

Research Article

AN ASSESSMENT OF BIO-MEDICAL WASTE GENERATION, TREATMENT AND RELATED RISKS IN WEST BENGAL

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ABSTRACT

Bio-Medical wastes are mainly infectious wastes generated by health care units which give potential threat to human health and environment. Improper disposal, management of such wastes may lead to spread of contagious diseases of humans and it also causes land, air and water pollution. Medical care is very essential for humans and the wastes from the sector are also unavoidable. But proper planning; use of proper tools, machines, methods of segregation; reduction of waste in volume and treatment of Bio-Medical waste is very much necessary to prevent spread of transmissible diseases and deterioration of environment. According to Central Pollution Control Board, West Bengal ranks 5th in terms of Bio-Medical waste production among all the States of India in the year 2014 as the State produces 42236.99 kg waste per day. 46.17 percent of the waste per day is left untreated in West Bengal. Thus, it may harm physical and social environment as a whole. This paper is an attempt to find out the nature, sources, rate of increase of Bio-Medical wastes in West Bengal; identification of the health and environmental hazards related to it and critical review of the State in control of such wastes.

Keywords: *Bio-Medical Waste, Health Care Units, Health Hazards, Land Pollution, Management*

INTRODUCTION

Bio-Medical Waste refers to any waste that includes anatomical waste, pathological waste, infectious waste, hazardous waste and other waste generated in health care facilities and medical laboratories that require special handling. Previously the terms “pathological” and “institutional” wastes were used to refer to what is now considered “bio-medical” waste (Santra, 2005). “It also includes the wastes generated during research activities involving the production or testing of biological, which means any preparation made from organisms or micro-organisms or product of metabolism and biochemical reaction” (Sharma, 2016). Bio-Medical Wastes (BMW) deteriorates public health and cause environmental degradation if they are not disposed off and treated properly. Innumerable diseases, infections, health hazards may take place due to such wastes. According to the West Bengal Pollution Control Board (WBPCB) the total number of diagnostic centre in the State is 3169 among which BMW is generated by 2572 pathological centre in the year 2009. Total BMW generated in the State is around 12000 MT per year. With the 1% increase per year the annual generation of BMW in the State has been estimated upto 13500 MT in the year 2020. 45% of the BMW is made up of recyclable materials; if they are properly segregated, decontaminated and recycled then a good number of resources can be obtained in environmental friendly manner. But if they are left unmanaged in the dumpsites then it will definitely cause environmental pollution. Thus, the untreated waste can cause serious health and environmental degradation which is a matter of great concern (Data Source: WBPCB, 2010).

Objectives

The objectives of the paper are-

- To find out the sources, nature of BMW and the health, environmental hazards associated with its disposal
- To examine the generation, treatment, capacity of treatment of BMW in West Bengal and its comparison with other States of India
- To find out the deficiencies of management of such wastes in West Bengal
- To suggest some suitable measures to address the problem

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MATERIALS AND METHODS

The methodology incorporates collection of secondary data from Central Pollution Control Board, West Bengal Pollution Control Board, Environment and Health & Family Welfare Department to find out the nature, magnitude of BMW generation and treatment in West Bengal. Necessary books, journals, papers, maps are referred to present the vulnerability of such wastes in our state. All the data thus, obtained is analyzed, tabulated and represented through suitable cartographic techniques. ArcGIS 9.3 is used to prepare maps.

Study Area

The study area includes the State of West Bengal having the latitudinal and longitudinal extent of 21° 38' to 27° 10' North latitude and 85° 50' to 89° 50' East longitude respectively. The State covers 88752 sq km area and is bounded by Bangladesh in the east; Jharkhand, Bihar, Chhattisgarh in the west; Assam, Sikkim in the north east; Nepal in the North West; Odhisa in the south west and Bay of Bengal in the southern part. The State is divided into 20 districts and the last addition Alipurduar district came in 25th June, 2014. The Districts in the northern part of the State are Darjeeling, Jalpaiguri, Alipurduar, Coochbehar, North Dinajpur, South Dinajpur, Maldah, Murshidabad, Birbhum and the Districts of southern part includes Bankura, Bardhaman, Purulia, Nadia, West Midnapore, East Midnapore, Hugli, Howrah, Kolkata, North 24 Parganas and South 24 Parganas.

RESULTS & DISCUSSION

Sources, Nature and Methods of Disposal of BMW

They mainly originate from general hospitals, veterinary hospitals, nursing homes, health care units, medical institutions, pathological laboratories, medical research organizations, funeral sites, slaughter houses, health camps, blood donation camps, blood banks and from any other medical sector.

According to West Bengal Pollution Control Board, from the total waste generated by health-care activities, almost 80 – 85 % is general waste comparable to domestic waste. The remaining approximate 15 - 20% of waste is considered hazardous materials that may be infectious, toxic or radioactive. When all the waste is mixed together, 100% of the waste turns infectious and hazardous as well as become unmanageable.

They consist of solids, liquids, sharps, and laboratory waste which are detrimental to humans. Disposable syringes, bloods, diagnostic samples, needles, swabs, bandages, linen, plastics, glasses, unused medicines, medical devices, wastes and body parts of infected patients or animals, and other general wastes spread infections if they are not treated.

Thus, segregation of medical waste at the point of origin, proper disposal and treatment is essential to combat all sorts of pollution and infection.

Health & Environmental Hazards Associated with BMW

Human Health Hazard: For the doctors, nurses, sweepers and other workers of medical organizations BMW is occupational hazard. They are prone to the diseases and the viruses are such dangerous that they can cause human death. Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), Human Immunodeficiency Virus (HIV) transmission, gastro enteric infection, respiratory infection, blood stream infection, skin infection, radioactive toxicity etc can take place due to improper management of BMW.

“Among the 35 million health care workers worldwide, the estimations show that each year about 3 million receive hard exposures to blood borne pathogens, 2 million of those to HBV, 0.9 million to HCV and 170,000 to HIV” (www.wseas.us/e-library).

Environmental Degradation: Land, air and water pollution takes place due to improper handling of BMW. Wastes dumped in hospital site not only pollute land but also generates foul odour. Such wastes attract domestic animals and thus, unhygienic condition is created. Water pollution takes place when the wastes are dumped into water bodies. It harms the ecological system in the water. Burning of wastes in the campus sites produce dioxins and Furans which pollutes air. When the BMW gets mixed with other solid wastes of municipality, household wastes in rural and urban areas then it becomes highly hazardous in nature.

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Table I: Methods of Disposal of BMW

Sl. No.	Bio-Medical Category Waste	Treatment and Disposal
1	Human Anatomical Water (Human tissues and organs)	Incineration/deep burial
2	Animal Waste (tissues, organs, carcasses, fluid blood)	Incineration/deep burial
3	Microbiology and biotechnology waste (Waste from lab cultures, from production of biological, toxins and devices used)	Autoclaving/micro-waving
4	Waste Sharps (Used or unused needles, syringes, scalpels, blades, glass etc that may cause puncture and cuts)	Chemical disinfection/autoclave/micro-waving and mutilation/shredding
5	Discarded medicines and cytotoxic drugs	Incineration/ Disposal in landfills
6	Solid Waste (Items contaminated with blood and body fluids including cotton, dressing, plaster casts, lines and beddings)	Incineration/autoclave/micro-waving
7	Solid waste	Chemical disinfection/autoclave/micro-waving/mutilation/shredding
8	Liquid waste (Laboratory waste, washing cleaning, housekeeping and disinfecting activities)	Disinfect- chemically and discharge into drains
9	Incineration ash	Disposal in municipal landfills
10	Chemical waste (Chemical used in production of biological, chemicals used in insecticides etc)	Chemical treatment disinfections and discharge of drains for liquid and secured landfill for solids

Source: Sharma, 2016

Condition of West Bengal in Generation and Treatment of BMW

According to Central Pollution Control Board (CPCB) Karnataka, Maharashtra, Kerala, Tamil Nadu generated 82123 kg/day, 53385.5 kg/day, 52794.398 kg/day and 43284 kg/day BMW respectively in 2014. West Bengal ranks after Karnataka, Maharashtra, Kerala and Tamil Nadu in terms of BMW generation but in all the above mentioned States more than 95 percent of BMW is treated. Karnataka, Maharashtra treated 100 percent and Tamil Nadu, Kerala managed to treat 99.99 Percent, 95.90 Percent of BMW generated per day respectively in the year 2014. During 2014, West Bengal accounts for 8.53 percent of the total BMW generation per day in India that is 42236.99 kg waste per day. But it is the only State where only 53.83 percent of the total waste per day is treated, and the rest is left untreated. Thus, West Bengal is lacking far behind all of these States (Figure 1). Department of Health and Family Welfare, Govt. of West Bengal took initiative for proper and safe management of BMW in West Bengal. Bio-Medical Waste (Management and Handling) Rules came in 1998 and West Bengal Pollution Control Board (WBPCB) became the designated authority to oversee management of BMW in the State under Environment Department. Health and Family Welfare Department (H&FWD) was responsible to provide funds and other infrastructural support to the occupiers under it to implement the BMW Rules. The Deputy Director of Health Services and the Chief Medical Officers of Health (CMOH) were the licensing authorities for private Health Care Units (HCU) in Kolkata and other Districts respectively (H&FWD, 2008).

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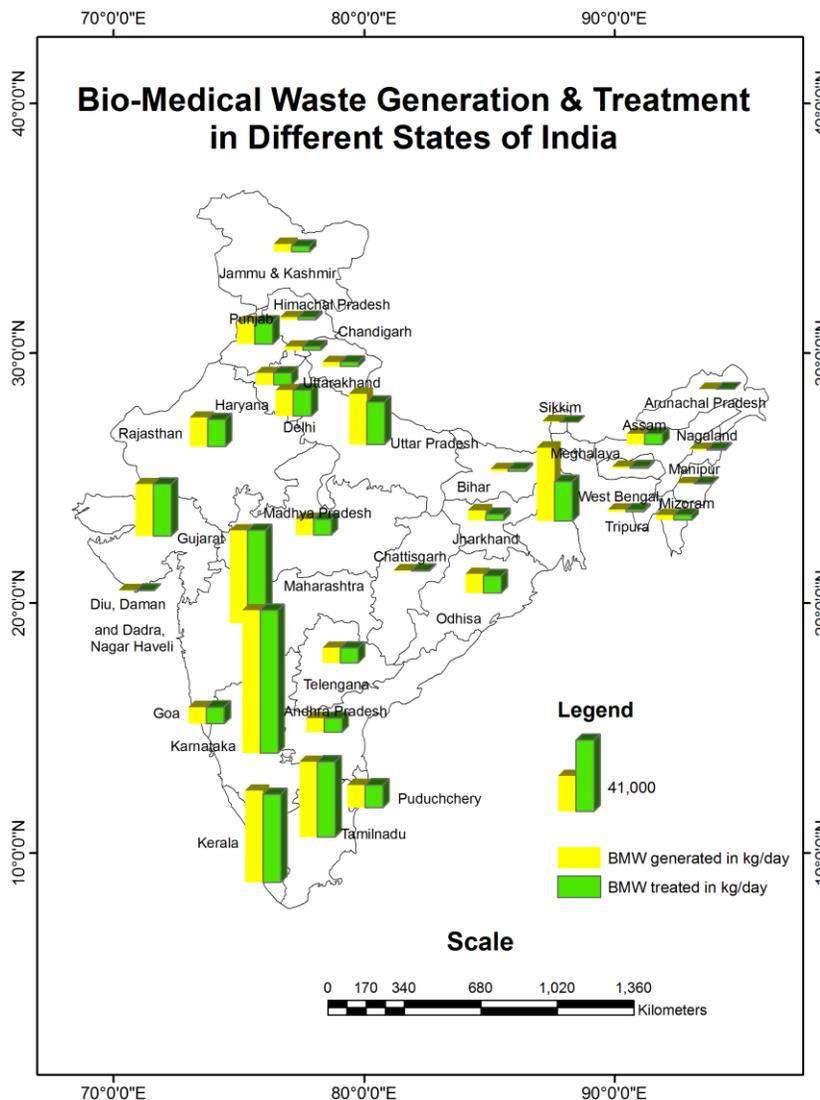


Figure 1: BMW Generation and Treatment in India

Data Source: CPCB, 2014

Table II: Position of Health Care Unit Running Without Treatment Facility in West Bengal

Year	2008	2010	2012	2014
Total number of Health Care Facilities (HCF) in the State	6297	5583	6440	7198
No. of Common Biomedical Waste Treatment Facilities (CBWTF)	6	7	6	6
No. of HCF utilizing CBWTF's/Private agencies	3811	5196	6318	5751
No. of HCF having own treatment and disposal facilities	18	19	16	10
No. of HCF applied for authorization	2609	2975	3107	3519
No. of HCF granted authorization	2609	2961	3037	3455
No. of HCF/CBWTF violated BMW rules	1695	393	30	25

Source: CPCB, 2008, 2010, 2012, 2014

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BMW generation in West Bengal is increasing every year as the number of Health Care Units (HCU) is increasing. The amount of BMW in West Bengal has risen from 23498.25 kg/day to 42236.99 kg/day from 2008 to 2014 (Figure 2).

There is an increasing trend of population in West Bengal and the need of HCU is also increasing to provide protection to the population suffering from different kind of diseases. Total number of HCU increased from 6297 to 7198 from 2008 to 2014. Thus, within a period of 8 years about thousands of new HCU came in West Bengal but the number of Common Biomedical Waste Treatment Facilities (CBWTF) remained same. There are only 6 CBWTF working in West Bengal. In the year 2014 only 10 Health Care Facility (HCF) had own treatment and disposal facilities. This number has decreased from 18 in the year 2008. During 2008, 2609 HCF applied for authorization under BMW rules and in 2014 the number increased to 3519. This entails that huge no. of HCF are not even authorized and in most cases they are the ones which create greater amount of wastes in the environment. One positive sign for the State is that the HCF or CBWTF which violate BMW rules has been decreased from 1695 to 25 in between the period of 2008 to 2014 (Table II).

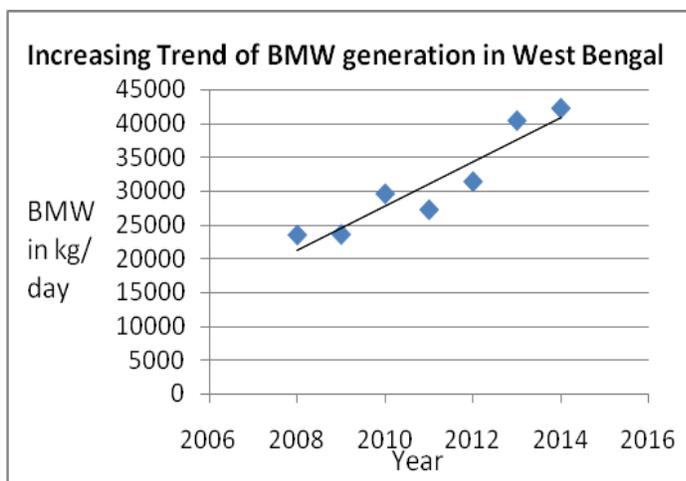


Figure 2- Increasing Trend of BMW

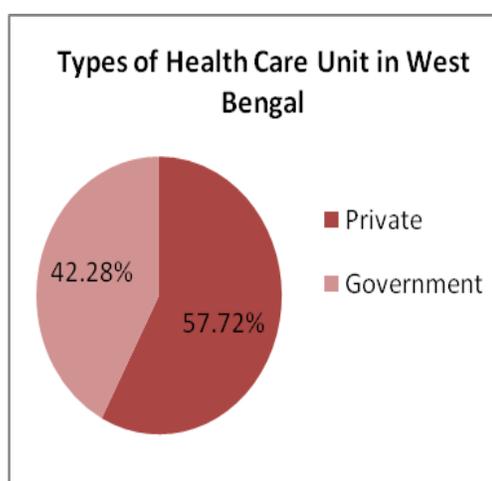


Figure 3- Types of Health Care Units
 Source: CPCB, 2008 to 2014 (Fig-2) & WBPCB, 2010(Fig-3)

Both Government and private HCU are set up each year but the percentage of private HCUs is more compared to Government HCU. According to WBPCB in the year 2009 about 57.72 percent of HCU was private and 42.28 percent of HCUs were run by Government (Figure- 3). The HCUs which are run by Government mostly generate huge amount of BMW due to absence of proper monitoring and safe management of wastes. But private HCUs charge more from the patients thus, they are well maintained and BMW is properly treated in those units.

According to WBPCB, the bedded HCUs create 90.28 percent of BMW that is 10833729 kg in 2009. Thus, it is the main source of BMW generation followed by the other sources like non-bedded HCU and path lab which produce 882600 kg and 283574 kg waste respectively during 2009 (Figure 4). Generally, plastic, glass, metal in BMW are recyclable while other materials are considered as non recyclable (though cloth, linen can be recycled). In case of non-bedded HCU, it is found that only 10.77 percent waste is non-recyclable and 89.23 percent is recyclable (Figure 5). But for bedded HCU, 59.63 percent is non recyclable and 40.37 percent is recyclable (Figure 6).

Thus, it should be mentioned that the bedded HCU create greater waste that cannot be recycled compared to non-bedded HCU. So, non-bedded HCUs are less precarious for the environment. In our State there are greater numbers of non-bedded HCU. According to WBPCB there are 3780 bedded HCU and 14244 non-bedded HCU in West Bengal in the year 2009.

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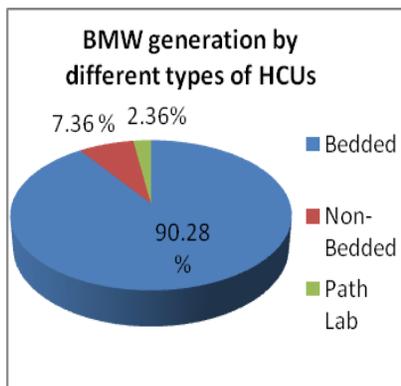


Figure 4-BMW generation by HCUs

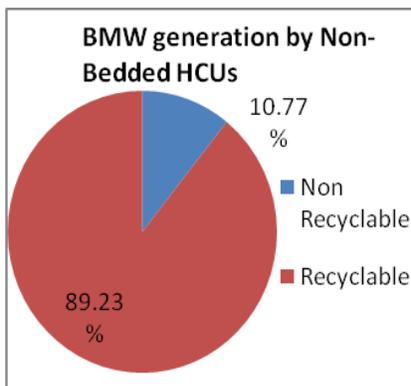


Figure 5-Generation of BMW by Non-Bedded HCUs

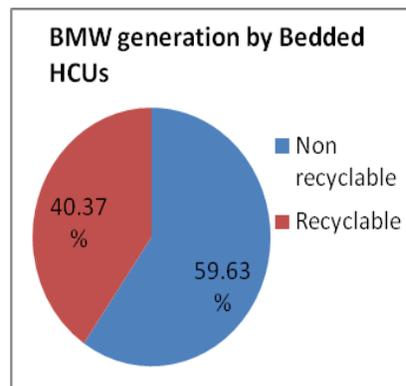


Figure 6-Generation of BMW by Bedded HCUs

Source: WBPCB, 2010

The percentage of BMW generation (in kg) of different districts of West Bengal in 2009 is compared in Figure 7. It is evident that as population, numbers of health care unit are more in Kolkata so waste generation is also highest. Kolkata generates 29.08 percent of total waste generation (in kg) of the State in 2009. North 24 Paraganas and Barddhaman generated 10.02 percent and 9.31 percent of the total BMW of State in 2009. North and South Dinajpur generated only 0.88 percent and 0.77 percent of BMW during the same period.

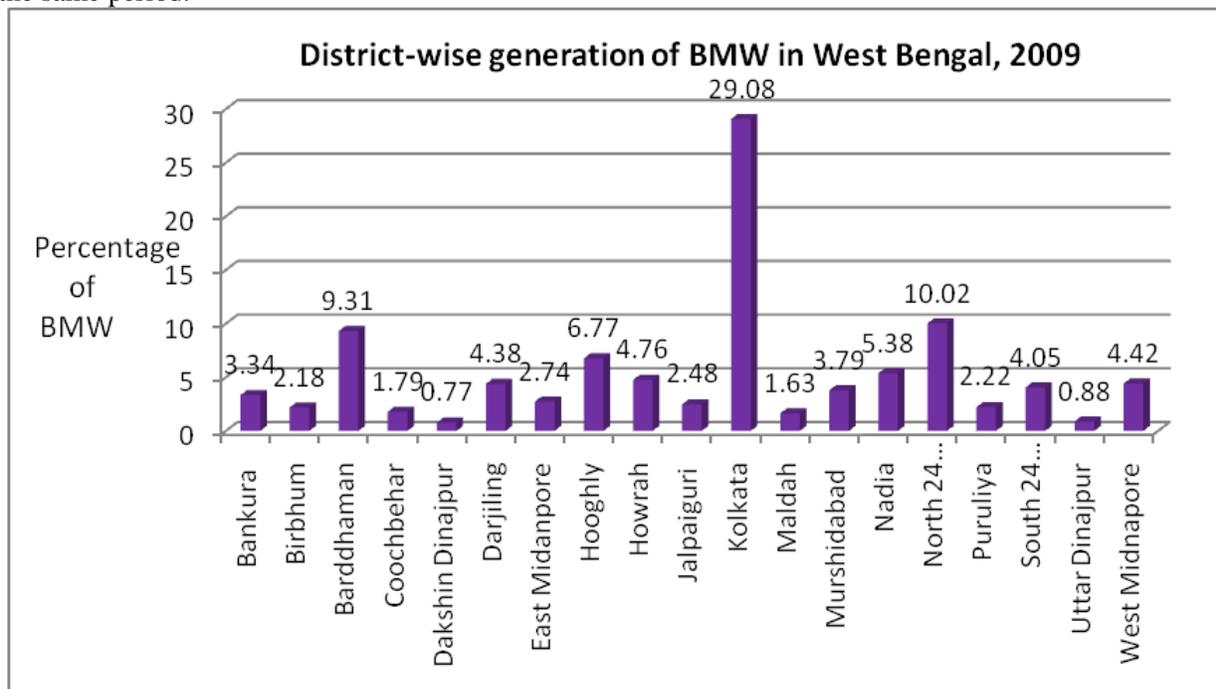


Figure 7- BMW generation in different Districts of West Bengal

Source: WBPCB, 2010

Deficiencies in Monitoring and Management of BMW in West Bengal and Recommendations

Management of BMW is done by several ways such as segregation of waste at the point of origin, transportation of waste by closed vehicles with BMW sign, disposal of waste by proper method and treatment of waste by proper technique. Mismanagement in BMW treatment occurs due disobedience of BMW rules by hospitals, unauthorized HCUs; lack of coordination between WBPCB and health

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departments of the State and absence of strict rules to enforce proper management of wastes. Figure 8 shows the region-wise account of annual BMW generation, treatment and actual capacity of treatment in 2009. It is found that in every region the treatment of BMW is very less compared to the waste generated and treatment capacity. In North region (Darjeeling, Jalpaiguri, Coochbehar, Uttar Dinajpur, Dakshin Dinajpur, Maldah) and Central region (Murshidabad, Nadia, North 24 Paraganas, Hugli) 14 percent, 29 percent of BMW is treated annually but the capacity of treatment is slightly higher than generation that is 1453143 kg and 2987149 kg respectively. Southern region (Kolkata, Hugli, South 24 Paraganas) records highest generation of BMW that is 4547845 kg, but only 42 percent is treated and the treatment capacity is 2841123 kg which is lower than generation of BMW. In West (Bankura, Barddhaman, Birbhum, Puruliya) and South West region (Purba & Paschim Medinipur) 14 percent and 5 percent BMW is treated respectively in the year 2009. But it is unfortunate to mention that the actual treatment capacity is much higher. West and South West region has capacity of 2838446 kg and 1831132 kg waste treatment annually. There must be deficiency in management and other related problems due to which the wastes are not treated adequately.

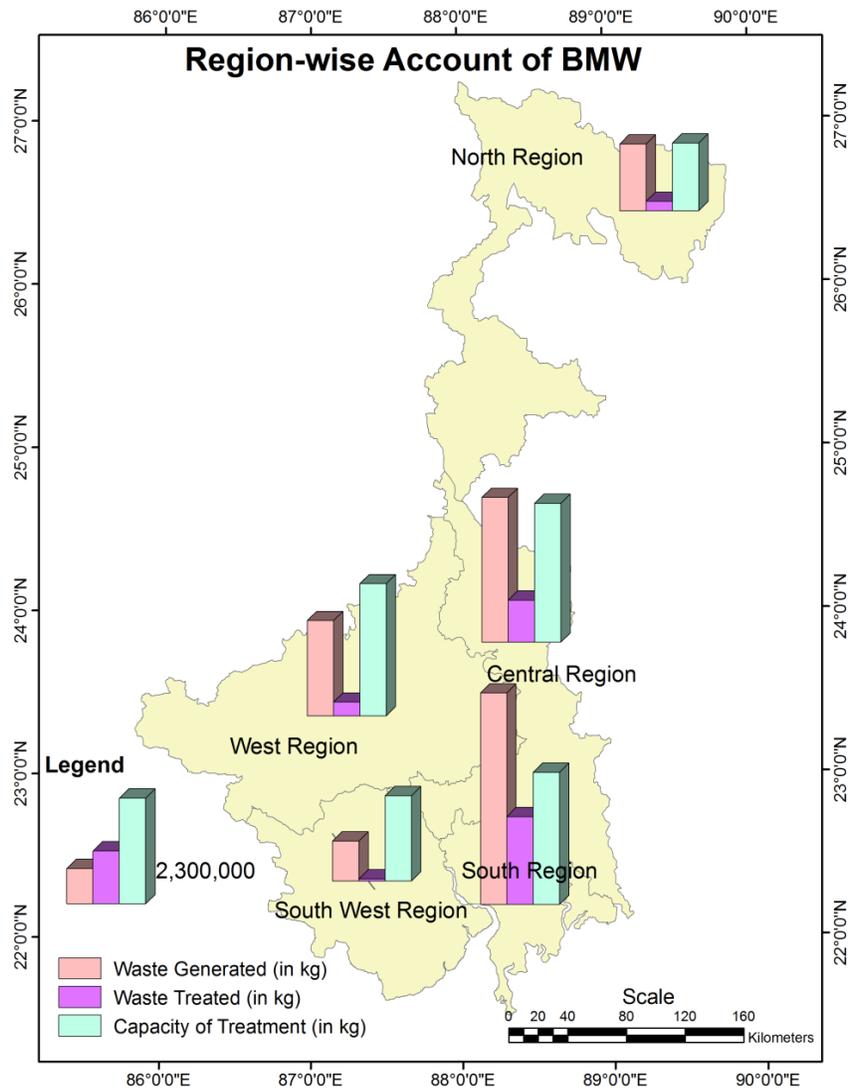


Figure 8-Regionwise account of BMW in West Bengal Source: WBPCB, 2010

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Table III: Ministry Classification and Colour Coding for Bio-Medical Waste

Classification	Description	Colour Code
Type A Class 1	Human Anatomical	Red
Type A Class 2	Animal Anatomical, infected a. Non Anatomical infected	Orange
Type A Class 3	b. Laboratory Waste c. Wastes from DNA works	Yellow
Type B Class 1	Animal Anatomical, non infected	Blue

Source: Santra, 2005

- Wastes must be segregated at the point of origin and must be labeled as bio-waste and toxic waste. Colour coding and classification of BMW is done by Government for proper management (Table III). But according to the Audit Report of Environment and Health & Family Welfare Department (H&FWD), there is absence of adequate quantity of colour coded bags during 2008. The staffs are also not properly trained. BMW is detrimental to human health so awareness must be spreaded amongst all staff. Health hazard takes place due to mishandling of waste during recycle of untreated waste. Rag pickers collect the untreated wastes and sell them in the market without disinfection. Therefore it is imperative to use environmentally safe method for the disposal of wastes by HCUs.
- BMW must be transported in covered, closed, dedicated vehicles to ensure maximum protection. According to the Audit Report of Environment and H&FWD, five Municipal authorities, out of eight test checked, used to carry BMW from six sampled HCUs in uncovered vehicles causing serious environmental contamination in 2008. The situation has not improved due to lack of monitoring on transportation of BMW. The current data of transportation status of BMW is not available but the increasing level of BMW is indicating the probability of transportation of BMW without proper protection.
- There are different categories of wastes like human waste, anatomical waste, sharps, liquid waste, solid waste etc, which are treated by different mechanism (Table I). The HCUs which are running in the State should have either agreement with CBWTF for treatment of wastes or they must contain facilities to manage waste by stand alone facilities. But it is found that only 5751 HCFs out of total 7198 HCFs are using CBWTF or any private agencies for treatment of BMW and only 10 HCF has their one stand alone facility to treat waste (Table II). There is need of strict rules to ensure agreement of all the HCF of the state with CBWTF, private agencies or development of own technique to manage waste. The HCUs which will violate the rules should be punished by law.
- In most of the cases it is found that though there is presence of adequate waste treatment facilities still due to the unprofessional behavior of the workers only few facilities are operational. Thus, if all the facilities are not functioning then treatment of wastes would be lesser. There is also unavailability of common waste treating facility for most of the HCU. Following the Audit reports of Environment and H&FWD it can be mentioned that there are no common waste treatment facility set up for 510 HCUs in six districts of North Bengal either by Health & Family Welfare Department or by any private agency during 2008. Improvement of infrastructural facilities is very much necessary. Necessary equipments, storage facilities and other waste treatment facilities must be provided by the Government.
- The health care facilities both authorized and un-authorized violate the rules of BMW frequently. According to the audit reports of Environment and H&FWD it is found that 7 HCU recorded storage of untreated BMW inside or outside the hospital premises, 2 HCU sold untreated bottles, 9 HCU used untreated saline/ fluid bottles, 5 HCU of Kolkata dumped and burnt infected linen articles, 13 HCUs discharged liquid wastes into drain without disinfection and 4 rural hospitals dumped anatomical BMW in campus pit and burnt non anatomical waste in campus. North Bengal Medical College and Hospital recorded absence of BMW storing vats of 589 beds near Siliguri. In Burdwan Medical College BMW was

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mixed with other wastes at the point of origin. Such records of H&FWD during 2008 are shocking. Hospitals, private agencies are not maintaining the minimum standards. The license of these HCU must be sued and a notification should be generated that if any HCU will ever violate rules then their license will never be reissued.

- Plastic carry bags are banned by WBPCB in ecologically sensitive areas but they are randomly used and organizations that make plastic are getting authorization easily. According to WBPCB 30 plastic manufacturing units applied for and were granted registration in 2008 and majority of the said manufacturing units were tiny in nature and were mostly operating without any regulatory permission. In every medical store or in institutions plastic carry bags are quite common. Plastic creates land pollution as they are not easily degradable. Thus, its availability and use must be checked by Government effectively.
- Mercury is used in manufacturing blood pressure devices, thermometers, gastro intestinal devices and many other types of equipment. It is very poisonous and causes harm to humans. Thus, equipments containing mercury must be disposed of and treated carefully. According to WBPCB annual generation of mercury waste only from thermometers in bedded HCUs amounts to 32.429 Kg in 2008. It is to be kept in mind that one spoonful of mercury can contaminate a large lake. When 1 microgram of mercury can pose serious health risk, generation and spill of around 32 Kg elemental mercury waste only from thermometers in bedded HCUs alone must be a serious concern.
- There is lack of coordination between WBPCB and Health & Family Welfare Department thus there is no periodical visit to HCF to check out their status of disposal. Proper inspection and monitoring is required to control the menace. WBPCB and Health & Family Welfare Department should recruit more staff and increase their strength to control wastes. Workers must be properly trained and they should be careful while managing the wastes. Government departments should monitor their work.

Conclusion

The above discussion clearly indicates the presence of adequate treatment facilities of BMW but there is lack of interest of the monitoring body to check their functioning. The operational deficiencies of West Bengal Pollution Control Board, Environment and Health & Family Care Department are mainly responsible for the excessive increasing levels of BMW. Enforcement of laws, proper monitoring, functioning is thus very much necessary to overcome the situation.

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