

1. Overview

(1) Background and features of the practice

Biomass utilization is a practice that gathers organic resources (biomass) and uses them by converting them into energy or products within the limit of resilience of the natural resources. This biomass originates in biological sources such as wood, herbaceous plants, and animal waste, which is a naturally occurring inexhaustible resource. This practice has been widely practiced around the world.

Unlike fossil fuels which are exhaustible resources, biomass is a renewable resource that allows repetitive utilization. The carbon dioxide emitted from burning biomass originates in the carbon dioxide that the biomass absorbed through photosynthesis in its growth phase. Thus, the overall balance of carbon dioxide emissions in this practice can be considered even (carbon neutral). Therefore, biomass utilization is attracting attention as useful means to create cyclic and low-carbon societies. Biomass has been adopted around the world as an alternative to fossil fuels.

In areas that have utilized biomass, systems such as secondary forests and secondary grasslands have been created through the continuous involvement of humans for many years. Such forests and grasslands have provided habitats for many species and have served as the source of various ecosystem services. Thus, promoting biomass utilization is extremely effective under the perspective of biodiversity and ecosystem service conservation.

(2) Details of the practices and their applicability

Biomass utilization roughly includes two categories: energy use and material use.

Furthermore, the added values of using natural resources vary greatly depending on the form of utilization. In general, utilization for pharmaceutical and eating purposes are associated with the greatest values, followed in order by their utilization as materials, feed, fertilizers, and energy. Thus, whenever possible we should carry out cascade utilization in which biomass is utilized in the order by which it has the greatest added value.

1) Utilization of biomass as energy

- i. Details of the practice
 - The utilization of biomass as energy is the practice of converting biomass into energy used in houses or industries (as electricity or fuel).
 - A wide variety of utilization styles are possible depending on the types of natural resources used as materials and the types of conversion technologies. Suitable utilization is selected based on natural conditions and the social environments of a specific area.
 - Widely practiced methods include: manufacturing of charcoal and pellets from wood, biogas power generation using livestock excreta, and ethanol production using feed crops.
- ii. Range of application
 - There are various types of biomass that can be used as the materials. All areas have potential resources for this practice.
 - Nonetheless, possible realistic application must be examined based on conditions such as natural restrictions (e.g. effects on ecosystems through utilization) and socioeconomic restrictions (e.g. cost effectiveness and demand for produced energy).

iii. Implementing bodies

- Biomass utilization consists of extensive processes from the collection of natural resources, conversion, utilization, disposal, to reproduction. Thus, there is a possibility that various local residents will be involved in planning and project operations.

[Cases]

In Japan No.9: Regional circulation that combines biogas power generation with agriculture and livestock husbandry in Kyotango City, Kyoto Prefecture, Japan

Around the world No.6: Community forestry in Thailand

2) Utilization of biomass as materials

i. Details of the practice

- The utilization of biomass as materials is the practice of using biomass in manufacturing products. However, it does not include industry applications through extraction of specific constituent (e.g. manufacturing of chemical products, cosmetics, processed foods).
- As with biomass utilization as energy, a wide variety of utilization styles are available depending on the types of natural resources used as materials and the types of conversion technologies. Suitable practice is selected based on natural conditions and the social environments of each area.
- Representative products manufactured using biomass as raw materials include construction materials, fibers, papers, and industry materials.

ii. Range of application

(Same as the utilization of biomass as energy)

iii. Implementing bodies

(Same as the utilization of biomass as energy)

[Case]

Around the world No.5: Land use and natural resource utilization and management in Kampong Cham, Cambodia

2. Effects obtained from these Cases regarding the sustainable use and management of natural resources

Implementation of the practices in this category is associated with the following effects in the sustainable use and management of natural resources and the maintenance of a healthy secondary nature.

(1) Effects on the sustainable use and management of natural resources (socioeconomic effects)

- Natural resources can be overexploited due to various factors such as conversion of farmland into plantations, non-sustainable slash-and-burn agriculture, excessive collection of fuel wood, and reckless development. By working on the effective use of natural resources and development of never-used resources through the introduction of biomass utilization, we can expect that the use of natural resources to be controlled to proper levels in balance with the resilience of the environment. As a result, we can expect to realize a sustainable use of provisional services.
- There are areas where natural resources are underused due to various factors including population outflows caused by a decline in the agricultural, forestry, or fishery industries, or the popularization of fossil fuels and chemical fertilizers. In such areas, we can expect that the use of natural resources will increase to proper levels in balance with the resilience of the environment through the introduction of biomass utilization and by working on to create demand for the new natural resources. As a result, we can expect to realize a sustainable use of provisional services.
- With the improved health of ecosystems, which are the origin of natural resources, we can expect that multi-dimensional functions such as regulatory services (e.g. disaster prevention, climate regulation functions), supporting services (e.g. nutrient salt circulation, prevention/removal of pests), and cultural services (e.g. inheritance of local cultures, provision of places for ecotourism) that originate in the ecosystem to stabilize or improve. As a result, we can expect that various benefits will be provide to local residents.
- Through the above procedures, we can expect the effects of revitalizing rural areas with agriculture, forestry, and fishery, including increased income for local residents and the production of a safe and comfortable living environment. In developing countries or regions, the expected effects include reduced health hazards associated with the conventional use of firewood, as well as an improved social status of women and increased time for children to study due to a reduction in time needed in collecting firewood.

(2) Effects on the health of the secondary nature (effects on ecosystem and biodiversity)

- Through the introduction of biomass utilization, we can expect restoration of secondary nature such as farmland, forests, grasslands, and coastal oceans that have been deteriorated due to overexploitation or under-exploitation. As a result, we can also expect improvements in the biodiversity of these areas.
- The efforts of biomass utilization are expected to promote the absorption of GHG gases, which is an aspect of the ecosystem regulatory services. It is also expected to mitigate global climate change, and contribute to biodiversity conservation.

3. Toward the implementation of this practice : Points of planning and examples of action items based on the “Five Perspectives” of the SATOYAMA Initiative

The following sections describe points and action items to plan the implementation of this practice in areas with secondary nature.

Table: Points of planning and action items based on the “Five Perspectives” of the *Satoyama* Initiatives

“Five Perspectives” of the Satoyama Initiative	Points of planning	Action items
(1) Resource use within the carrying capacity and resilience of the environment	<ul style="list-style-type: none"> Based on the current uses and problems of natural resources in an area, it is necessary to determine the amount of biomass available for utilization that is in balance with the resilience of the environment. It is necessary to determine the amount to utilize so that biomass utilization will not impede the area’s ecosystem services, conservation of biodiversity, and other natural resource uses. 	<ul style="list-style-type: none"> Sort out current conditions and issues associated with the use and management of natural resources. Determine the amount of biomass available for utilization.
(2) Cyclic use of natural resources	<ul style="list-style-type: none"> It is necessary to select resources and conversion technologies which can help eliminate problems associated with an area’s natural resource utilization (e.g. overexploitation, under-utilization, inefficient usage). It is necessary to create healthy and efficient resource flows in the entire utilization process from the collection, conversion, usage, disposal, and recycling of natural resources. 	<ul style="list-style-type: none"> Select resources to utilize and conversion technologies. Create the entire utilization process.
(3) Recognition of the value and importance of local traditions and cultures	<ul style="list-style-type: none"> It is necessary explore the applicability of the traditional knowledge of the region. 	<ul style="list-style-type: none"> Verify applicability of traditional knowledge.
(4) Natural resource management by various participating and cooperating entities	<ul style="list-style-type: none"> It is necessary to create a system to properly identify stakeholders and facilitate smooth consensus building and role assignments. 	<ul style="list-style-type: none"> Identify stakeholders and establish implementation systems.
(5) Contributions to local socio-economies	<ul style="list-style-type: none"> It is necessary to create project plans so that the benefits generated from biomass utilization can be restored to the area as new employment (means of livelihoods, cash income) for local residents. It is necessary to plan programs for education, human resources development, and capacity building to promote sustainable use and management of natural resources and continuous project operations. 	<ul style="list-style-type: none"> Employment plans for local residents Plan for education, human resources development, and capacity building.

(1) Resource use within the carrying capacity and resilience of the environment

Points of planning	<ul style="list-style-type: none"> Based on the current uses and problems of natural resources in an area, it is necessary to determine the amount of biomass available for utilization that is in balance with the resilience of the environment. It is necessary to determine the amount to utilize so that biomass utilization will not impede the area's ecosystem services, conservation of biodiversity, and other natural resource uses.
Action items	<ul style="list-style-type: none"> Sort out current conditions and issues associated with the use and management of natural resources. Determine the amount of biomass available for utilization.

“Utilization within the range of resilience of the environment” is the most important prerequisite of the sustainable use of natural resources. The meaning and effects of biomass utilization cannot be realized without satisfying this prerequisite. “Utilization that is in balance with the resilience of the environment” is required in secondary nature when the amount of natural resource used is smaller than the resilience of the environment, because progress in the ecological succession of plants might bring deterioration to the quality of ecosystem services and biodiversity.

The past use and management of individual areas were not necessarily conducted in conditions that were in harmony with the resilience of the environment. It is possible that they now face problems such as overexploitation or under-utilization. Therefore, introducing biomass utilization is seen as an opportunity with the expectation of improving the usage and management of natural resources.

As a fundamental procedure in implementing this, it is necessary to clarify the current conditions and problems of the use and management of natural resources, and then determine the amount of biomass available for utilization so that it will not impede the conservation of ecosystem services and biodiversity as well as other uses of natural resources.

Table: Examples of operations to ensure usage within the carrying capacity and resilience of the environment

Action items		Examples of operations
Organize current conditions and problems of the use and management of natural resources		<ul style="list-style-type: none"> Overview of the local natural environment and ecosystem Types, distributions, and quantity of available natural resources in the area Details of the past use of natural resources (stock and flow) Problems associated with the above aspects (e.g. overexploitation or under-exploitation of natural resources)
Examine the amount of biomass available for utilization	i. Natural resources to protect	<ul style="list-style-type: none"> Study distribution ranges and quantity of natural resources to protect based on various perspectives including the conservation of biodiversity, conservation of water sources, and cultural inheritance.
	ii. Natural resources to use for other purposes	<ul style="list-style-type: none"> Based on the perspective of cascade utilization, examine the general policy for the uses of local natural resources, starting with uses of higher added values (food and pharmaceutical → materials → feedstuff → fertilizer → energy). Of the above, examine the ranges and quantity of distribution of natural resources to utilize for purposes other than biomass utilization.
	iii. Amount of biomass available for utilization	<ul style="list-style-type: none"> Excluding i. and ii. above, calculate the amount of biomass available for utilization within the range of the resilience of the environment targeting the following natural resources and lands. <table border="1" style="margin-left: 20px;"> <tr> <td> <ul style="list-style-type: none"> a. Resources that originate in natural organisms (amount of growth in trees and herbaceous plants) b. Wastes that originate in organisms (the generated amount of inedible parts of agricultural crops and livestock wastes) c. Lands that can grow resource crops and energy crops (amount of crops to harvest) </td> </tr> </table>
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(2) Cyclic use of natural resources

Points of planning	<ul style="list-style-type: none"> • It is necessary to select resources and conversion technologies which can help eliminate problems associated with an area's natural resource utilization (e.g. overexploitation, under-utilization, inefficient usage). • It is necessary to create healthy and efficient resource flows in the entire utilization process from the collection, conversion, usage, disposal, and recycling of natural resources.
Action items	<ul style="list-style-type: none"> • Select resources to utilize and conversion technologies. • Create the entire utilization process.

While biomass utilization constructs one form of resource circulation within itself, it may influence the entire natural resource circulation of an area by being involved with other land uses and the usage and management of natural resources through wide-range processes including the collection, conversion, utilization, disposal, and recycling of natural resources.

Due to wide range of effects, the planning of this practice is obviously expected not to give negative impact on an area's natural resource circulations; it is also expected to actively improve the health and efficiency of an area's natural resource circulation by creating new relationships between land use and natural resources (e.g. utilization of never-used resources and cascade utilization).

As a procedure to do so, it is necessary to focus on natural resources that are deeply involved with issues of natural resource uses in an area (e.g. overexploitation and under-exploitation) and natural resources associated with inefficient uses (e.g. wastes produced from utilization and never-used resources). It is also important to select resources to be utilized and conversion technologies that will improve such problems, and then plan healthy overall processes that center around them.

Table: Examples of operations to ensure the cyclic use of natural resources

Action items	Examples of operations
Examination of resources to utilize and conversion technologies (examine energy to produce or types of products)	<ul style="list-style-type: none"> • Examine possibilities for solutions by following biomass utilization targeting natural resources that are deeply involved with an area's issues on the use of natural resources (e.g. overexploitation and under-utilization). <div style="border: 1px dashed black; padding: 5px; margin: 5px 0;"> <ol style="list-style-type: none"> a. Explore the possibility of using other types of natural resources that replace natural resources that are deeply involved with the problem of overexploitation through the introduction of new biomass conversion technologies. b. Explore efficient ways to use natural resources that are deeply involved with the problem of overexploitation through the introduction of new biomass conversion technologies. c. Consider developing new ways to use natural resources that are deeply involved with the problem of under-exploitation through the introduction of new biomass conversion technologies. </div> • Examine the possibility of utilizing inefficiently used natural resources (e.g. wastes produced in utilization and never-used resources) through the introduction of new conversion technologies. • In addition to the above two points, examine other conditions (e.g. possible demand for energy or products produced through conversion, and costs and technical standards of conversion technologies) and select resources to use and conversion technologies.
Examine the overall process	<ul style="list-style-type: none"> • Plan overall processes including the collection, conversion, utilization, disposal, and recycling of natural resources centering around the resources to use and conversion technologies selected in above procedure. • Targeting this entire process, verify negative impacts on local natural resources circulation (e.g. use of supplemental materials, gas emissions, waste water, and wastes) and check whether cascade utilization is being efficiently implemented.

(3) Recognition of the value and importance of local traditions and cultures

Points of planning	<ul style="list-style-type: none">• It is necessary explore the applicability of the traditional knowledge of the region.
Action items	<ul style="list-style-type: none">• Verify applicability of traditional knowledge.

Local wisdom of traditional resource circulations and knowledge of useful plants may include information that can be utilized for the selection of target resources for biomass utilization and conversion technologies.

Also, some social systems (e.g. shared uses and role assignments) that have supported the traditional use and management of natural resources may be used in the management of natural resources that become the sources of biomass utilization.

Thus, as a part of the preliminary research to plan the implementation of this practice, it is necessary to sort details and locations of traditional knowledge, identify their natural and social rationalities in scientific ways, and examine their applicability.

(4) Natural resource management by various participating and cooperating entities

Points of planning	<ul style="list-style-type: none">• It is necessary to create a system to properly identify stakeholders and facilitate smooth consensus building and role assignments.
Action items	<ul style="list-style-type: none">• Identify stakeholders and establish implementation systems.

Biomass utilization consists of widespread processes including the collection, conversion, utilization, disposal, and recycling of natural resources. Thus, there is a possibility that many local residents will be involved in its utilization. The participation and support of NGO/NPOs, government organizations, and private companies are often necessary to obtain the funding and skills required for planning and project operations.

Thus, the planning of a biomass utilization project requires the participants to organize the details of the extend and relationships of stakeholders inside and outside the area and then construct systems for smooth consensus building and role assignments through the involvement of stakeholders.

In the management of natural resources that become the sources of biomass utilization, it is particularly necessary to construct a system to share the benefits and burdens through the participation and cooperation of various groups, such as by conducting management with the participation and cooperation of not only land owners but also beneficiaries of biomass utilizations.

(5) Contributions to local socio-economies

Points of planning	<ul style="list-style-type: none">• It is necessary to create project plans so that the benefits generated from biomass utilization can be restored to the area as new employment (means of livelihoods, cash income) for local residents.• It is necessary to plan programs for education, human resources development, and capacity building to promote sustainable use and management of natural resources and continuous project operations.
Action items	<ul style="list-style-type: none">• Employment plans for local residents• Plan for education, human resources development, and capacity building.

In addition to ensuring sustainability with regard to natural aspects, ensuring socioeconomic sustainability that supports sustainability of nature is essential in realizing the sustainable use and management of natural resources. Specifically, biomass utilization that produces energy and products with marketable values are associated with great industrial potential to promote local revitalization. Thus, it is necessary to actively explore their contributions to the local society and economy as a part of project planning.

It is effective to supply new employment (means of livelihood, cash income) as a direct contribution to local economies. In addition to direct employment in manufacturing, distribution, and the sale of energy and products, compensation should be paid to managers of the natural resources that are used as materials.

In order to ensure the long-term continuity of sustainable biomass utilization, it is important that individual participants involved in the extensive processes fully understand the concepts of the use and management of natural resources and gain sufficient knowledge and skills to put them into practice. Thus, it is necessary to obtain the support of NGO/NPOs, government organizations, and private companies to provide programs for education, human resources development, and capacity building targeting local residents.

Meanwhile, a private company that has headquarters outside the target area may serve as the main entity of a project when incorporating conversion technologies that require advanced technologies or large amount of initial investment. In such cases, it is required to put special efforts in employment, education, human resources development, and capacity building in order to maintain harmony between corporate activities and local socioeconomic operations.