

Methods to Calculate Existing Biomass Volume in Japan

Supplementary Document for The
East Asia Biomass Town Workshop
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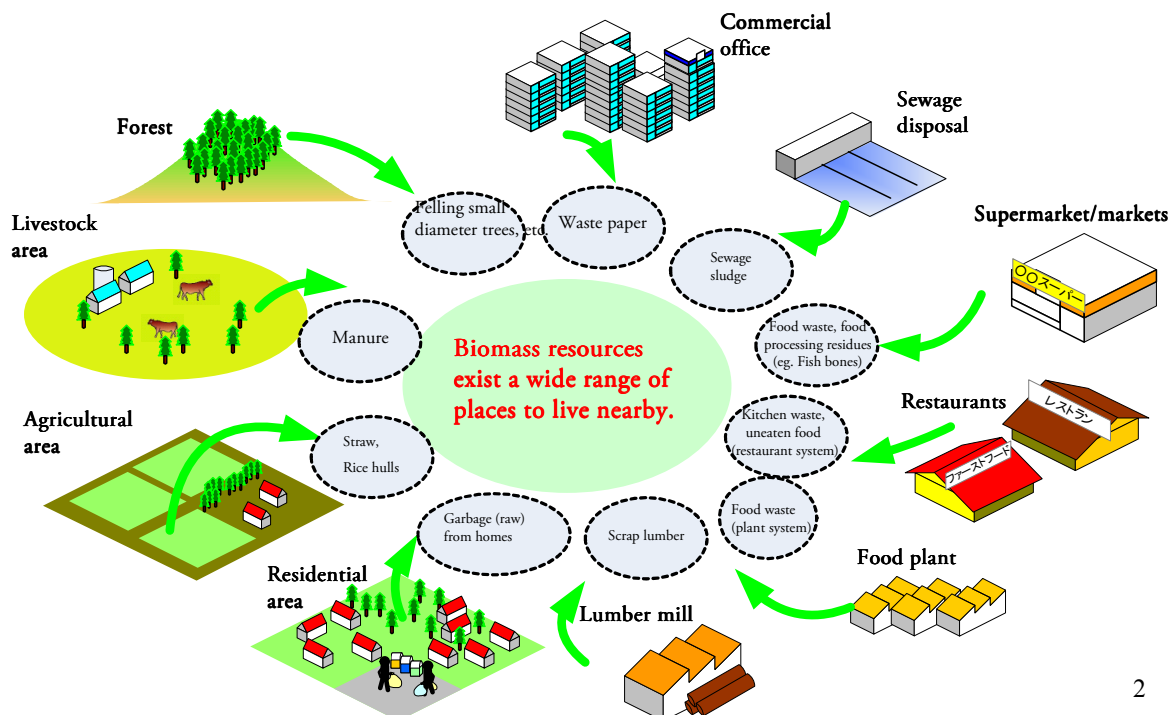


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■ Estimating the Existing Biomass Volume

To promote the effective utilization of unutilized biomass in the region, one must first understand the existing biomass volume as well as current utilization volume.

$$\text{Existing Biomass Volume} = \text{Unutilized Biomass} + \text{Utilized Biomass}$$



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◆ Checking the type of biomass resources

Due to its various generation location and form, biomass includes diverse types of materials. Information regarding the existing biomass volume is gathered by organizing the biomass information using biomass categories.

- A common classification system used in Japan is described in the below table.
- As shown in the next page, there are other classification systems based on generation location and biomass properties.
- It is important that the classification system meets suits the local conditions and characteristics.

Table Japanese Biomass Classification Based on Utilization Status (Utilized / Unutilized) [Example 1]

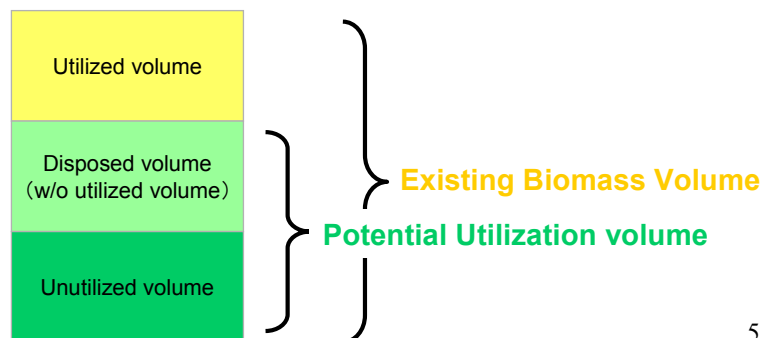
Utilization biomass	Unutilization biomass
Manure	Forest wood waste
Food processing residues and Food waste	Straw
Waste edible oil	Rice hulls
Scrap lumber	Food processing residues (vegetable, etc.)
Discarded timber	Fruit pruning branches
Woody waste from Trees lining a street, City park and Home pruning branches	Mowed grass in the golf course
Mowed grass from Road, Riverbed and Cowed grass of city park	Driftwood in dam and harmed tree
Sewage sludge, Human waste sludge and Agricultural sludge	Dead branch and dead tree in the golf course, etc.

Table Japanese Biomass Classification Based on Generation Location and Properties [Example 2]

Classification 1	Classification 2	Classification 3	Classification 4
Food	Industrial waste	Food processing residues Waste edible oil	
	Non-industrial waste (from homes)	Household waste Waste edible oil	
	Non-industrial waste (from businesses)	Food processing residues Waste edible oil	
Livestock	Industrial waste	Livestock manure	Cattle manure Pig manure Poultry manure
		Livestock carcass	
Agricultural	Industrial waste	Agricultural residues	Straw Rice hulls Food residues Fruit pruning branches
Woody	Forestry	Forest waste Pruning branches	
	Others	Drift wood in dam	
	Public administration	Pruning branches of trees lining a street Park pruning branches Cowed grass of Riverbed	
	Industrial waste	Woody waste of construction	From demolition work From building work From construction
		Others: woody waste Scrap lumber	From pellets and packaging tool From lumber mill From carpentry From furniture factory
	Non-industrial waste (from business)	Woody waste of construction Discarded timber	From demolition work From building work From construction
Non-industrial waste (from homes)	Others: woody waste	From pellets and packaging tool	
Marine	Industrial waste	Fisheries residues Marine processing residues	
	Non-industrial waste (from businesses)	Fisheries residues Marine processing residues	
Household waste	Public drainage facility	Sewage sludge Agricultural sewage sludge Swage sludge residues	
Others	Others	Others	

◆ Understanding The Existing Biomass Volume and Utilization Status

- Existing biomass volumes are estimated according to each biomass type (classification)
- To determine the existing biomass volume and utilization volume available, one must understand the process of biomass generation and distribution process
- Information regarding each biomass are generally gathered from the biomass generation sites (sources)
- Through conducting interviews at biomass sources and with the users, one must check whether the obtained data reflects the reality on the ground
- If accurate information cannot be obtained from the sources, statistics are used
- Again, it is important to understand the existing biomass volume and the utilization volume through the data that accurately portrays the current realities of biomass generation



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◎ Methods to Estimate Existing Volumes of Various Biomass Types

- Generally, existing biomass volume is calculated based on statistical data and the standard biomass generation volume per unit that are available for various biomass types.
- For statistical data, surveys conducted by countries, government institutions and research institutions/universities are commonly used.
- Standard biomass generation volume per unit can be calculated utilizing the statistical data. However, it is usually available in research and studies that have been published in the past.
- In case it is difficult to obtain all the necessary biomass data within the region, data are estimated through extrapolation of related data that are available. (Example: If one can only obtain biomass generation volume from one food factory, but have information on the town's gross food sales, one can extrapolate the town's total biomass generation volume from food factories.)

If:

- Actual measurements can be obtained at biomass generation sources
- Field interviews and survey data can be obtained (Example: Waste generation volume data from food factories)



Obtain biomass volume based on actual data measurements

If:

- Actual measurement of biomass volume is difficult



Obtain biomass volume based on statistical data, standard biomass generation volume per unit and extrapolation

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◎ Example 1: Estimating Livestock Manure Volume

Manure Volume (t/year) = Number of livestock/type × Standard manure generation volume/unit (kg/head/day) × 365days ÷ 1000(kg/t)

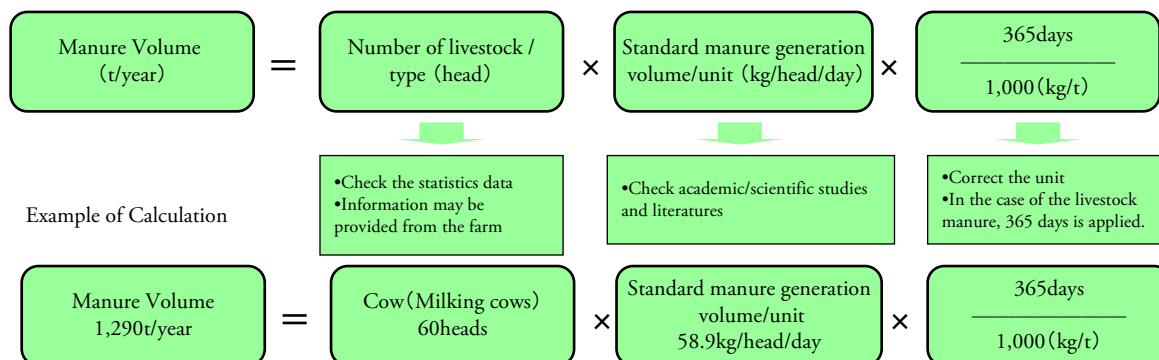


Table Standard Livestock Manure Generation Volume / Unit in Japan

Type	Growing period	The volume of manure (Unit) (kg/head/day)
Cow	Milking cow	58.9
	Dry cow & nulliparous cow	35.8
	Breeding cow	24.6
Cattle	Under 2 years	24.3
	2 years and over	26.7
	Daily cattle	25.2
Pig	Fattening pig	5.9
	Breeding pig	10.3
Chicken	Chick	0.059
	Chicken	0.136
Broiler		0.130

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◎ Example 2: Estimating Straw and Rice Hulls Volumes

➤ Straw = Cultivation Area /City/Breed × Rice (polished & unpolished) Weight/Breed × Standard Generation Volume of Straw

➤ Rice hulls = Cultivation Area /City/Breed × Rice (polished & unpolished) Weight/Breed × Standard Generation Volume of Rice Hulls

Rice breed decide the standard generation volume / unit.

Therefore it is important to use the data relevant to the rice breed of target region

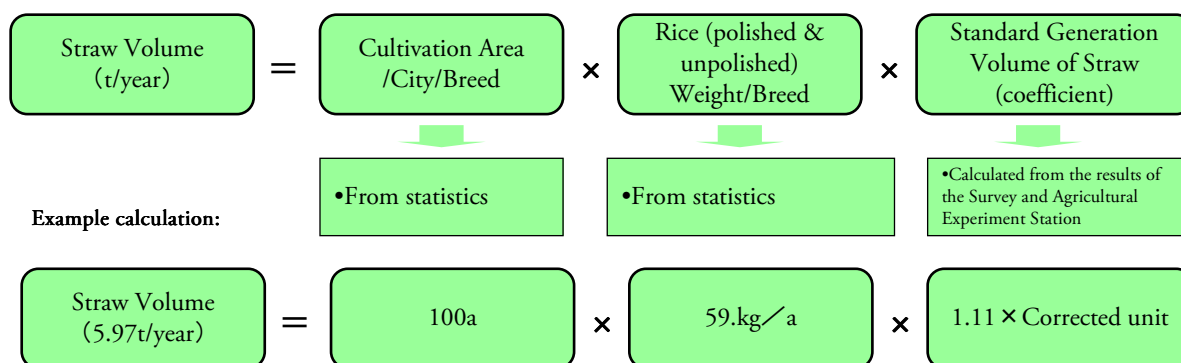


表 稲わら・もみ殻の発生原単位例

品種例	精玄米重 (kg/a)	わら重 (kg/a)	もみ重 (kg/a)	発生原単位 (玄米 1 kg 当たり)		
				わら	もみ	わら+もみ
あきたこまち	64.5	78.2	14.9	1.212	0.231	
こしひかり	52.2	65.4	13.1	1.252	0.252	
各種の平均値	59.7	—	—	1.11	0.24	—

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◎ Estimating Household Garbage Volumes (Raw Waste)

➤ Biomass volume of household garbage in Japan are usually estimated from data collected at the municipal incineration plants

➤ Garbage (Raw Waste) Generation Volume =

$$\text{Total Waste Material Volume Collected at Incineration Plants} \times \text{Percentage of Raw Garbage}$$

➤ When garbage is not sorted at collection, the percentage of raw garbage is estimated from the composition data of collected garbage, etc.

◎ Estimating Food Waste Volumes (from Food Factories)

➤ Volume of food waste generated in food manufacturing and processing plants differ according to the plant size and food material. Therefore, it is difficult to use a unified standard generation volume/unit. Ideally, generation volume should be calculated through stakeholder interviews.

➤ If stakeholder interviews are infeasible, the food waste generation volume is obtained by extrapolating the data of the generation volume from one manufacturing / processing plant.

◎ Estimating Food Waste Volumes (from Businesses)

➤ Similarly to food waste from households, it is difficult to establish a unified standard biomass generation volume / unit for food waste that are generated from small-scale restaurants, markets, and supermarkets. Therefore, generation volumes are ideally determined through stakeholder interviews.

➤ Furthermore, each communities have different treatment/disposal routes of food wastes. Therefore, it is important to understand the diverse routes for each food waste types.

➤ In Japan, several municipalities collect and treat food waste from businesses with food waste from households. Therefore, food waste volumes from businesses are calculated in a similar way to food waste volume from households.

◎ Estimating Sewage Sludge Volumes

➤ Volumes of biomass generated from waste water management, such as sewage sludge, are best obtained through interviewing each facilities within the target area. In Japan, data from each waste water treatment facilities are kept at municipal governments, and these data are used.

➤ Biomass resources related to sludge pertain significant volumes of water. Each biomass have different percentage of water content, and therefore, it is important to obtain information regarding their generation location, character, water content along with the generation volume.

◎ Estimating Woody Biomass Volumes

- For estimating woody biomass volumes, effective categorization is crucial.
- The generation mechanism differs depending on whether the woody biomass is generated from demolition work of homes and buildings, from lumber mills, or from forests.
- The generation mechanism must be clarified prior to estimating the generation volume of woody biomass
- Data on woody biomass generated in forests are lacking in Japan. Therefore, it is common that generation volume of woody biomass from forests is extrapolated from the forest area within the target region.
- Wood biomass generated from lumber mills (such as remaining mill ends) can be estimated through interviews at mills.

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◆ Organizing Gathered Biomass Information

- As shown in the table below, it is useful to organize the gathered biomass information according to the following categories.
- Biomass type, classification, estimated generation volume, data used for estimation of generation volume, data year, data source, other/notes

Example of How To Organize Gathered Biomass Information: In Case of Livestock Manure

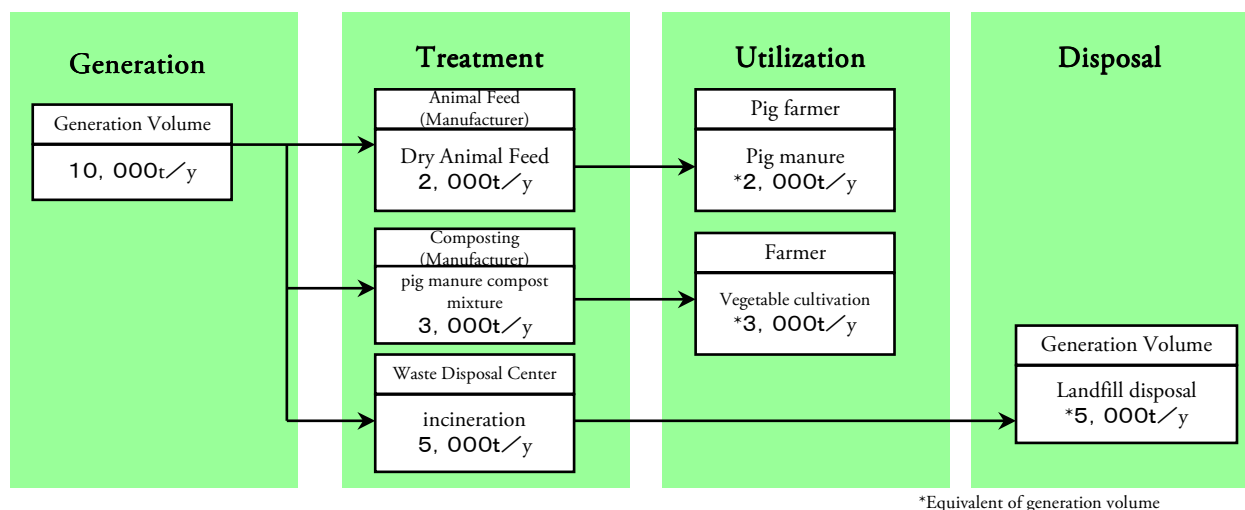
Biomass Type	Livestock Manure (Milking Cows)
Classification	Agricultural / Industrial Waste / Animal Manure / Cow Dung
Estimated Generation Volume	1,290t/year
Estimation Method/Equation	$60 \text{ heads} \times 58.9\text{kg/head/day} \times 365\text{days} \div 1,000\text{kg/t}$
Data Used for Estimating The Generation Volume	1) Number of livestock: Milking Cows = 60 heads 2) Standard manure generation volume / unit: Manure volume of milking cows = 18.9kg/head/day
Data Year	20XX
Data Source	1) Number of livestock: XX Research Institute, 20XX 2) Standard manure generation volume / unit: XX Agricultural Testing Center, 20XX
Other / Notes	Standard generation volume is the volume right after excretion. Standard volume must be modified according to the farming condition, type, and waste treatment methods.

*When creating a database of the gathered biomass information, an additional column is usually inserted to insert the numerical values.

◆ Organizing Information on Biomass Treatment, Utilization and Disposal Conditions

- Information on how the various biomass is treated and utilized can be organized as below.
- For example, in case of food biomass, the percentage/volume in which it is utilized as animal feed, fertilizer, methane fermentation, etc. are recorded. In case of agricultural biomass, the percentage/volume in which it is utilized as fertilizer, (farmhouse) litter, methane fermentation, etc are obtained.
- As illustrated below, in Japan, it is common to organize the treatment, utilization and disposal information/data in a flow chart.

Household Garbage (Raw Wastes)



◆ Organizing Data on Existing Biomass Volume

Table: Existing Biomass Volume and Utilization Methods

Biomass Classification	Existing Volume	Conversion/ Treatment method	Utilization Volume	Utilization Method/Distribution	Utilization Rate
Industrial Waste	35,509t		14,307t		40%
Manure	9,600t	Composting	9,600t	Composting stock, Farmland reduction	100%
Garbage (raw) from homes	8,272t	Incineration	0t		0%
Garbage (raw) from business	4,728t	Incineration	0t		0%
Waste edible oil	294t	Incineration, Partially stocked	0t		0%
Sewage sludge	3,816t	Incineration	2,766t	Cement stock	96%
		Composting	483t	Composting stock	
		Dehydration	407t	Cement plant fuel	
Human waste sludge	942t	Incineration	0t		0%
Settlement waste sludge	7,857t	Composting	1,051t	Composting material, Farmland reduction	13%
Unutilized Biomass	23,057t		22,260t		97%
Straw	19,000t	Farmland reduction	18,000t	Mixed into rice field	99%
		Livestock use	800t	Floor covering for livestock barn	
Rice hulls	3,600t	Composting	500t	Composting material	81%
		Farmland reduction	2,200t	Plow into rice field	
		Carbonizing	200t	Soil enhancement (heat retention)	
		Livestock use	100t	Floor covering for livestock barn	
		Drainage culvert Construction use	400t	Agricultural drainage Constriction material use	
Thinned wood	457t	Fabricated piling	60t	Piling wood use	13%