

# Integrated waste management in the review of technology and environmental law aspects

I K Irianto<sup>1</sup>, G Y Arygunartha<sup>1</sup>

<sup>1</sup> Agrotechnology Faculty, Warmadewa University, Jalan Terompong 24, Denpasar, Indonesia

E-mail: irianto65spl@gmail.com

**Abstract.** Bali Province has an area of 5,636.66 km<sup>2</sup> or 0.29 percent of the total Indonesian archipelago, which is administratively divided into 8 regencies, 1 city, 55 sub-districts, 701 villages / kelurahan, 1430 Desa Pakraman, and 3945 Banjar/Adat. The area of each regency / city is as follows: Buleleng 1,365.88 km<sup>2</sup>, Jembrana 841.80 km<sup>2</sup>, Tabanan 839.33 km<sup>2</sup>, Badung 418.52 km<sup>2</sup>, Denpasar 127.78 km<sup>2</sup>, Gianyar 368.00 km<sup>2</sup>, Klungkung 315 km<sup>2</sup>, Bangli 520.81 km<sup>2</sup>, Karangasem 39.54 km<sup>2</sup>. Concerned by environmental quality standards and environmental damage criteria, the results show about 2163.6 m<sup>3</sup> per day of waste generation located in the city of Denpasar which is the center of the city in Bali. Waste that is not transported on average in all cities in Bali per day reaches 593 m<sup>3</sup>. This is due to the limited land and infrastructure of transportation and equipment of landfill, as well as labor and work methods applied. The waste management model used and integrated with the optimization of cooperation between districts and cities is expected to be an alternative solution to the waste problem in Bali.

## 1. Introduction

The Provincial Government of Bali in an effort to realize waste management, has normatively set various legal products that can be used as guidelines in managing the environment in its region, such as Bali Provincial Regulation Number 4 of 2005 concerning Pollution Control and Environmental Damage. One of the substances developed in the legal product is to give authority to the Governor in implementing environmental pollution and / or damage control through the establishment of a place and a waste treatment system and its supporting components. This will greatly determine the achievement of regional structuring in accordance with its designation so that environmental carrying capacity will be maintained [1].

In assessing the source of the authority of making laws and regulations by referring to the classification or grouping based on the source, area of authority, the nature of the force in force, the contents (material). Schematically the position of legislation in the systematics of law, including in the written legal environment. What is meant by written law is a law established and stipulated by an authorized official, in a certain format. This authority can be obtained through attribution, delegation and sub delegation.

A good law must have three foundations, namely: a philosophical foundation, a sociological foundation and a juridical basis. The philosophical foundation which is the philosophy of life of the Indonesian people, contains moral and ethical teachings which basically contain good and bad values.



Good values are the views and ideals that are held in high esteem. In it there are values of truth, justice, decency, and various values that are considered good, all good values are contained in Pancasila as a view of life, and the ideals of the nation. Therefore, the rules of law that are formed and contained in the legislation must reflect the philosophy of life of the Indonesian people and do not conflict with the nation's moral values.

Observing the basis for the formation of laws and regulations as described above, the legal basis for the authority of the Provincial Government in making Governor Regulation is constitutionally article 18 of the 1945 Constitution of the Republic of Indonesia in conjunction with Law Number 10 of 2004 and Law Number 32 of 2004 [2]. With the amendment to the 1945 Constitution, in article 18 there is a change related to the affirmation of the authority of the regional government in the implementation of autonomy in the region, especially that matter can be examined in the provisions of article 18 paragraph 2 and paragraph 6, which is as follows: a) Article 18 paragraph 2 states: Provincial, regency, and city regional governments govern and manage their own government affairs according to the principle of autonomy and co-administration; b) Article 18 paragraph 6 states: Regional Governments have the right to set regional regulations and other regulations for carry out autonomy and assistance tasks. With these two provisions, it can be examined that the existence of the authority of the Provincial Government of Bali in making governor's regulations textually has been regulated in the 1945 Constitution, but substantially the governor's regulations are made while still referring to the principles of autonomy and regional interests in the framework of regional development in order attainment of the welfare of its people. As stipulated in Law Number 32 of 2004 in article I number 5 states that the definition of regional autonomy as a right, authority and obligation of the autonomous region to regulate and manage their own government affairs and the interests of local communities in accordance with laws and regulations.

In the concept of autonomy there is the principle of independence but remains in a unified implementation of government in the framework of the Unitary Republic of Indonesia. Substantially the authority of the Regional Government related to environmental management in a broad sense including the impacts arising from environmental management in Law No. 23 of 1997 is regulated in several related articles, namely: To realize integration and harmony in the implementation of national policies regarding environmental management, the government based on laws and regulations can: a) Delegate certain environmental management authority to the apparatus in the region; b) Include the role of the Regional government to assist the Central Government in implementing environmental management in the region [3,4]. Article 13 paragraph 1: In the context of carrying out environmental management, the Government may submit part of the affairs to the Regional Government to become household affairs [5]. In the provisions of Article 1 number 16 and number 18, waste is residual business and / or activity, d. with hazardous and toxic material waste is the residue of a business and / or activity containing dangerous and / or toxic materials which due to their nature and or concentration and / or amount, both directly and indirectly, can pollute and / or damage the environment, and / or can endanger the environment, health, human survival and other living things. The existence of various types of waste is a consequence of the existence of environmental management carried out by humans and parties who carry out various businesses that have a relationship with the environment. If we look at the principles and objectives of environmental management according to Law Number 23 of 2004 in Article 3 it is stated: Environmental management carried out with the principles of state responsibility, the principle of sustainability, and the principle of benefits aims to realize sustainable development that is environmentally sound in the context of development Indonesian people as a whole and the development of Indonesian society entirely in the faith and devotion to God Almighty. Because each of these development processes in various forms of activity cannot be avoided from the generation of waste, so the effort that must be considered is how to make an appropriate plan related to the location of waste disposal.

Waste management can be done through 3 stages of activities namely collection, transportation and final disposal. Collection is defined as waste management from its original place to the temporary disposal site before heading to the next stage. Transportation stage is carried out by using a means of

transportation in the form of a particular transportation to the final disposal / processing site. At this stage also involves workers who at a certain period of time transport waste from a temporary landfill to a landfill (TPA). At the stage of final disposal / processing, the waste will undergo physical, chemical or biological processing so as to complete completion whole process.

## 2. Methodology

This study aims to examine waste management in several urban districts in Bali. There are three stages of research, namely knowing the quality and characteristics of waste: 1) Regional authority in waste management; 2) Regional model in waste management; 3) Time of research carried out from 16 August 2016 to 28 September 2017. Location of data collection in several districts such as: Tabanan, Klungkung, Gianyar, Denpasar, Badung by looking at the quality and characteristics of waste based on raw materials, material sources and processes. Regional authority in waste management is based on the Constitution, KEPMEN, Regional Regulations. The waste management model is based on primary, secondary and landfill locations. The quality and characteristics of waste are carried out by identification, mathematical calculations and then compared with established quality standards. The authority is carried out with the basic reference review philosophy, Constitution, KEPMEN, local regulations. Model of landfill collection, transportation and location.

## 3. Results and discussion

The results showed the condition of the generation and existing of solid waste in 8 districts and 1 city (Denpasar, Badung, Gianyar, Tabanan, Jembrana, Singaraja, Karangasem, Klungkung, Bangli). Garbage in the area comes from domestic and non-domestic rubbish which includes residential rubbish, shops, restaurants, hotels, offices, public facilities, street sweeps and tourism, which is mostly organic waste. Solid waste management in each regency and city is more dominantly managed by the Government through related agencies, as shown in Table 1.

Waste management is a systematic, comprehensive and sustainable activity which includes reduction and handling of waste. So that management in urban areas, today faced with various problems that are quite complex. These problems include the high rate of landfill waste, public concern (human behavior) which is still very low and problems in the activity of final disposal of waste (final disposal).

**Table 1.** The average amount of waste generation per day in 2007.

No	Regency/City	Daily Average
1	Denpasar	2163.6
2	Badung	1151.4
3	Gianyar	184.1
4	Tabanan	332.1
5	Klungkung	112.5
6	Bangli	103.1
7	Karangasem	111
8	Buleleng	311.45
9	Jembrana	283.2
	Bali	4752.45

Table 1 shows that the biggest daily waste generation occurs in Denpasar City, followed by Badung and Tabanan Regencies, then Gianyar Regency, this tends because these two regencies are affected by the development of Denpasar City as the Capital of Bali Province, and Badung Regency as Regency which the largest has facilities and infrastructure to support tourism.

### 3.1. Population mobility

The biggest daily waste generation occurs in Denpasar City, followed by Badung and Tabanan Regencies, then Gianyar regency, this is likely because these two regencies have been affected by the development of Denpasar as the capital of the province of Bali, and Badung Regency as the largest regency having facilities and tourism supporting infrastructure. As a result of the above conditions 1 city and 3 regencies (Denpasar, Badung, Gianyar and Tabanan) carry out an integrated waste management effort namely “Sarbagita Urban Area Waste Management Plan” developed through the coordination of BPKS (Sarbagita Sanitation Management Agency) with the Sanitation Office of each Regency / City by utilizing the Integrated Waste Management Installation (IPST) in Suwung as seen in the signpost of this waste management project. Landfill in Klungkung Regency, Pikat village, Dawan District is indeed remote and far from the neighborhoods of community settlements but the disposal process becomes ineffective landfill tends to have a negative impact on the air because of the smoke. There is no processing such as making compost due to the location is difficult to get water for treatment.

### 3.2. Qualitative Discussion

One of the main objectives of environmental management is the implementation of environmentally sound development and the controlled use of natural resources wisely. There is no country in this world that does not carry out the development process. The process of developing a country is basically understood as an effort to use resources, both natural and human as well as the environment, through the application of a technology, to improve people's welfare. Indeed, pollution and damage to the environment are mostly due to the impact of development activities that are not environmentally oriented. Many community and industrial activities produce waste that is thrown away into the environmental ecosystem, making the environment unhealthy.

Environmental pollution according to the understanding in the Environmental Law Number 23 Year 1997 Concerning Environmental Management Chapter 1 General Provisions Article 1 Item 12 states that “Environmental Pollution is the entry or inclusion of living things, energy substances, and / or other components into the environment by human activities so that the quality drops to a certain level which causes the environment”.

The concept of sustainable development has been applied and elaborated in law in “Regional Regulation of the Province of Bali Number 4 of 2005 Concerning Pollution and Environmental Damage Control” and also stated in the Governor’s Regulation on Environmental Quality Standards and Environmental Damage Criteria. The waste management model / system in Suwung is implemented by: 1) Household waste, market canoes, restaurant / restaurant waste and hotel waste collected by residents or waste officials, and carried out a process (recycle, reuse and reduce), then transported to the depot transfer or to TPS; 2) Street trash and other public places are collected at the edge of the road and then transported by garbage truck to the depot transfer; 3) Waste is transferred to the depot and the TPS is transported by garbage truck to a landfill (TPA) at IPST Suwung; 4) Waste management up to the depo and TPS transfer is carried out by the community and scavengers, while from the transfer of the depo to the TPS to the TPA is managed by the DKP or in cooperation with the private sector; 5) The waste management system is based on management zones in each zone or some zones are cooperated with third parties (private), in terms of transportation to the final landfill in Suwung.

### 3.3. Quantitative discussion

For other regencies, waste management is carried out individually by the relevant department, cooperation or agreement has not yet been carried out in waste management, so that in the future it is expected that new management will take place in other regencies so that the potential possessed in the regency in waste management can be carried out optimally. Until 2006 the level of service from each SARBAGITA region both served by DKP / DKLH and private operators (village/kelurahan) was determined based on the average garbage produced each day divided by the average production of waste per person per day (2.2 liters / person / day, survey results and PPP-SWM, BUIP 2000 analysis) and in accordance with SNI 19-3983-1995 solid waste generation based on medium / small city classification

of 2.75 liters person / day which is averaged average so that the average waste production per day per person is  $V = (2.2 + 2.75)/2 \sim 2.5$  liters / person / day =  $0.0025 \text{ m}^3$  / person / day.

Based on the average population growth in each of the cities / regencies, the range of growth in the level of service of each cleaning service and private operators in other regencies at least follows the conditions [6-8]. However, this cannot be done by each district on the service and private operators, given the large and high cost of handling sanitation and waste management. Given the increasingly limited land in urban areas where people are increasingly difficult to find locations to dispose of waste, the need for business or action from the government and the private sector (community) in participating in handling the waste dump. So there are several efforts that can be done including: 1) Reducing (reducing) waste from the source of waste generation; 2) Reuse of waste in this case are materials that are still suitable for use without going through processing first; 3) Recycling of waste which must be preceded by the processing of such waste as plastic waste, beverage bottles and paper; 4) Composting for organic waste. As a source of energy in this case is electrical energy. Making a mutual agreement is the most optimal way that can be implemented in the management of waste, so that costs can be reduced.

Based on the data and solutions in waste management, it has been discussed but until now it has not been realized [13, 17]. The cooperation between the four districts / cities, namely Denpasar, Badung, Gianyar, and Tabanan (Sarbagita) has not yet provided an answer. The proof of this collaboration is only limited to technical discussions even though the projections are very mature.

TPA Suwung as a barometer of waste management in Bali with an area of 40 hectares, is the widest landfill compared to other regencies in Bali [14, 16]. Until now, it also remains loose in processing waste, the volume of rubbish in Badung and Denpasar, which is around 2000 - 2500  $\text{m}^3$ . distribution flow with the conveyance has been carried out to the maximum. The condition indicates that the garbage production of urban residents is very high and continues to increase along with the increasing population. The waste problem is indeed difficult to solve and this condition not only occurs in big cities like Denpasar, this also happens in other districts [9-11]. Based on Table 2, the average volume of unloaded waste in all regencies and cities in Bali reaches 593  $\text{m}^3$  per day, this is due to the limited means and infrastructure of transportation and equipment, limited land for final disposal, labor and work methods applied. The volume of waste is increasing every day, especially in urban areas while there is less free space for landfills, optimizing cooperation between districts and cities is expected to be an alternative solution to the waste problem in Bali [12]. Such as the case of the existence of household and industrial waste production in Klungkung reaching 160  $\text{m}^3$  per day, meanwhile, the final landfill (TPA) in the Sente, Pikat, Dawan regions is estimated to only have a capacity of 5-10 years in the future because the garbage entering the Sente landfill around 160  $\text{m}^3$  per day. Therefore, a new location is needed to process garbage that is like "invading" Klungkung every day. The Klungkung Environment Agency (DKLH) has difficulty determining the right location for the TPA.

#### 4. Conclusions

Waste in the regency of the city of Bali originates from domestic and non-domestic waste which includes residential, shopping, restaurants, hotels, offices, public facilities, street sweeps and tourism, which are mostly organic waste. Solid Waste Management in each Regency and City is more dominantly managed by the Government through related agencies, Balinese Development with cultural insights imbued by Hinduism and based on Tri Hita Karana is a form of community spirit in implementing sustainable development. The concept of sustainable development has been applied and elaborated in law in "Regional Regulation of the Province of Bali Number 4 of 2005 Concerning Pollution and Environmental Damage Control" and also stated in the Governor's Regulation on Environmental Quality Standards and Environmental Damage Criteria. The volume of garbage that is not transported on average in all Regencies and Cities in Bali reaches 593  $\text{m}^3$  per day, this is due to the limited means and infrastructure of transportation and equipment, limited land for final disposal, labor and work methods applied.

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The integrated waste management model with the optimization of cooperation between districts and cities is expected to be an alternative solution to the waste problem in Bali.