

11 Direct and indirect impacts

- Use of agricultural biomass residue as an alternative energy source would negatively impact on food security. Residues such as ash and char from thermal processes should be used for soil improvement to minimise the negative impact to land productivity. Additionally, this residue should be used locally to enhance the potential of nutrient circulation in the district.
- Burning emits more greenhouse gas than non-burning of crop residues, but non-burning practice may increase net GHG emissions from the paddy rice cultivation system, depending on the water management system used.
- Product marketing is a key driving force to raise utilisation rates of agricultural biomass residue and livestock waste. Conversely, shortages in residue and waste inputs to facilities could occur if there are too many facilities.

12 Existing practices

- Thailand promotes residue's utilisation as an alternative to open burning.⁴
- National biogas programme for improving energy security in rural Asia: Bangladesh, Cambodia, Indonesia, Lao PDR, Nepal, Pakistan and Viet Nam.⁵
- Biomass town programme in Japan.⁶

13 Conclusion

The success of any kind of agricultural biomass residue and livestock waste utilisation project depends on the conversion routes, plant scale, market price of products, plant factors, and the cost of biomass, thus policy rules, stakeholder involvement and sound technology applications are needed for sustainable management of agricultural biomass residue and livestock waste.

Reference documents and existing guidelines

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i For Further Information

IGES Institute for Global Environmental Strategies

2108-11, Kamiyamaguchi, Hayama, Kanagawa, 240-0115, JAPAN
TEL: +81-46-855-3720 FAX: +81-46-855-3709
Email: iges@iges.or.jp URL: <http://www.iges.or.jp>

Promoting full-scale use of agricultural biomass residue and livestock waste

Janya Sang-Arun Institute for Global Environmental Strategies (IGES), Japan
Nirmala Menikpura Institute for Global Environmental Strategies (IGES), Japan

01 Outline of indicator

Agricultural biomass residue and livestock waste are readily found in rural areas, with manure left exposed and biomass burnt in the open. These materials can be used to improve farm productivity—specifically, produce food and energy, generate incomes and reduce environmental impacts. Unfortunately, these residues and waste are not being fully utilised, for example, it was estimated that open burning of rice straw residue is practiced over an estimated 4.7 million hectares of rice fields in Thailand, with residues amounting to 21.7 million tonnes per year.¹ Only part of the rice straw is being used in some of the provinces as animal feed and for energy production.²

The indicator “promoting full-scale use of agricultural biomass residue and livestock waste” aims to maximise use of agricultural biomass residue and livestock waste through reuse and recycling measures. This would bring about a number of co-benefits, including GHG emission reduction, energy security, poverty reduction, sustainable livelihoods in rural areas, investment mobilisation, regional economic gains and public health improvements.



Fig.1 Burning of crop residues³

02 Type of indicator

Quantitative indicator

03 Policy goals to be monitored by this indicator

This indicator can monitor the achievement of **Goal 12** proposed under the draft Ha Noi 3R Declaration on Sustainable 3R Goals for Asia for 2013-2023. The primary quantitative indicators selected for Goal 12 are:

- Amount of agricultural biomass residue and livestock waste used
- Number and capacity of new projects initiated that use agricultural biomass residue and livestock waste as material input

In light of the potential co-benefits that can be achieved, the following quantitative indicators would also be useful in measuring the overall socio-economic and environmental progress made by effective utilisation of agricultural biomass: (1) Annual biomass residue generation, (2) Annual biomass utilisation to recover energy and nutrients, (3) Annual GHG reduction via effective utilisation of agricultural biomass, (4) Total renewable-energy production using agricultural biomass, (5) Net fossil-fuel savings, (6) Number of employment opportunities created, (7) Annual income generation via agricultural biomass based projects at regional level, and (8) Annual country's currency savings (due to avoided imports of fossil fuel and materials).

04 Definition and scope

- Agricultural biomass residue refers to plant residues leftover after harvesting; generally crop residues and weeds.
- Livestock waste refers to excreta and manure of animal raised and also organs of dead animals.
- Agricultural biomass residue and livestock waste can be used for the purposes of soil enrichment (e.g., soil cover material, animal feed, biochar), as a medium for food production (e.g., mushrooms), energy generation (e.g., electricity, biogas, solid fuel, bioethanol), and so on.



Fig.2 Use of crop residues for soil cover³



Fig.3 Use of crop residues for electricity generation

05 Policy instruments useful for promoting full-scale use of agricultural biomass residue and livestock waste

- Economic instruments are important for promoting full-scale use of agricultural biomass and livestock waste, especially at small and medium-scale farms. Creating market demand for agricultural biomass residue and livestock waste by developing markets for products utilizing these materials, use of a feed-in-tariff and use of the carbon market would act as key drivers to encourage farmers, entrepreneurs and investors.
- Introduction of appropriate cost-effective technologies applicable at the local level.
- Promotion of local investment and private businesses for biomass utilisation and replication of the most suitable schemes (e.g., biomass down) throughout the country. Intervention from governments, private sectors, NGOs and academia would increase awareness and the capacity of farmers and communities to use locally available agricultural biomass residue and livestock waste, especially in remote areas.²
- Public education on sustainable agriculture, organic farming and environmental impacts would greatly aid in promoting full-scale use of farm residues. Inserting such into school programmes could substitute in remote areas where farmers have low capacity for investment and suffer labor shortages.

06 Merits of implementation

- The practice of burning agricultural biomass residue to reduce the risk of uncontrolled fires and prevent insects and pathogen outbreaks is widespread. Promoting full-scale use of agricultural biomass residue can contribute significantly to successful implementation of policies geared towards ending open burning, and also reduce the risk of health and environmental impacts, and more importantly, life and property loss due to uncontrolled fires.

- Livestock waste is often left unattended, and this accumulated high-moisture waste generates a foul odour, methane and contaminates water and soil. Utilisation of this waste for soil amendment, energy generation and so on can significantly reduce negative impacts on the environment and public health.
- Use of agricultural biomass residue and livestock waste can significantly increase farm productivity and thus improve household livelihoods of farmers, generating new jobs for non-farmers, and thus increase resilience.
- Providing green energy to local communities.

07 Similar indicators and supporting indicators

- Non-burning practice/policy
- Reduction of annual amount of agricultural biomass residue burnt
- Quantity of compost production from agricultural biomass residue and livestock waste
- Organic farming policy and organic products in the market
- Quantity and number of facilities for renewable energy production from agricultural biomass residue and livestock waste

08 Methodology of data collection and calculation

- Primary indicators on the amount of agricultural biomass residue and livestock waste used can be measured by scale at the plant or site level. The number and capacity of new projects using agricultural biomass residue and livestock waste can be recorded based on registration data. Measurement of the amount of agricultural biomass residue and livestock waste used by entrepreneurs can be monitored via keeping records of residue and waste inputs to facilities. Monthly energy production and manure production can be recorded at the plant level, thus total annual production at the regional level can be calculated by totaling data from all plants.
- In practice, there are many small-scale agricultural biomass residue and livestock waste utilisation projects at the farm and community level that do not keep systematic records. For such cases, the amount of residue and waste used by farmers and communities can be approximated based on sampling. If agricultural biomass residue is used for soil cover, the amount of residues can be estimated based on total cultivation area multiplied by average biomass residue production per unit area. Statistics maintained by the Ministry of Agriculture may provide average national values for agricultural biomass residue for crop production. However, there are many variables, such as the density of plants, invasion of weeds and types of plants. Sampling plots at each farm would improve the accuracy of data collection.

09 Challenges and concerns

- In general, estimation of on-farm use of agricultural biomass residue and livestock waste is challenging, especially where only a portion of the residue and waste is utilised and farmers do not keep records. In this case, farm residue and waste generation and utilisation can be estimated based on area and productivity of crops or number of livestock.
- Small-scale agricultural biomass residue and livestock waste utilisation projects and entrepreneurs may not keep proper records of residue and waste inputs and operations may be intermittent, which will affect the accuracy of data collection.
- The number and capacity of new projects using agricultural biomass residue and livestock waste as material inputs may not represent actual utilisation, but can enable estimates of potential use.

10 Appropriate data management by stakeholders

- Generally, the Ministry of Agriculture responsible for agricultural promotion should maintain data on agricultural production, with actual data collected by local offices of the Ministry. Local administrative offices such as city offices should keep records of entrepreneurs and factories in their jurisdictions. Such frameworks can be developed based on the national administrative system.
- Entrepreneurs and farmers utilising agricultural biomass residue and livestock waste should maintain records to the extent possible to enable estimations of residue and waste they use.