping malls and companies etc, aiming at establishing the environmental consideration program by each facility and to operate, assess, review and report its cycle. The mayor or governor would certify target organizations and receive reports from them. In the future, the Mamminasata's Original Environmental Guideline for households can also be introduced.

Appropriate approaches to the enhancement of environmental awareness would vary in accordance with the target groups. The concept of approach to each target group and the desirable public support is tabulated in the following.

**Table 2.1: Approach to Each Target Group**

| | Children (and their mothers) | Adults (mainly fathers and young people) | Business Sector, NGOs and Communities |
|---|---|---|---|
| **Private Initiative** | | | |
| short term | - enjoy and understand local resources<br>- enjoy environmental science<br>- become inspired to think about environment<br>- start with amusement of environment (games, experiments, play)<br>- realize the importance of local history, culture, economy and nature | - reduce housekeeping expenses<br>- save energy in daily life<br>- become oriented to environmental-friendly life style | - generate environmental business opportunities<br>- reduce operation costs (daily expenses: electric charge, water charge)<br>- reduce, reuse and recycle waste (recyclable disposal materials)<br>- increase profits or benefits |
| long term | - become interested in environment<br>- establish own identity with pride and confidence | - become proud of local environment<br>- to stimulate insight into local resources | - contribute to local communities<br>- enhance spirit for cooperation |
| **Public Support** | | | |
| short term | - train teachers in environmental education<br>- cooperate with formal and informal schools<br>- recruit paid volunteers for environmental education | - publicize environment-friendly life-style<br>- publicize way of collection of garbage by type | - provide space for environmental businesses<br>- financially support environmental businesses |
| long term | - subsidize operation cost of environmental education<br>- found informal small schools for environmental education<br>- establish Mamminasata's original environmental guideline for schools | - subsidize purchase of eco-products<br>- establish Mamminasata's original environmental guideline for families | - foster leaders in environment<br>- establish environment expert system<br>- establish Mamminasata's original environmental guidelines for hotels, restaurants, shopping malls and companies |

An example of the public sector involvement in the solid waste disposal is illustrated in the following diagram. "Community business" is launched by regional people to resolve various problems. The purpose is to secure the benefit dealing with issues on residential area and cooperating each other.

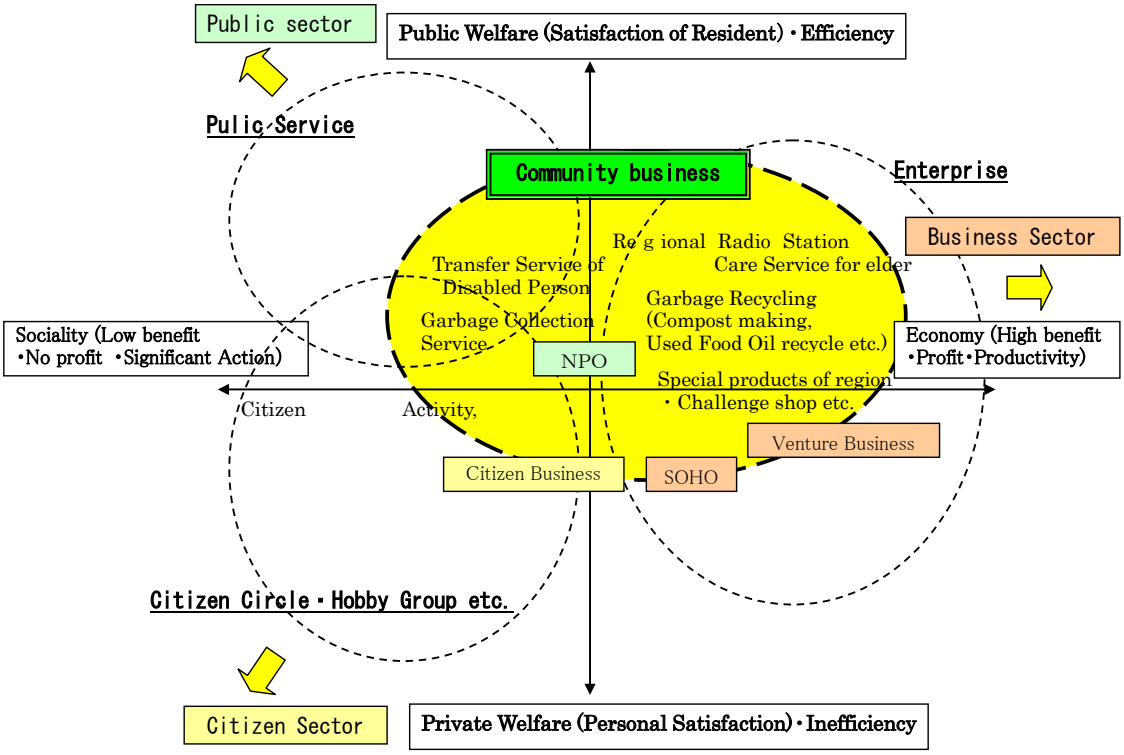



**Figure 2.2: Image of the Public Sector Involvement (Community Business)**

## 2) Pilot Operation of Environmental Awareness at Schools and Communities

In the course of this JICA study, four pilot programs have been operated for the enhancement of public awareness through a public participatory system and environmental education. Reduce, Reuse and Recycle (3R) activities for children and residents are implemented to improve their living environment, including ditch cleaning and tree planting. The pilot program consists in the following.

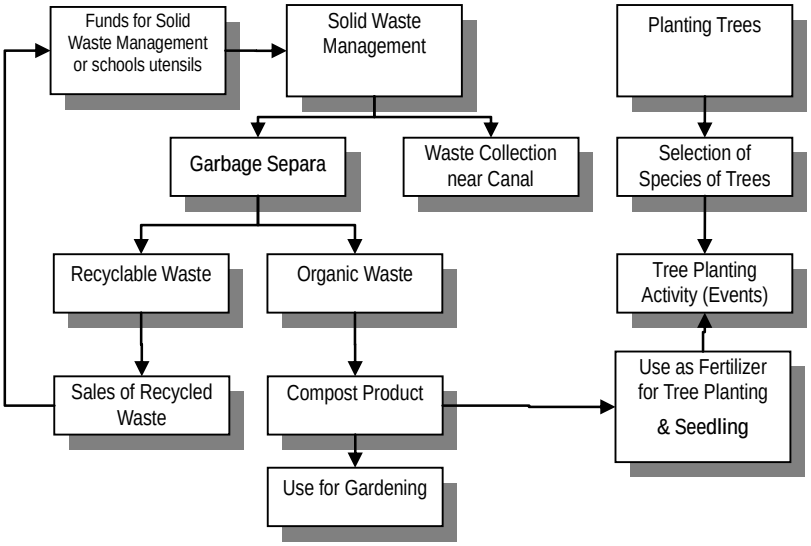



**Figure 2.3 Pilot Project Scheme**

As shown on the above diagram, the pilot program include solid waste management and tree planting and it has been divided into four sub-programs in aspect of the specific features of areas and target groups for sustainable implementation:

(i) Healthy exchange program (Solid Waste Management – clean canal activity)
(ii) Garbage management at households (Solid waste management- garbage separation)
(iii) Environmental education practice at school (Solid waste management- Tree planting)
(iv) Implementation of integrated urban environment improvement at Lakkang Conservation Area

The target groups of each sub-program are summarized in the following table.

**Table 2.2: Target Groups of each Sub-program**

| Activity/Objective / Sub-Program | Waste discharge and collection | 3R activities | Tree Planting |
|---|---|---|---|
| Healthy Exchange Program | for community | - | - |
| Garbage Management at Households (Solid Waste Management- Garbage Separation) | - | for community | - |
| Environmental Education and Practice at School | - | for students | for students |
| Integrated Urban Environmental Improvement at Lakkang conservation area | - | for students<br>for community | for students<br>for community |

The programs i) and ii) above will be discussed in the Sector Study on Solid Waste Management, and the programs iii) and iv) are introduced here.

(1) Environmental education and practice at schools

Activities at schools focus on the introduction of the value of recyclable material. It is important to disseminate the importance of separation of solid waste to the young generation. The target group is primary school students. The student only asked to conduct a simple activity which is to bring recyclable material and collect it in school. The collected material is sold to a recycling collector. Students will decide how to utilize the revenue, for example for buying utensils etc. Other activity is to encourage student to plant trees in schoolyard or around the school or their houses.

**Table 2.3: Environmental Education and Practice**

| Title of sub-program | Environmental education and practice at school |
|---|---|
| Target Place | Primary schools |
| Characteristic of area: | - |
| Specific purpose : | To introduce the value of recyclable material<br>To increase the awareness of children for proper solid waste manage<br>To plant 100 – 1000 tress per school every year |
| Time and duration of program | Dec 2005 - Feb 2006 |
| Target group | School student age 7-10 years-old |
| Inputs | a. Garbage bins ( one set)<br>b. NGO staffs<br>c. Active supervision from Projects |
| Procedure | a. Socialization and explanation of program to the related stakeholders ( Headmaster, PTA, teachers, student representatives)<br>b. Provision of garbage bins<br>c. Meetings and discussions<br>d.. Decided the kind of trees and location of tree planting in the school yard and surroundings |
| Indicators | a. Volume and value of recyclable waste<br>b. Comparison between before and after implementation on spots of dirty area |
| Output and progress | Several socialization program are conducted |
| Participation of core participants | Selected schools agree to participate and conduct the program |
| Advantage of the implementation | Students will influence the parents and surrounding community to increase the awareness of garbage<br>Fund raising from selling the recyclable material will encourage students initiative activities. |

(2) Integrated urban environment improvement at conservation area

The urban zone in Mamminasata except for Makassar City, has enough open spaces for planting and converting them into green spaces. Lakkang ward in Makassar City offers a chance to create parks or green spaces. Lakkang ward is isolated from the city by the Tallo river and wetlands extending along the river. The inexistence of bridge across the river maintains the natural environment. Proper management of waste separation and composting, together with a tree planting program, is a base for development of eco-tourism. In this area, the school/student is a core of community participation approach both for solid waste management and tree planting activities.

**Table 2.4: Integrated Urban Environment Improvement**

| | |
|---|---|
| Title of sub-program | Integrated urban environment improvement at Lakkang conservation area |
| Target Area | Kelurahan Lakkang ( Lakkang ward) |
| Characteristic of the Area: | Conservation area surrounded by Tallo river or wetlands |
| Specific purpose : | To introduce the value of recyclable material<br>To increase the awareness of children for garbage management problems<br>To plant yearly 500 tress in the village<br>To implement garbage separation and composting for zero waste at the conservation area |
| Time and duration of program | Dec 2005 - Feb 2006 |
| Target group | Primary school and community in the ward |
| Inputs | a. Garbage bins ( five sets)<br>b. NGO staffs<br>c. Active supervision from Projects |
| Procedure | a. Socialization and explanation of program to the related stakeholders ( Headmaster, PTA, teachers, student representatives)<br>b. Provision of garbage bins<br>c. Meetings and discussions<br>d.. Decided the kind of trees and location of tree planting in the school yard and surroundings<br>e. Training for composting |
| Indicators | a. Volume and value of recyclable waste<br>b. Comparison between before and after implementation on spots of dirty area<br>c. Volume of compost production |
| Output and progress | Several socialization program are conducted<br>Strong commitment of the chief of ward |
| Participation of core participants | Students and community are willing to participate |
| Advantage of the implementation | 1. Students will influence the parents and surrounding community to increase the awareness of garbage<br>2. Fund raising from selling the recyclable material will encourage students initiative activities.<br>3. Better livelihood and introduction of ecotourism |

These pilot operations have substantially enhanced the environment awareness to the people involved and demonstrate how the environment-friendly society/community is attainable by the participation of citizens.

(3) Tree planting activities

The green cover area in Mamminasata, especially Makassar city, is limited. In order to promote the awareness on environment in Mamminasata, a tree planting pilot project has been implemented.

The green promotion focuses on Lakkang Village located in the conservation zone of Makassar city. The target to inspire the participation is school pupils, community and young generations.

(i) Meeting and Discussion with target groups on kinds of tree and time

schedule for planting day

(ii) Distribution of seedlings to schools and communities

(iii) Planting day ceremony and planting works

(iv) Planting in the school yard, main road of housing complex, home yards

A total of 2,496 seedlings were distributed, with intensive participation of school masters, teachers, pupils, related government offices and local leaders.

**（Green planting in Lakkang village in Makassar）**

**Green planting in Makassar city）**

**（Green planting inGowa regency）**

**（Green planting in Maros regency）**

**（Green planting in Takalar　regency）**

**Table 2.5: Tree Planting Activities**

| Target Area | Target groups | Input | Number of seedlings | Cooperation with |
|---|---|---|---|---|
| **Conservation Zone** | | | | |
| Lakkang village | School pupils and Community | Vegetables seed and mango and jackfruit tree seedlings | **412** | Head of village and school master and teachers |
| **City Center / Semi-urban Zone** | | | | |
| **MAKASSAR** | | | | |
| Primary school SD Toddopuli | School pupils | Mango, rambutan, palm and shading tree seedlings | **230** | PTA |
| Primary school SD Mulia Bakti | School pupils | Mango, jackfruit and rambutan tree seedlings | **200** | PTA |
| Housing Complex Panakukang IV Toddopuli | households | Mango, jackfruit and rambutan tree seedlings | **230** | Informal leaders |
| **GOWA** | | | | |
| Primary School SD Unggulan Paccinongan | School pupils | Mango, rambutan and shading tree seedlings | **277** | Dinas of cleaning and PTA |
| Housing Complex BTN Paccinongan and BTN Pao-pao | households | Mango, rambutan, wooden and shading tree seedlings | **680** | Dinas of cleaning, informal leaders. |
| **MAROS** | | | | |
| Primary School SDN 1 | School pupils | Mango, rambutan, lemon and shading tree seedlings | **227** | Dinas of cleaning and PTA |
| Housing Complex Solojirang | households | Mango, jackfruit, rambutan tree seedlings | **67** | Dinas of cleaning, head of village |
| **TAKALAR** | | | | |
| Primary school SDN Ballo | School pupils | Jackfruit tree seedlings | **150** | Dinas of cleaning and PTA |
| Housing Complex Ballo Indah | households | Shading and Wooden tree seedling | **400** | Head of village, DINAs of environment and cleaning |

## 2.3. Promotion of Recycling System

In Mamminasata, the recycling system has already been initiated, like in the case of a factory for making compost and another factory for reproduction of vinyl products. However, the organic and non-organic wastes are disposed of in a mixed form, making such recycling business less profitable and sustainable.

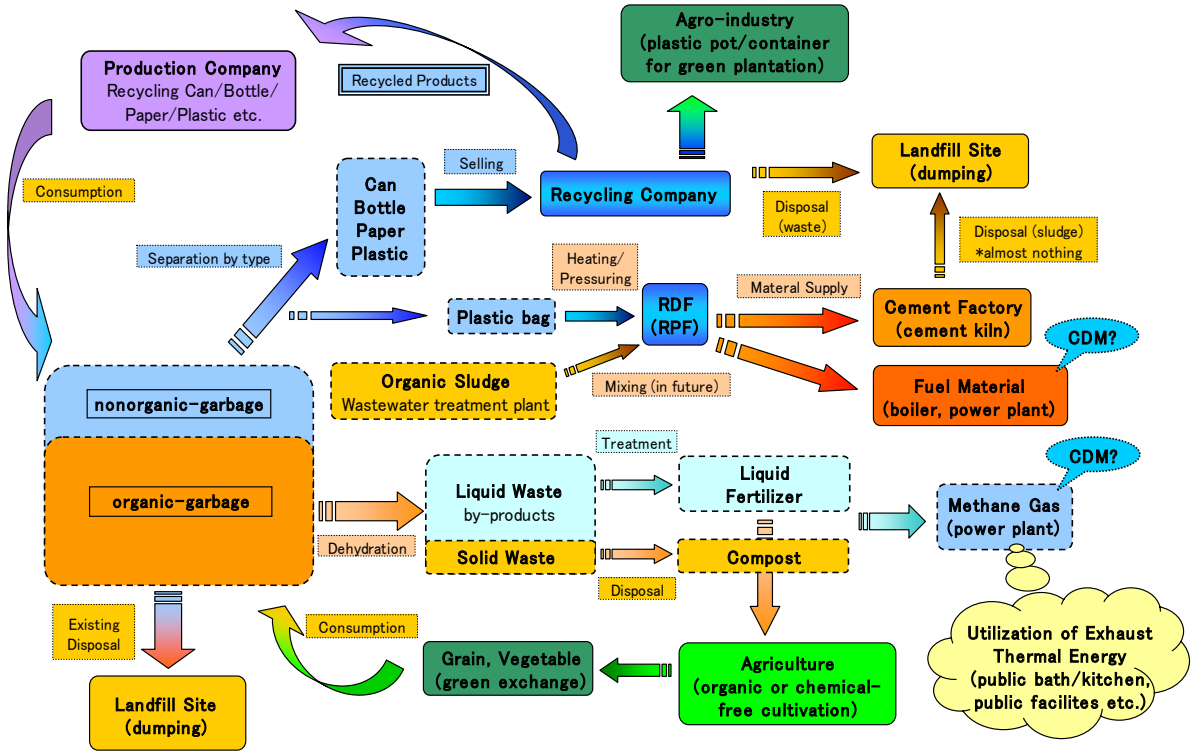



**Figure 2.4: Solid Waste Recycling Model**

The above diagram shows a model of solid waste recycling in a form applicable to Mamminasata. At present, recyclable can, bottle, cardboard, paper and plastic bottles are separated by garbage picker at the landfill site and sold to recycling companies. Plastic bags are difficult to manage, and therefore it is recommended to collect them separately and use them for making refused plastic fuel. In addition, the recycled plastic pots and containers will be utilized as agricultural tools for seeding and carry. Compost and liquid fertilizer will be made of organic solid waste that account for 70 ~ 80 wt% in Mamminasata. Methane gas obtainable in processing compost and liquid fertilizer will also be used for fuel at home and public facilities (e.g., public cooking utilities).

It is reported that the commercial operation of the compost manufacturing enterprise in Mamminasata has found it rather difficult to market their compost to farmers due mainly to the lack of verification that their products are organically not less effective than the chemical fertilizer. Farmers are usually conservative, and some public support will be required in analyzing the effectiveness and promoting organic farming in Mamminasata.

In Takalar regency, the chemical-free vegetable cultivation (sayur sehat) with the citizen participation are carried under the initiative of the Governor who learned the organic farming in Kyoto. The handmade compost is utilized to grow crops and vegetables.

**Healthy vegetable (Sayur Sehat) cultivation in Takalar regency**

## 2.4. Expansion of Green Space

As discussed at the time of defining the framework for the spatial plan formulation, the Mamminasata metropolitan area is less covered with green/forest, and the expansion of green space is one of the targets to attain. The green area framework has been set in the following manner.

**Table 2.6: Green Area Framework for Mamminasata**

| | unit | Makassar | Maros | Gowa | Takalar | Total |
|---|---|---|---|---|---|---|
| **Current** | (%) | 2.4 | 44.5 | 19.8 | 19.0 | 28.7 |
| | (ha) | 440 | 46,620 | 14,300 | 10,450 | 71,810 |
| **Future Target (Provisional)** | (%) | 5.0 | 56.7 | 33.1 | 22.8 | 38.7 |
| | (ha) | 900 | 59,490 | 23,890 | 12,530 | 96,810 |
| **Additional Area Required (Provisional)** | (ha) | +460 | +12,870 | +9,590 | +2,080 | +25,000 |

The land use zoning plan is proposed in such a way that the conservation area is classified into (i) legally protected area, (ii) existing forest area, (iii) afforestation area, and (iv) water-front reserve area. Respective zones are demarcated as shown in the following.

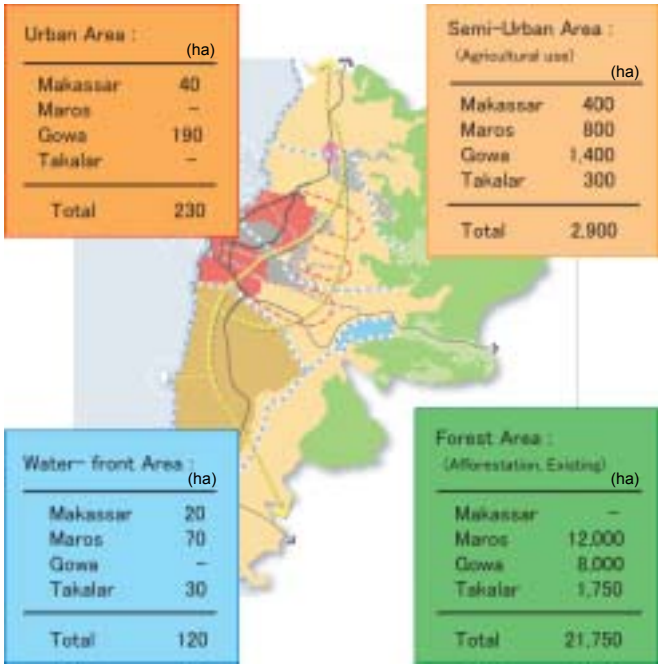



**Figure 2.5 Green Area Expansion Plan**

The land use zoning clearly shows where the tree planting program should be promoted in the conservation area. There is a sizable land to reforest. Tree planning in the water-front reserve area should also be promoted by the public initiative. Since the flood control in the Tallo river and Maros river is planned through non-structural measures (e.g., creation of retarding basin), as discussed separately in the Flood Control and Drainage Study, reforestation should be strategically promoted in such reserved area under the land use zoning.

Tree planting should also be promoted in combination with the proposed infrastructure development in Mamminasata. For instance, road construction will be designed with green coverage in cross section to mitigate the pollution and enhance the amenity. Construction of water supply system and sewerage system, as well as construction of a new landfill site for solid waste disposal, should go hand-in-hand with the promotion of green spaces in and around the public facilities.

The public sector is also expected to collaborate with NGOs, communities, associations and other organizations to promote tree planning in public and private spaces all over Mamminasata. Specific measures are proposed to:

(i) Designate a tree planting week in November so that every group and individual would cooperate in tree planting;

(ii) Designate model schools and residential blocks to specifically promote tree planting for demonstration and awards;

(iii) Put up a board in a public space to show how many trees have been planted by district and/or block, how many public/private fund has been used for tree planting;

(iv) Designate a rule of building space and open space on the owned land, encouraging to plant trees in the open space/gardens;

(v) Encourage the people to plant a tree on a memorial day (e.g., birthday, anniversary of marriage, graduate from school);

(vi) Encourage the people to love flowers and plant them in and outside the houses and streets.

The public sector should monitor and show how the tree planting program is in progress and how it is contributing to the environmental protection and amenity enhancement for the people in Mamminasata.

One of the possible approaches to realize reforestation in a sizable area is to apply the Clean Development Mechanism (CDM) under the Kyoto Protocol. Foreign enterprises who wish to get a credit for reduction of their emission of the pollutant. It is recommended that the reforestation plan be formulated and forwarded to the potentially interested enterprises in the world asking for their investment in exchange for the CDM credit.

In Indonesia, at present, there are some problems regarding the CDM program,

particularly for reforestation/afforestation projects. Such problems are:

(i) Forestry Department is not ready for CDM. (e.g., institution, human resources, working guidelines, regulations concerning with the mechanism of CDM)

(ii) The problem is related with land availability and land ownership are still unclear

(iii) The assurance on income is not definite.

On the other hand, the assessment for CDM in reforestation/afforestation is rather difficult in the following.

(i) Evaluation of baseline volume (carbon offset volume without plantation)

(ii) Evaluation of carbon offset volume by tree species

(iii) Growth of plants during the project term

(iv) International value of CER (Certified Emission Reduction)

However, it does not mean that this is impossible. The Indonesian Forestry Reformation Society (Masyarakat Perhutanan Reformasi Indonesia (MPI)) has initiated preparation for reforestation projects in Sidrap regency. The project area (750 ha) is already prepared by the local government for CDM and it has already got a donor from Finland. The process of approval both at the national level and in donor countries is strict and complicated. If the Sidrap regency project turns out to be a successful model, then, other regencies will find it easy to promote the afforestation program.

## 2.5. Management for EIA

BAPEDALDA is in control of EIA procedure and AMDAL technically evaluates the substance of EIA report through the natural, social and pollution items. At present, AMDAL committee is established in South Sulawesi Province, Makassar city, Maros and Gowa regency.

BAPEDALDA at the provincial/regency level will determine whether EIA should be conducted by central, provincial or regency-city authority. The presentation of EIA framework is proceeded before the field survey at the project site. Thereafter, the document of EIA (ANDAL), Environmental Management Plan (UKL) and Monitoring Plan (UPL) are made by the project execution organization. Direct and indirect impacts should be properly assessed.

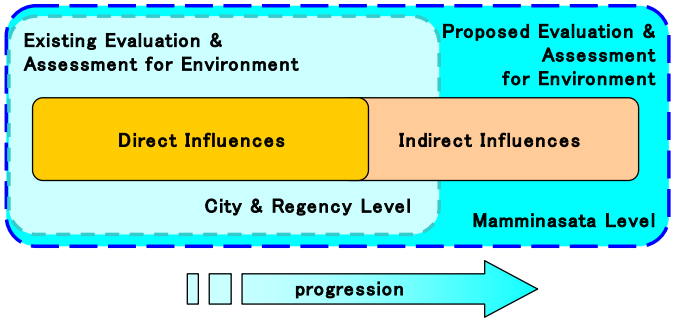



**Figure 2.6 Progress in Environmental Impact Assessment**

# 3. ACTION PROGRAM

## 3.1. Actions for Creation of Environment-friendly Mamminasata

### 1) Proposed Action Programs

A slogan has been set for the integrated spatial plan in Mamminasata to create a "creative, clean and coordinated metropolitan area". The action programs to be proposed for the protection of the environment and enhancement of the amenity will follow this slogan.

Action programs are proposed for (i) promotion of environmental awareness, (ii) waste and garbage collection and recycling, (iii) protection of biodiversity and natural resources, (iv) air pollution control, and (v) water contamination control. The proposed actions are summarized in the following table.

**Table 3.1: Proposed Action Programs (Proposed)**

| Issue | Short Term | Long Term |
|---|---|---|
| Environmental Awareness | ① Environmental Education (Ecology/Economy Education)<br>② Participatory Tree Planting<br>③ Painting Contest<br>④ Symposium on Urban Planning and Environmental Protection<br>⑤ Informal Education at Green School<br>**Environmental Education and Tree planting** | ① Creation of Environment Conservation Village<br>② Environmental Contest among Tourism Facilities<br>③ Introduction of Environmental Maistor System<br>④ Construction of Environment-friendly Houses<br>⑤ Study for Community Money (Eco-money) Introduction |
| Waste and Garbage Material Recycling | ① Garbage Collection by Type<br>② Compost Making<br>③ Used Food-oil Recycling<br>**Beautification Campaign** | ① Emforcement of Relationship with Agriculture<br>② Plastic Bag Charging System (Consumer Paying System)<br>③ Empowerment of Garbage Picker<br>④ Institution of CDM Study Group |
| Natural Resources and Biodiversity | ① Creature Breeding<br>② Mangrove Plantation | ① Afforestation through CDM<br>② Institutionalization of CDM Assessment<br>③ Preservation of Tallo and Maros River Estuaries |
| Air Pollution Control | ① Decrease in Lead in Gasoline<br>② Bio-diesel Fuel (BDF) Production | ① Rape Blossoms Project<br>② Reduction in Vehicle Traffic |
| Water Contamination Control | ① Seaside Beautification<br>② Cleaning in Drainage Canals<br>**Beautification Campaign** | ① Biological Purification in Water-front Zone |

Among the action programs proposed above, the waste and garbage recycling program will be discussed separately in the Solid Waste Management Study.

### 2) Basic Policy and Procedure

Although more creative and fresh ideas/programs will be suggested, it is important to strengthen the relationship and cooperation among stakeholders in Mamminasata with a common target to create a really comfortable and a clean residential area, as well as to keep up a good condition of biodiversity for the benefit of the residents and the future generations.

Each action plan is valid individually for the creation of environment-friendly residence, but the combination of each action plan is more effective. In this context, the collaboration with residents, public organization and other stakeholders is valuable. Moreover, it is important to monitor the result and modify the program properly. It is essential to execute and continue the PDCA cycles (Plan, Do, Check, Action).

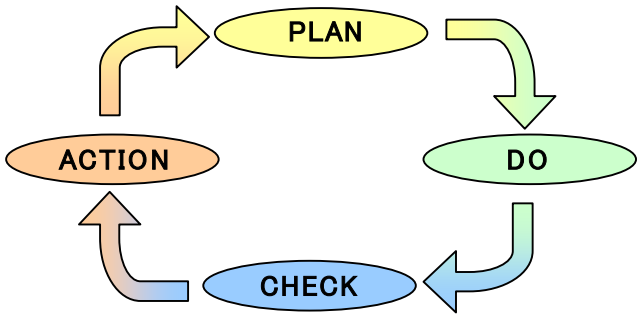



**Figure 3.1 Image of PDCA Cycle**

For residents (citizen), participation in the action programs are needed, enjoying genuinely their participation. Individual opinions should be spoken out sincerely. It is essential that the suggestion is made for improvement including the mind of participating, cooperating, supporting and doing willingly.

For the public institutions, the capability for project management, planning, continuance, sustainability and strong leadership for environment-friendly conception are needed. The most important factor is how to attract, entertain and please the participants in action programs, and how to sustain the interest in the environment-friendly action plans.

## 3.2. Promotion of Environmental Awareness

### 1) Short-tem Action Programs

As discussed in the foregoing Section, the environmental awareness should be promoted in every part of the activities in Mamminasata. The programs will include the following.

(1) Environmental Education

Primary focus will be put on the primary and secondary school education. It would include, but not limited to, the following actions:

(i) Dissemination of the pilot projects executed in the course of this Study to other areas;
(ii) Training of school teachers in the environmental education at schools;
(iii) Preparation and distribution of leaflets on the biodiversity in Mamminasata;
(iv) Promotion of solid waste collection, tree planting and other environmental activities at schools;
(v) Dissemination of the effect on health by the air and water pollution;
(vi) Visit to reservation forest and other reserved area for study on biodiversity;

(2) Participatory Tree Planting

Tree planting to attain the goal of green space in Mamminasata will be promoted as discussed in the foregoing Section. It will include, but not limited to, the following programs.

(i) Designate a tree planting week in November and everybody joins in tree planting in this week;
(ii) One house – one tree planting every year;
(iii) Tree planting on a memorial day (birthday, marriage anniversary, school anniversary)
(iv) Putting up a board to show how may trees have been planted in a certain period and where they have been planted;
(v) Promotion of the use of organic compost for fertilizing tree planting;

The participation of citizens and NGOs is important for successful implementation of tree planting in the urban zone. Since the space for tree planting in urbanized area is limited, tree planting along the roadside, public open space, and individual householder's garden are quite valuable.

On the other hand, the maintenance of roadside and public space trees would become a burden on the public budget. Therefore, it is necessary to establish a participation system of citizens and/or NGOs, as well as an adoption system[3] for communities and participants. The proposed action plan for tree planting in the urban zone is illustrated as follows.

[3] The applicants get the tree ownership, and after they rear and maintain the trees as watering and fertilizing. The sponsors buy the tree ownerships, the contractors execute the growth and care based on the contributed fund.


**Figure 3.2: Tree Planting Program in Urban Zone**

The maintenance of the afforestation program is also an issue to be addressed in the Suburban and Protection zone. Therefore, the participation of residential people, cooperation of communities and support of private enterprises are essential for the success in tree planting in these zones. Introduction of the CDM program into afforestation will also be studied. The proposed plan for afforestation in the Suburban and Protection zone is illustrated as follows.

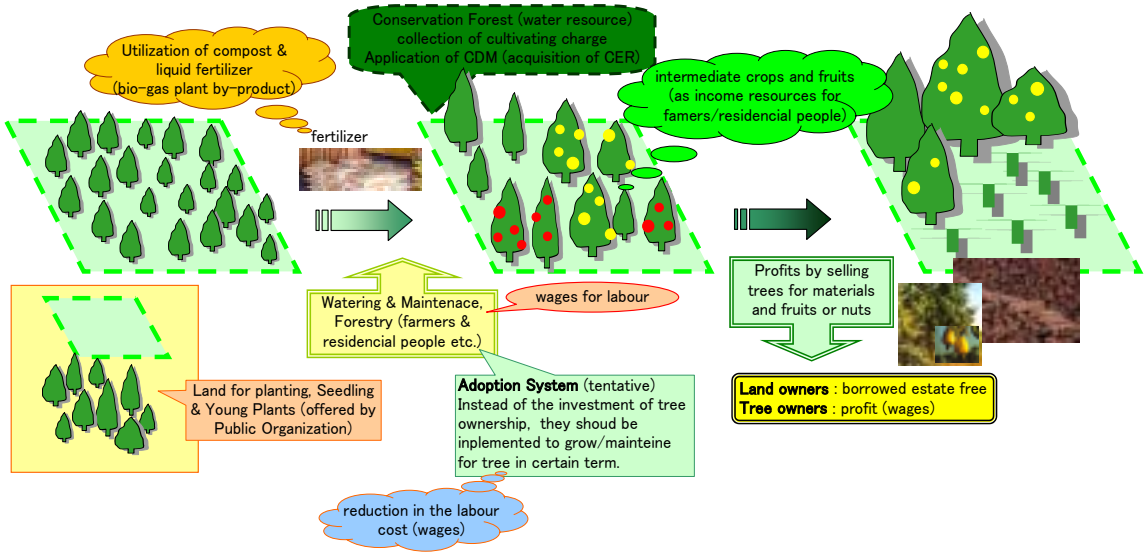



**Figure 3.3: Afforestation Program in Suburban and Protection Zone**

(3) Painting Contest

In the course of the JICA Study, a painting contest has been held among the secondary school and high school students. Nearly 150 paintings have been offered, drawing attention of the school children. This contest is to be continued on an annual basis. It is encouraging that not only the education sector but also private enterprises have cooperated in executing the contest.

(4) Symposium on Urban Planning and Environmental Protection

For the students and adult, symposiums and/or workshops will be held to discuss on the creation of the environment-friendly metropolis in Mamminasata and how to transfer to the next generations.

(5) Informal Education at Green School

Some informal schools in Makassar offer the environmental education with meals for green education. They should be encouraged more. An idea is to put it in such a form that university students would more actively collaborate in informal education at green schools.

**2) Long-term Action Programs**

(1) Creation of Environment Conservation Village

A pilot project has been executed to make Lakkang village an "Eco-Village". We must see how it is sustainable. In the event that Lakkang village proves successful, it will show a model for creating the eco-villages in rural areas in Mamminasata. Village leaders will be invited to see how the model is operated and if it is practicable in their villages.

**(Lakang village in Makassar)**

(2) Environmental Contest among Tourism Facilities

Tourists are more conscious about the environment and amenity, though hotels, restaurants and other tourism facilities are currently less aware of the environmental consideration. An idea is to encourage them to obtain ISO14000 certificate and provide them some awards for their contribution to the creation of the environment-friendly metropolitan area in Mamminasata.

At the first step, the establishment of Mamminasata's Original Environmental Guidelines is to be considered under citizen participation and cooperation of stakeholders. A model is seen in Minamata city, Japan where the original Environmental Guideline for householders has been established. It is a para-standard

different from the official ISO14000 Standard. After the establishment, the children have turned into realizing the significance of the environmental load reduction in energy and resource saving.

(3) Introduction of Environmental Maistor System

An idea is to extend an environment maistor certificate to excellent organic farmers, butterfly breeders, compost manufacturer, excellent villagers in separate garbage collection and so on. A creative approach specific to Mamminasata will enhance the public awareness on the environment.

(4) Construction of Environment-friendly Houses

Reportedly, a house with its building surface covered with green has less heat/ temperature inside, and it does not need air-conditioning. Real estate developers and academic circles would collaborate to construct such a type of residence and offices to save energy and enhance the amenity.

## 3.3. Biodiversity and Natural Resource Protection

### 1) Short-term Action Programs

(1) Creature Breeding

Schools in each regency will promote some creature breeding as practical science. For instance, schools in Maros may adopt butterfly breeding, while Takalar schools may introduce fishery cultivation. Revenues from the breeding activities may be used for purchasing teaching materials at schools. The program will constitute an environmental education at the same time.

(2) Mangrove Plantation

Mangrove forest area has been decreasing in the coastal zone in Mamminasata, and mangrove tree planning is to be promoted. It can be a program for tree planting as proposed previously, or it may be promoted separately by NGOs and other groups interested in the environmental protection. University students are also encouraged to participate in this program.

**(Mangrove plantation in Takalar)**

### 2) Long-term Action Program

(1) Afforestation through CDM

Afforestation in the designated area will be promoted by applying the CDM credits. The public offices and UNHAS will form a task force and collaborate in preparing a

plan for such a program and invite international enterprises to invest.

(2) Institutionalization of CDM Assessment

The public and academic sectors are expected to set up a study group on CDM assessment and facilitate the application of this mechanism for the attainment of a creative and clean metropolitan area in Mamminasata.

(3) Preservation of Tallo and Maros River Estuaries

Biodiversity in the estuary of the Tallo and Maros rivers will be systematically assessed as a continued research program of UNHAS, step by step and year by year. It is important that the university education would involve more practical learning by doing, and such a research program would be appropriate for a program of university education and research.

## 3.4. Air Pollution Control

### 1) Short-term Action Program

(1) Decrease in Lead in Gasoline

It is observed that air pollution in Mamminasata is partly caused by high contents of lead in gasoline for vehicle operation. It is quite unhealthy, and lead contents should be decreased by defining in the environmental regulations.

(2) Bio-Diesel Fuel Production

An innovative program is proposed to evaluate a possibility of developing bio-diesel fuel (BDF) using food oil wasted in the region. BDF is used for diesel engine without any reform, and it would decrease the suspended particulate matters (SPM). It is reported that BDF will decrease black lead in exhaust gas by 67% and $CO_2$ by 24% if compared with diesel fuel. Badan Pengkajian dan Penerapan Teknologi (BPPT) has been testing this BDF. It is proposed that viability and sustainability of BDF is assessed by the public and/or academic circles for practical introduction in Mamminasata.

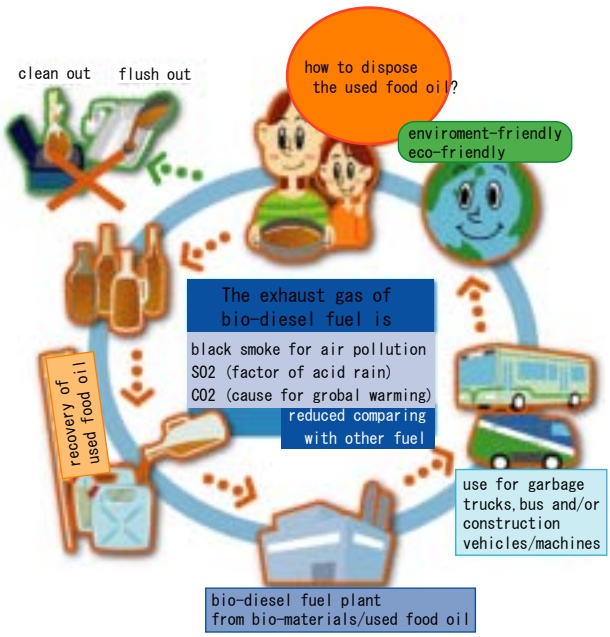



**Figure 3.4: Recycle Image of Bio-Diesel Fuel**

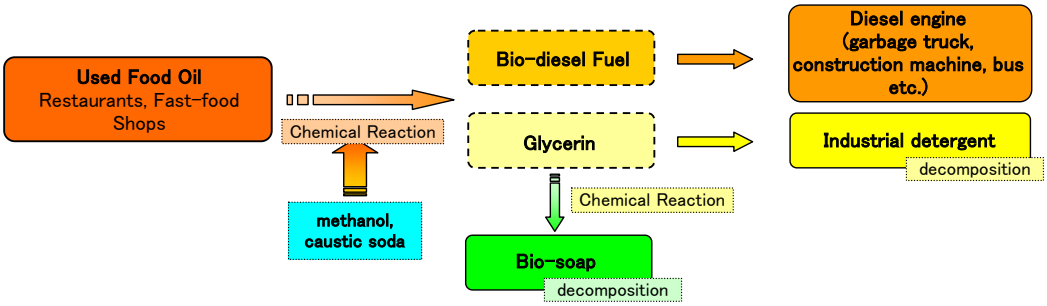



**Figure 3.5: Diagram of Bio-Diesel Fuel Program**

### 2) Long-term Action Program

(1) Rape Blossoms

A trial and study is proposed for cultivation of rape seeds and other vegetable oil in combination of the green space expansion in water-front reserve zones along the major rivers in Mamminasata. Rape seed oil is proposed as it can be utilized for production of BDF mixed with wasted food oil. Study on production of ethanol and its use for fuel would also be recommended.

(2) Reduction in Vehicle Traffic

The environmental impacts of the reduction in traffic through the introduction of large bus services in Mamminasata, instead of further increase in Pete-Pete micro-bus should be assessed scientifically.

## 3.5. Water Pollution Control

### 1) Short-term Action Programs

(1) Seaside Beautification

It is really regrettable that the seashore of the Losari Beach is full of garbage and polluted by sewerage and effluent directly discharged into the beach without treatment. Although the JICA study is recommending to implement an off-site sewerage treatment stage by stage in Mamminasata, there is no need to wait for such a treatment plant to put into operation. At least, pedestrians along the Losari Beach should observe not to throw garbage into the seashore. The environment awareness program should be particularly formulated to this end. Other coastal zone should also be promoted for beautification.

(2) Cleaning in Drainage Canals

The pilot project has proved, at least during the study period, that the health exchange program is effective. Such a participatory program should be disseminated to other canal zones where low income households are dwelling. Likewise, drainage canals should be flushed by the Jenneberang water throughout the year.

### 2) Long-term Action Program

(1) Biological Purification in Water-front Zone

Combined with the water-front conservation program, it is suggested to study how the biological purification could be effective in the control of the eco-system in river and blackish water zone. For instance, mangrove planting has been proved effective in blackish water. It should be proved how effective is the cultivation of palm (nipah) along the rivers.

Although more creative programs will be conceivable, it is suggested that a step be taken by all stakeholders in Mamminasata with a common target to create a clean metropolitan area for the benefit of the people and the future generations.

## 3.6. Action Plan by Zone

Mamminasata is classified into 4 zones i.e., (i) Urban zone, (ii) Agricultural zone, (iii) Forest zone, and (iv) Water-front zone. The action plans for the respective zones are shown in the following figure.

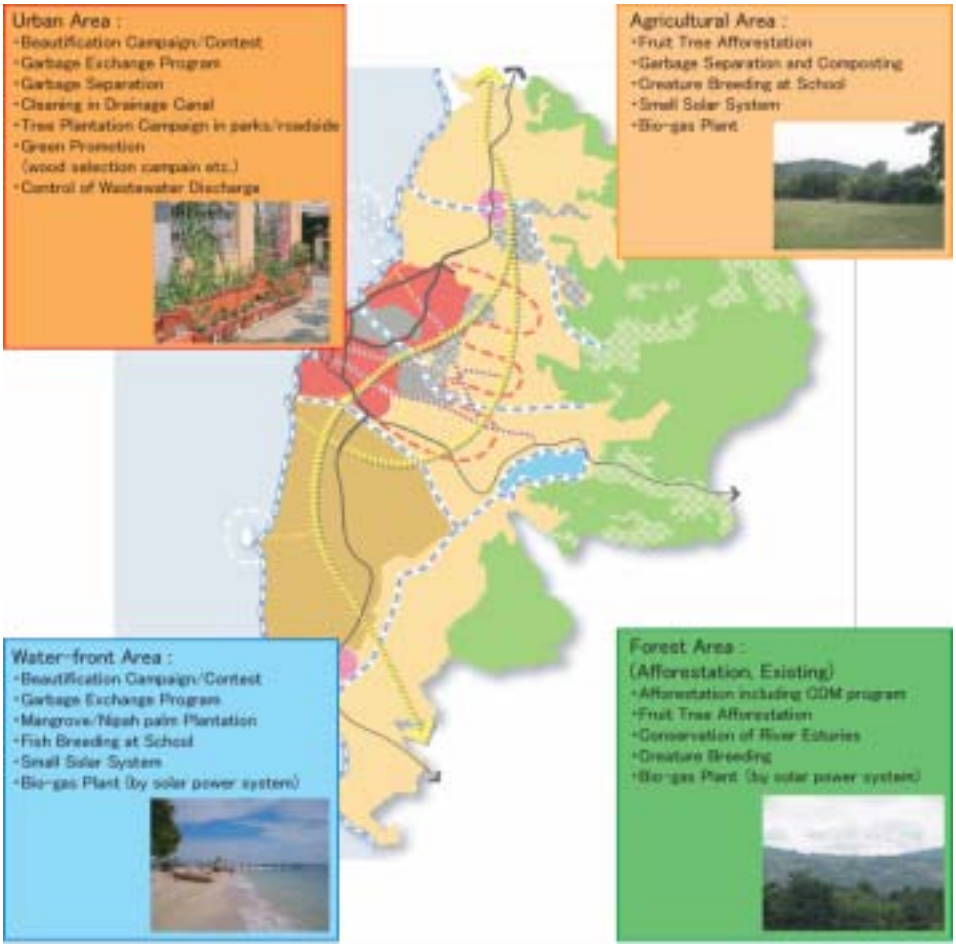



**Figure 3.6: Action Plan by Zone**

### 1) Urban Area

The beautification campaign is a main program of action plans in Urban area. Basically, the beautification campaign is presided by the public institution and private companies support as sponsors. The participation and cooperation of residents and NGOs are essential.

The main action programs of the beautification campaign are garbage exchange, garbage separation, cleaning in drainage canal and tree plantation. The vital elements are the participation of citizen, the adoption system and the reduction in maintenance and/or nourishment cost.

A tree planting day will be designated by the provincial government in a participatory approach. The adoption system for growing trees will be introduced. A child's name is stuck on each tree in order to have them understand the ownership and responsibility to care for by watering.

The organic compost from the left-over of householders and sludge of roadside ditches can be used as fertilizer for trees.

The wastewater treatment plants are desirable as the drastic measure to improve the present condition. Other supporting measures for the control of wastewater will include the following.

(i) To obligate that the septic tank is made certain to equip for new house
(ii) The promotion for the combined household wastewater treatment facility
(iii) The examination for establishment of gravel water filtration system[4] at meeting place of drainage canal/channel in Makassar city

### 2) Agricultural Area

A core program is garbage separation and composting in agricultural area. The dry and wet garbage is separated. Basically dry garbage is recycled and wet garbage is composted. The compost is applied usefully as fertilizer for cultivation or afforestation.

### 3) Forest Area

In Forest area, main program is afforestation (including the fruits tree plantation). Although, CDM is considered to be useful for afforestation program, a participatory green plantation plan is suggested for promotion in the meantime.

(i) Measure for participatory system

[4] This system is widely utilized for river water treatment applied the natural purification process. This way is resolved the organic matters and constituents by microorganism during the river water runs through the gravels and small rocks.

- Innovation of adoption system
- Advancement for participation of students
- Promotion for involvement of universities and public companies
- Support by NGOs (project management and creation of fund etc.)

(ii) Utilization of organic fertilizer and composting

- Garbage compost making and creation of garbage recycling system
- Advancement for garbage exchange program (evolution for green exchange program)

(iii) Application of CDM program

- Ensuring the calculation methodology of CDM baseline volume
- Accumulation of the data on carbon offset volume by tree species

(iv) Policy for afforestation of public sector

- Definition of principle for afforestation
- Creation of positive action plan for green plantation

The estuaries of Tallo river and Maros river are valuable in eco-system, and they should be conserved. It is also considered effective to plant mangrove and nipah palm along the rivers.

**4) Water-front Area**

The collection of garbage must be implemented as part of beautification campaign at beaches and islands in the water-front area.

It is also needed to implement the mangrove plantation in order to conserve the coastal line, as well as to preserve the ecosystem and the multiplication of fish and shellfish. A trust fund might be established to collect contributions from individuals, organizations and companies interested in the mangrove seedlings. It is also important to disseminate the information of activities through mass-media.

A relation/responsibility matrix for the proposed action programs is tabulated in a summarized form in the following page.

**Table 3.2 Relation/Responsibility Matrix for Proposed Action Programs**

| No | | Proposed Action Programs / Related Institutions | BKSDA–Natural Conservation Office | Dinas of Health | Local Environmental Impact Control Board | Dinas of Water Resources Management | Dinas of Agriculture | Dinas of Forestry | Dinas[1] of Environmental Management and Beautification | Dinas[2] of Sanitary and Parks | Dinas[3] of Spatial Plan and Environmental Management | Reginal Drinking Water Supply Company | Dinas of Social | Dinas of spatial planning service and housing | Dinas of Workforce | Regional Development Board | House of Assembly | Dinas of Education | Dinas of Tourism and Cultural |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Environmental Awareness | Environmental Education (Ecology/Economy Education) | | | ◎ | | | | ◎ | ◎ | ◎ | | | | | | | ◎ | ○ |
| 2 | | Participatory Tree Planting | ◎ | | ○ | △ | | ◎ | ◎ | ◎ | ◎ | △ | | ○ | | ○ | | ○ | ○ |
| 3 | | Painting Contest | | | ○ | | | △ | ○ | ○ | ○ | | | ◎ | | ○ | | ◎ | |
| 4 | | Symposium on Urban Planning and Environmental Protection | ○ | △ | ◎ | ○ | △ | △ | ◎ | ◎ | ◎ | △ | △ | ○ | | ○ | ○ | ○ | △ |
| 5 | | Informal Education at Green School | ○ | △ | ○ | ○ | △ | △ | ○ | ○ | ○ | △ | △ | ○ | | △ | | ◎ | |
| 6 | | Creation of Environment Conservation Village | △ | △ | ◎ | | △ | | ◎ | ◎ | ◎ | | △ | △ | | △ | △ | ○ | ○ |
| 7 | | Environmental Contest among Tourism Facilities | | △ | ○ | △ | | | ○ | ○ | ○ | | | ○ | | △ | | | ◎ |
| 8 | | Introduction of Environmental Maistor System | | | ○ | | | | ○ | ○ | ○ | | △ | | ◎ | | | ○ | ○ |
| 9 | | Construction of Environment–friendly Houses | | △ | △ | | | | △ | △ | △ | | △ | ○ | | ○ | ◎ | | △ |
| 10 | | Study for Community Money (Eco–money) Introduction | | | | | | | | | | | ◎ | | △ | | | ○ | △ |
| 11 | Natural Resources and Biodiversity | Creature Breeding | ○ | | ◎ | | | △ | ○ | ○ | ○ | | | | | | | ◎ | △ |
| 12 | | Mangrove Plantation | ○ | | ○ | △ | | ○ | ○ | ○ | ○ | | | △ | △ | △ | | ○ | ○ |
| 13 | | Afforestation through CDM | ◎ | | ○ | △ | | ◎ | △ | △ | △ | △ | | | ○ | | | △ | △ |
| 14 | | Institutionalization of ODM Assessment | ○ | | ○ | △ | | ◎ | △ | △ | △ | △ | | | | | | △ | |
| 15 | | Preservation of Tallo and Maros River Estuaries | ◎ | | ○ | | | | ○ | ○ | ○ | | △ | △ | | △ | | ○ | ○ |
| 16 | Air Pollution Control | Decrease in Lead in Gasoline | | ◎ | ○ | | | | ○ | ○ | ○ | | | | | | | △ | |
| 17 | | Bio–Diesel Fuel Production | | ○ | ◎ | | | | ◎ | ◎ | ◎ | | | | ○ | | | △ | |
| 18 | | Rape Blossome | △ | △ | ○ | | ◎ | ○ | △ | △ | △ | | | △ | △ | △ | | ○ | ○ |
| 19 | | Reduction in Vehicle Traffic | | ○ | ◎ | | | | ○ | ○ | ○ | | | △ | | △ | | △ | |
| 20 | Water Contamination Control | Seaside Beautification | ○ | △ | ◎ | | | | ◎ | ◎ | ◎ | | | △ | | △ | | ○ | ◎ |
| 21 | | Cleaning in Drainage Canals | | ◎ | ○ | △ | | | ○ | ○ | ○ | | △ | ○ | △ | ○ | | ○ | |
| 22 | | Biological Purification in Water–front Zone | △ | △ | ◎ | ○ | △ | △ | ○ | ○ | ○ | | △ | △ | △ | △ | | △ | △ |

Remarks ◎ : Main Institution
○ : Coopration Institution
△ : Supporting Institution

Notes DINAS1) : in Makassar City
DINAS2) : in Maros, Gowa and Takalar Regency
DINAS3) : in Takalar Regency

# ANNEX

## PILOT PROJECT OF TREE PLANTING

### Back ground

Mamminasata area is designed as an eco-friendly and human-centered metropolis. To attain this goal, green area must be increased and more trees should be planted. Makassar city needs to double its green area. Green movement would require the enhancement of people's awareness living in the area. Abundant sunshine and relatively high temperature make trees and green spaces most important amenities in the Metropolitan Area of Mamminasata.

In this Study, a Tree Planting Pilot Project has been conducted to identify the methods, constraints and problems, so that a practical form of people's activity in planting could be examined for the implementation of the Mamminasata spatial plan.

### Purpose

1. To increase people's awareness of the importance to amenities of green area
2. To derive a practical and implementable form in tree planting, that can be widely applied in other areas.

### Expected output

1. Children understand the importance of tree and green space
2. Children have experience in planting trees by themselves
3. The awareness of surrounding community is increased

### Method

Basically, a participatory approach is applied.

1. Target groups: children ( primary school);
   two schools in the city each represent high economy class and middle economy class and one school in the proposed green area of Makassar city , one school each in Maros, Sungguminasa –Gowa and Takalar
2. Target Location: Schools and housing complexes

   School Areas.
   - SD Unggulan Toddopuli, Kelurahan Paropo, Kecamatan Panakukang, Makassar.
   - SD Mulya bakti, Jl. Sungai Saddang, Kelurahan Balla Parang, Kecamatan Rappocini, Makassar.
   - SD Negeri Lakkang, Kelurahan Lakkang, Kecamatan Tallo, Makassar.

- SD Unggulan Paccinongan, Kelurahan Paccinongan, Kecamatan Somba Opu, Kabupaten Gowa.
- SD Negeri Ballo, Kelurahan Ballo, Kecamatan Mapakasunggu, Kabupaten Takalar.
- SD Negeri 1 Maros, Kelurahan Turikale, Kecamatan Turikale, Kabupaten Maros.

Settlement areas nearby the target schools:

- Public housing of Panakukang IV Toddopuli, Kelurahan Paropo, Kecamatan Panakukang, Makassar .
- Public housing of Gladiol, Kecamatan Panakukang, Makassar.
- Kelurahan Lakkang, Kecamatan Tallo, Makassar.
- BTN Paccinongan, Kelurahan Paccinongan, Kecamatan Somba Opu, Kabupaten Gowa.
- BTN Ballo Indah, Kelurahan Sombalabella, Kecamatan Mappakasunggu, Kabupaten Takalar.
- Lingkungan Solojirang, Kelurahan Turikale, Kecamatan Turikale, Kabupaten Maros.

3. Facilitator : NGO
4. Implementator : Government and JICA Study Team

**Activities**

1. Explanation of the program to attract the attention and willingness of teachers and children to participate
2. Discussion on how to implement the program: kinds of trees, place and schedule
3. Preparation of seedlings
4. Tree planting ceremony and implementation.

The details of activities are as follows:

1. Program at schools are explained to school-masters, teachers and representative of pupils. All schoolmasters are enthusiastic and actively participate in encouraging their pupils. List of socialization meetings is presented in Table A1

**Table A 1: List of Socialization Meetings and Discussions (Tree Planting Program)**

| Region | Target location | Socialization –discussions meeting schedule | Participants | |
|---|---|---|---|---|
| | | | numbers | category |
| Makassar | School | Dec 3, 2005 | 35 | Pupils, head master, teachers. PTA |
| | | Dec 3, 2005 | 28 | Pupils, Dinas of education, master, teachers. PTA |
| | | Dec 3, 2005 | 57 | Pupils, master, teachers. |
| | Community | Dec 30, 2005 | 103 | Community, Community leaders, head of ward office |
| | Housing complex | Nov 22, 2005 | 28 | Community, ward office staffs, community leaders. |
| Maros | School | Dec 1, 2005 | 18 | Dinas of sanitation, Dinas of education, Pupils, head master, teachers. PTA |
| | | Dec 24, 2005 | 87 | Pupils, head master, teachers. PTA |
| | | Dec 26, 2005 | 80 | Pupils, head master, teachers. PTA |
| | Community | Dec 31, 2005 | 19 | Community, ward office staffs, community leaders, youth groups, women group., religion group |
| Gowa | School | Dec 2, 2005 | 30 | Dinas of sanitation, Dinas of education, Pupils, head master, teachers. PTA, Pupils |
| | | Dec 6, 2005 | 31 | |
| | Community | Dec 17, 2005 | 36 | Community |
| Takalar | School | Dec 3, 2005 | 70 | Pupils, teachers, head master, PTA |
| | Community | Dec 3, 2005 | 31 | Community |
| | | Dec 6, 2005 | 38 | Community |

2. A total of 2,046 seedlings are distributed to 6 schools and 4 housing complexes. Seedlings consist in shading trees (e.g., Mahoni and Tanjung), Ornamental trees (e.g., palm trees) and fruit trees (e.g., mango, jackfruits, orange and rambutan). Variety and quantity distributed is listed in Table A2. Two schools in Makassar city, which represent middle and high economies, have no more space in the schoolyard to plant trees. For these two schools they decided to plant the trees along the street in front of schools, and pupils who are willing to plant trees in their house yard can bring a seedling to their house. Seedlings are prepared by NGOs.

**Table A2: Distributed Seeds and Seedlings to Schools and Communities**

| Target Area | Target groups | Input | Number of seedlings | Cooperation with |
|---|---|---|---|---|
| **MAKASSAR** | | | | |
| **Conservation Zone** | | | | |
| Lakkang village | School pupils and Community | Vegetables seed, mango and jackfruit tree seedlings | **412** | Head of village and school master and teachers |
| **City Center** | | | | |
| Primary school SD Toddopuli | School pupils | Mango, rambutan, palm and shading tree seedlings | **230** | PTA, head master, teachers |
| Primary school SD Mulia Bakti | School pupils | Mango, jackfruit and rambutan tree seedlings | **200** | PTA, head master, teachers |
| Housing Complex Panakukang IV Toddopuli | households | Mango, jackfruit and rambutan tree seedlings | **230** | Informal leaders |
| **GOWA** | | | | |
| Primary School SD Unggulan Paccinongan | School pupils | Mango, rambutan and shading tree seedlings | **277** | Sanitation and PTA Services |
| Housing Complex BTN Paccinongan and BTN Pao-pao | households | Mango, rambutan, wooden and shading tree seedlings | **680** | Sanitation Services, informal leaders. |
| **MAROS** | | | | |
| Primary School SDN 1 | School pupils | Mango, rambutan, lemon and shading tree seedlings | **227** | Sanitation Services and PTA |
| Housing Complex Solojirang | households | Mango, jackfruit, rambutan tree seedlings | **67** | Sanitation Services, head of village |
| **TAKALAR** | | | | |
| Primary school SDN Ballo | School pupils | Jackfruit tree seedlings | **150** | Environment and Spatial Plan Services and PTA |
| Housing Complex Ballo Indah | households | Shading and ornamental tree seedling | **400** | Head of village, Environment and Spatial Plan Services |

3. Active participation of government officers

   Positive responds from government officers are noticed. Some suggestions and cooperations are received. At the beginning, government institutions were not willing to collaborate, but after series of explanations and field visits, they took initiative to collaborate and participate in almost all activities.

4. Community participation

   All schools head master and teachers responded positively and actively collaborated. For this reason, the activities at school run smoothly as scheduled. Minor revisions for the implementation have been made only for the reason of dense curriculum and schools examination time.

**Evaluation and Suggestions**

Most target groups understand the purpose. Provision of seedlings by purchasing seedlings from other NGOs is one weakness to be criticized. It will be more sustainable if the seedlings are prepared by pupils or some community groups surrounding the target location. In this extent, the roles of NGO must be strengthened by increasing skills and knowledge on environment issues and tree planting. Roles and funding by government should also be encouraged by assuring the budget allocation and implementation of tree planting program.

Based on the experience in the pilot project implementation, several suggestions are made to assure the sustainability of the action plan program (Table A3). For easy start and more fruitful result, it is suggested to encourage and prepare budget for integrated tree planting with solid waste management at all schools and colleges. Total number of 2,240 schools with total number of 525,000 pupils and university students ( Table A4) it is possible to attain the target of one million trees a year. To make it more, significant, target location for the first year should be concentrated on the public space such as cultural heritage, public parks, etc. (Table A5).

**Table A3: Suggestions for Future Plan Based on Reflection and Assessment of Pilot Project Activities**

| Pilot Project items | Activities | Assessment | Suggestions for future implementation |
|---|---|---|---|
| Provision of Seedlings | Community and schools received the seedlings from NGO who purchased the seedlings through NGO network. | It is necessary that community and pupils understand how the seedlings is prepared. | NGO takes initiative to prepare nursery and growth seedlings in the neighbourhood for example : in the schoolyard or in the housing complex and encourage pupils and community to participate in watering or other works. |
| Planting | Planting by community and pupils started with ceremony | Planting ceremony can be considered as promotion and dissemination. This type of activities is very popular for Indonesian community. | Planting ceremony or Mamminasata Planting weeks can be establish during the beginning of rainy season, in October or November |
| Roles of NGO | Arrangement of socialization and discussions | NGO members have skills for communicating programs, however, technical skill and knowledge on greening and seedling preparation was limited | Selection of facilitators who have skills and experience in greening or environmental knowledge or academic back ground is necessary |
| Cost and fund | Paid by JICA | Pilot project should be considered only for promotion, introducing the idea and know how of the program implementation | Encouraging all schools and to prepare their own seedling nursery as part of school learning, assisted by government staffs and NGOs |
| Integrated program | Integration with solid waste management | The integration component is connected by the composting activities derived from waste selection. In this pilot project the composting part was not fully implemented for technical reason and NGOs capability | The cycle of waste selection – composting of organic waste component – using compost for seedling preparation – planting trees at planting week should be proposed . |
| Roles of related government institution | Participate in planting ceremony and invite the participants | Less initiatives and budget allocation for community based tree planting program. | Assistance and training on integrated plan for clean and green city. |

**Table A4: Number of Schools and Pupils in Mamminasata 2003**

| | **Makassar** | | **Maros** | | **Gowa** | | **Takalar** | | **Total** |
|---|---|---|---|---|---|---|---|---|---|
| | school | student | school | student | school | student | school | student | student |
| Primary schools | 477 | 139761 | 447 | 43253 | 445 | 73397 | 246 | 36128 | 292539 |
| Junior High school | 188 | 56839 | 63 | 12545 | 81 | 14587 | 37 | 17444 | 101415 |
| Senior High school | 123 | 39952 | 27 | 7297 | 28 | 8066 | 17 | 6622 | 61937 |
| College | 61 | 114189 | na | na | na | na | na | na | 114189 |
| Total number schools/students | 1615 | 350741 | 369 | 63095 | 195 | 96050 | 61 | 60194 | Schools 2240 Pupils 570080 |

na = data not available

**Table A5: List of Cultural Heritage in Mamminasata Which is the First Priority Target Location for City- Greening Program**

| City/Regency | Name of Cultural Heritage | Type of Cultural Heritage | Location |
|---|---|---|---|
| MAKASSAR | Fort Rotterdam | Historical building | Jl. Pasar Ikan, Makassar |
| | Fort Somba Opu | Historical building | Somba Opu District, Makassar |
| | The grave of Prince Diponegoro | grave | Jl. Diponegoro |
| | The grave of Tallo Kingdom | grave | |
| | Babul Firdaus (Jongaya) Mosque | Historical building | Jl. Kumala 150 |
| | Ma'mur Dato ribandang Mosque | Historical building | Jl. Sangir 28 |
| | Taqwa Mosque | Historical building | Jl. Dr. Wahidin Sudiro Husodo 155 |
| | Assaid Mosque | Historical building | Jl. Lombok Lr. 9A |
| | Anshar Mosque | Historical building | Jl. Somba Opu |
| | Ibu Agung Bahari Chinese Temple | Historical building | Jl. Sulawesi 43 |
| | Naga Sakti Chinese Temple | Historical building | Jl Sulawesi 43 |
| | Sociatet De Harmonie | Historical building | Jl. Riburane No.15 |
| | Kantor Dep. Keuangan (Treasury Dept. Office) | Historical building | Jl. Jend. Ahmad Yani No. 1 |
| | Kantor Pengadilan Negeri (State Justice Building) | Historical building | Jl. Kartini 18 |
| | Ujung Pandang Fort | Historical building | Jl. Ujung Pandang |
| | SD Timor (Timor Elementary School) | Historical building | Jl Timor 79 |
| | Sekolah HWA CHIAO I | Historical building | Jl. Bone rate 10 |
| | Kantor Walikota Makassar (Makassar City Major's Office) | Historical building | Jl. Ahmad Yani |
| | Musium Kota Makassar (Makassar City Museum) | Museum | Jl. Balai Kota 11 |
| | Stella Maris Hospital | Historical building | Jl. Somba Opu 273 |
| | Dinas of Cultural & Tourism of South Sulawesi Province | Historical building | Jl. Jend. Sudirman 32 |
| | Monument of Korban 40.000 jiwa | Monument | Jl. Korban 40.000 |
| | House of H.A. Mappanyuki | Historical building | Jl. Kumala |
| | House of A. Pangerang Pettarani | Historical building | Jl. Kumala |
| | The grave of Dato ribandang | Grave | Jl. Sinassara |
| | Rappocini Cemetery Complex | Grave | Jl. Rappocini Raya Lr 3A |
| MAROS | Leang-leang Cave | Cultural artefacts | |
| | Sumpang Bita Prehistoric Park | Historical park | |
| GOWA | Balla Lompo'a Museum | Historical building | |
| | The grave of Sultan Hasanuddin | Grave | |
| TAKALAR | Bungung Barania | well | |

**Photo A1: Explanation and Discussions with Pupils and Schools Surrounding Community on the Purpose and Method of Tree Planting Program**

Sungguminasa, Gowa

Makassar

Takalar

Maros

**Photo A2: Tree Planting Activities by Pupils and Teachers at Schools in Mamminasata**




**Photo A3: Greening Activities at Lakkang Conservation Area in Makassar, Vegetables for School Garden and Fruits Tree Planting by Community**

**Photo A4: Tree Planting Activities by Community at Housing Complex Sungguminasa Gowa**

**Photo A5: Tree planting at Housing Complex by Community at Maros**

**Photo A6: Tree planting Ceremony at Takalar, Attended by Schools and Community Arranged by Dinas of Spatial Plan and Environment**