The Ajinomoto Group, which has celebrated the 100th anniversary of its foundation, is now developing globally and marketing amino acid-based products, such as umami seasoning AJI-NO-MOTO®, and services for a wide range of fields, including feed, health, and pharmaceutical fields. Amino acids, which are the essential elements for all life, have profound possibilities. The business of the Ajinomoto Group is deeply related to life, and by expanding its amino acid business the Group contributes to solving problems concerning global resources and the environment while supplying people with tasty and healthy food products.
The Ajinomoto Group’s amino acid business has been contributing to the environment and development in many regions of the world. The Group produces amino acids, which are essential elements for life, at its global sites by fermenting locally harvested agricultural products such as sugar cane and cassava. The amino acid production process generates co-products in amounts that are several times larger than those of the main products, the amino acids. These co-products, which are also rich in natural nutrients, are supplied to local agricultural and livestock farmers and fishermen for use as feed and fertilizers. Feed-use amino acids are particularly expected to be more extensively utilized in the livestock industry around the world because they can greatly help reduce the environmental impact, and accordingly, the Group is pursuing more opportunities in its amino acid business. To minimize the environmental impact of the CO₂ emitted during the Group’s production of amino acids by fermentation, individual production sites in each country have been implementing progressive measures and outstanding results are beginning to emerge.

### Initiatives in progress based on four key points

**Procurement**  
- Toward sustainable procurement

**Production activities**  
- Minimizes the environmental impact of production
- Values the bounty of nature

**Products and services**  
- Contributes to the environment through product functions

**Procurement**  
- Cooperates with and contributes to the local agricultural industry

**Production activities**  
- Endeavors to achieve zero emissions for CO₂, discharged water, and other waste

**Products and services**  
- Makes full use of by-products as co-products

**Communication**  
- Explores the potential of amino acids and their co-products to enhance their environmentally beneficial functions and value

### Ecological production

**Procurement**  
- Cooperates with and contributes to the local agricultural industry

**Production activities**  
- Endeavors to achieve zero emissions for CO₂, discharged water, and other waste

**Products and services**  
- Makes full use of by-products as co-products

**Communication**  
- Explores the potential of amino acids and their co-products to enhance their environmentally beneficial functions and value

### Ecological use

**Procurement**  
- Cooperates with and contributes to the local agricultural industry

**Production activities**  
- Endeavors to achieve zero emissions for CO₂, discharged water, and other waste

**Products and services**  
- Makes full use of by-products as co-products

**Communication**  
- Explores the potential of amino acids and their co-products to enhance their environmentally beneficial functions and value

### Case

**The Bio-cycle**

Through the fermentation process, natural materials (sugars) are transformed into amino acids, which are then refined. This process requires more water and energy compared with general food production. In light of this fact, the Group is committed to reducing discharged water, waste, and CO₂ emissions from its amino acid production process to zero as a group-wide target.

**Co-products**

By-products from the amino acid production process are also rich in nutrients. The Group turns these by-products into co-products and makes the most efficient use of them in fertilizers and feed. The Group is striving to add higher value to these co-products.

**Environmental contribution through feed-use amino acids**

Amino acids, which support all life, are expected to contribute to the environment through their inherent functions. The Group is exploring new possibilities for amino acids using its accumulated expertise in life science.
Amino Acid Production and Ecology

One prerequisite for the production of amino acids is the necessity to constantly procure agricultural products to be used as raw materials. The Ajinomoto Group has been producing amino acids using its Bio-cycle, a resource recycling-oriented manufacturing framework, for more than 30 years.

In addition, the fermentation process requires a lot of water and energy, and accordingly it is essential to minimize the environmental impact by implementing measures to save energy and reduce the load of discharged water generated during the process.

Based on this recognition, the Ajinomoto Group is engaged in a range of zero emission activities at all plants where amino acids are manufactured by the fermentation process, both inside and outside Japan.

The Bio-cycle—A recycling-oriented framework for amino acid production

The Ajinomoto Group delivers its amino acid products to consumers all over the world. The Group’s representative product is AJI-NO-MOTO®, and it manufactures this and other amino acid products at its plants in Asia, the Americas, and Europe using locally cultivated agricultural products such as sugar cane, cassava, and corn as the raw materials.

A prerequisite for the sustainable procurement of local agricultural products is the necessity for the Ajinomoto Group to ensure that these products are grown taking into account the quality of the soil and the local environment. To achieve this, the Group has been operating with local farmers in the areas where it has manufacturing plants for amino acids for more than 30 years, aiming to establish a recycling-oriented amino acid production framework called the “Bio-cycle” in each of the areas.

In the Bio-cycle, after amino acids are extracted from the fermentation liquors made from locally procured agricultural products, the remaining liquids (by-products), which are also rich in nutrients, are processed into organic fertilizer. The fertilizer is then supplied to local farms to help improve their productivity. The Bio-cycle now serves as a model for recycling-oriented agriculture, which makes it possible to effectively use the blessings of nature in the locality and also to contribute to reducing the environmental load in the area.

The chart assumes worldwide annual production of approximately 500,000 tons of AJI-NO-MOTO® seasoning produced by the Ajinomoto Group using only sugar cane. The values for sugar cane grown and sugar production represent average global use, while the values for resources used for producing AJI-NO-MOTO® and values for by-products are based on actual Ajinomoto Group statistics.

Fostering zero emission activities in the manufacturing phase across the world

The Ajinomoto Group has its amino acid manufacturing plants in multiple countries and regions, which provide different manufacturing infrastructures, waste utilization options, and energy sources. Accordingly, each of the plants is devising and implementing its own measures to achieve “zero emissions,” which is the Group’s common target.

CO₂ emissions by the Ajinomoto Group totaled 2.31 million tons in fiscal 2008, and emissions by its plants outside Japan accounted for 77% of the total, because the Group has a lot of amino acid manufacturing plants outside the country. To reduce their emissions, the amino acid plants across the world have been introducing equipment appropriate for respective local business operations and infrastructures and have already achieved results.

For example in Brazil, a highly energy-efficient mechanical vapor recompression (MVR) technique was introduced to all five major amino acid manufacturing plants of the Group. Also in Indonesia, the Mojokerto Factory introduced a cogeneration system with dramatically high energy efficiency to reduce its CO₂ emissions.

For the Group’s initiatives to reduce GHG emissions and the load of discharged water, please also see p. 39-41.
Double Bio-cycles evolved in Thailand

Ajinomoto Co., (Thailand) Ltd. uses sugar cane and cassava as the main raw materials to produce amino acids. To date, as with the Group factories in other regions, the company has been converting by-products that are generated during the manufacturing process into organic fertilizers, while implementing Bio-cycle that helps improve the growth of locally produced sugar cane, cassava and rice. In addition to these efforts, the Kamphaeng Phet Factory of Ajinomoto Co., (Thailand) Ltd., which aims to be a “Green Factory,” has introduced a new boiler which utilizes local biomass as an energy source. This has brought about “Double Bio-cycles,” further benefitting the local community.

Halving CO2 emissions through adoption of a biomass boiler

The factory started to operate a biomass boiler in December 2008 to reduce CO2 emissions from manufacturing processes. Rather than heavy oil, this boiler is fueled by rice husks from rice cultivated in neighboring regions. Rice husks, which are an unused agriculturally derived resource, are carbon neutral1. The factory expects to reduce CO2 emissions by half and hopes that the boiler brings benefits not only for the factory, but also for the local communities. This new initiative has been dubbed the “Energy Bio-cycle.”

CDM project introduced for the first time in the Ajinomoto Group

The Japanese and Thai governments approved the above initiative as a CDM2 project in March and May, 2009 respectively and the Ajinomoto Group is applying for the project to be registered as a United Nation’s CDM project.

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1. Carbon neutral: Biological plants absorb CO2 by photosynthesis in their growth period, which offsets CO2 emissions from their incineration. So the CO2 emissions have no impact on the atmospheric CO2 emissions.
2. Clean Development Mechanism (CDM): One of the mechanisms set forth in the Kyoto Protocol. It enables projects that reduce emissions in developing country parties to be funded by entities in industrialized countries in return for credits for any emissions reductions that result from the project.
Another Product—Co-products—and Ecology

The Ajinomoto Group has established locally-contributing and recycling-oriented manufacturing processes so that nutrient-rich by-products that are generated in the amino acid production processes can be returned to agriculture, fisheries and livestock farming to make the best possible use of them as fertilizer and livestock feed.

By-products are the residual liquid after amino acid is taken from the fermentation process of agricultural products and are rich in nutrients including organic substances and minerals.

The Ajinomoto Group treats this by-product as a source of another important co-product, and makes efforts to promote it as a high-value product.

Co-products = High-value-added product

Rich in nutrients, by-products from the amino acid production process are recognized as another valuable bounty of nature and are fully utilized as fertilizer and livestock feed. The Group promotes the development of co-products in the same way as its amino acids.

Although about 90% of co-products are turned into fertilizer mainly in the agricultural industry, the effects and application vary depending on the regions and agricultural product. Further research and verification are underway.

In addition, using the same concept of returning the bounty of nature to the agricultural industry, the Group is working on R&D to contribute not only to agriculture but also to livestock and fisheries.

To produce higher-value-added co-products

In order to accumulate more knowledge and expertise to strengthen the Ajinomoto Group’s co-product business, including data on the effective use of co-products on local crops, which had been promoted at the Group’s amino acid manufacturing plants across the globe, we launched the “A-Link” project. Under this project, we will develop higher-value-added and in-demand co-products through collaboration between the Group’s production sites and regional technology centers around the world and the research institutes of Ajinomoto Co., Inc.

AJIFOL, which is a spray fertilizer for use on the leaves of plants to help them absorb nutrients, is an example of the Group’s high-value-added co-products.

Eiji Majima
General Manager,
Production and Technology Administration Center,
Amino Acids Company, Ajinomoto Co., Inc.

Expanded use of co-products across the globe

FD Green (Thailand) Co., Ltd.
FD Green (Thailand) Co., Ltd. is mainly engaged in the recycling of agricultural resources for Ajinomoto Co., (Thailand) Ltd. This company is actively conducting R&D and PR activities for the effective use of co-products under the slogan “We Will Make the World Green,” and has established its position as a top manufacturer of fertilizers in Thailand.

Ajinomoto Interamericana Industria e Comercio Ltda. and Ajinomoto Biolatina Industria e Comercio Ltda. (Brazil)
AJIFOL, which represents the Ajinomoto Group’s high-value-added co-products, was originally produced in its fermentation plants in Brazil. This product has been utilized as foliar spray fertilizer mainly for citrus fruits for about 20 years. In addition, it enables large-scale application and is widely used as a liquid fertilizer for major crops in Brazil, such as sugar cane, oranges, and coffee, and contributes to the agricultural output of the country, one of the leading agricultural countries in the world.

Kyushu Plant of Ajinomoto Co., Inc. (Japan)
The Kyushu Plant manufactures liquid and solid fertilizers using the by-products generated in its amino acid fermentation process. The plant is developing fertilizers that can improve the growth and yield of crops by testing their effectiveness as soil and foliar spray fertilizers and as fertilizers for wet-rice farming.
Agricultural development in Vietnam essential to a better life of the people

A liquid fertilizer, “AMI-AMI®” is a representative co-product of Ajinomoto Vietnam Co., Ltd. and is utilized as a fertilizer for various agricultural products cultivated in Vietnam. Vietnam is heavily dependent on agriculture, with more than 50% of the total population engaged in the production of a variety of products such as rice, vegetables, and fruits. By providing effective fertilizers that contribute to a better harvest, the company is helping to improve the lives of the people. Ajinomoto Vietnam Co., Ltd. is playing a vital role in establishing recycle-oriented agriculture that makes the best possible use of the blessing of nature in local communities.

Contributing to Vietnam’s agriculture based on the concept “Supply back”

Ajinomoto Vietnam Co., Ltd. purchases a large amount of cassava-derived starch for use as a raw material in the fermentation process for amino acid production. Producing one ton of umami seasoning AJI-NO-MOTO®, crystallized umami ingredients, generates 2.5 tons of co-products. Under the “Supply back” concept, co-products are given back to farmers who are supplying the raw materials. Ajinomoto Vietnam Co., Ltd. works on the co-products business and aims at making the crop more abundant, not only for cassava farmers, but also for farmers cultivating vegetables, fruits, nuts, coffee beans, rubber trees and the like, while being actively involved in technical training and promotion activities.

Special department set up to provide detailed assistance for the co-products business

It is necessary to provide individual farmers with detailed information on how to use the fertilizers as well as their effects. Ajinomoto Vietnam Co., Ltd. established Agriculture Development Department (ADD) to do this and carry out other tasks related to co-products, which are considered equally as important as amino acids production.

ADD implements basic research and experiments to enhance productivity in applying the fertilizer and provides detailed assistance to promote its use. It also verifies the effectiveness of applying the fertilizer in different locations and on different crops together with public institutions, in order to obtain certification for the fertilizer. The results of the research, experiments and verification are provided to farmers by technical staff through TV programs, technical training and the like.

For Ajinomoto Vietnam Co., Ltd. to continue its amino acid production, it is essential for the company to secure a stable supply of agricultural products to be used as materials. Presently, however, the area under cultivation has been decreasing in Vietnam, and the viability of agriculture itself will be threatened unless production efficiency is improved over the present level. To maintain the sustainability of our business, it is therefore essential to help improve local agriculture. To this end, we supply fertilizers of stable quality to local farmers at reasonable prices and also provide them with a range of information, including tips on how to use the fertilizers effectively. We aim to contribute not only to the dietary habits of the general population, but also to local agriculture in the country.

Hoang Van Quoc Chuong
Department Manager of ADD
Ajinomoto Vietnam Co., Ltd.

Trademarks are indicated by italics.
Feed-Use Amino Acids and Ecology

Feed-use amino acids provide the livestock industry with a lot of useful functions. Specifically, feed-use amino acids can be used as economical supplements to natural feed that tends to be deficient in amino acids. They also help mitigate the environmental issues faced by the industry by reducing greenhouse gas emissions and the load on soil and water from livestock excrement.

The Ajinomoto Group is further exploring the environmentally beneficial functions of amino acids and is making efforts to establish a system to spread the benefits to all the people in the world.

Environmental livestock farming spreading globally

For its feed-use amino acid business, Ajinomoto Co., Inc. has production bases in five countries in the world (France, U.S.A., Thailand, China, and Brazil), which together form a global AJINOMOTO ANIMAL NUTRITION Group. In particular in Europe, feed-use amino acids are being increasingly used in recognition of their environmental benefits in addition to the nutritious effects. In the future, feed-use amino acids are expected to be more widely used by the livestock industry all over the world, which will in turn help reduce the environmental impact of the industry.

Three contributions made by feed-use amino acids

Less environmental load on soil and water
—Reducing nitrogen in the excreta from livestock—

When animals are given feeds that are deficient in even one of the amino acids needed, the body cannot effectively use the other amino acids. These end up being wasted and excreted as nitrogen compounds. Excessive excretion of these compounds can have an impact on soil and water. Supplementing the deficient amino acids with feed-use amino acids improves the efficiency with which the animals’ bodies utilize amino acids. This leads to a lower amount of excreted nitrogen and helps reduce environmental load.

Combatting global warming
—Suppressing the generation of N₂O—

Nitrogen compounds from manure and urine are oxidized/reduced by soil and air, with some nitrogen being released into the atmosphere as nitrous oxide (N₂O). The greenhouse effect of N₂O is about 300 times that of CO₂. N₂O has the next largest impact on total global warming after CO₂ and methane. The use of feed-use amino acids can contribute to the prevention of global warming by reducing the amount of nitrogen contained in livestock excrement, which causes the generation of N₂O.

Helping solve food problems
—Effective utilization of farmland—

The use of feed-use amino acids also enables the simultaneous achievement of increased food production and environmental conservation. Common compound feeds for livestock are composed of ingredients such as corn and soybean meal. Nutritionally, 50 tons of soybean meal in 1,000 tons of compound feed can be replaced with 48.5 tons of corn and 1.5 tons of crystalline lysine. Since the yield per unit of land for corn, which is also the raw material for lysine, is about three times higher than that of soybeans, about 18 hectares of farmland can be saved by making the switch from soybean to corn production.

Effects of feed-use amino acids based on the Barrel Theory

Amino acids are essential nutrients for all animals. In particular, amino acids that cannot be synthesized within the body—known as essential amino acids—must be obtained through the diet. However, there are amino acids that tend to be deficient in conventional compound feeds such as corn, wheat and soybean meal given to livestock. Feed-use amino acids—represented by lysine, methionine, and tryptophan—are used to compensate for these deficiencies.
Combatting global warming through feed-use amino acids

The amount of nitrogen excreted by pigs and poultry given feed-use amino acids as supplements has been found to be about 30% smaller than the amount excreted with only conventional feed. The Ajinomoto Group has been verifying the greenhouse gas reduction effect of feed-use amino acids and actively discloses the results to spread the use of these amino acids and their effect across the world.

Mechanism of greenhouse gas (N₂O) generation from livestock excreta

The amount of nitrogen contained in livestock manure can be reduced by about 30% by adding feed-use amino acids to low-protein feed.

Conducting verification tests

The Ajinomoto Group has been trying to quantify the effect of feed-use amino acids, such as lysine, on the reduction of N₂O. In a joint research project with the National Institute of Livestock and Grassland Science of the National Agriculture and Food Research Organization (Japan) and Niigata University, the Group compared N₂O emissions from the manure treatment process between pigs given a feed-use amino acid-added low-protein feed and pigs given a conventional feed (high-protein feed with no amino acids added). Just as the Group had assumed, the test results implied that N₂O emissions would decrease with a supplement of feed-use amino acids in proportion to the decrease in the amount of nitrogen contained in the excrement. The results were presented at the 111th general meeting of the Japanese Society of Animal Science held at the University of the Ryukyus on September 28 and 29, 2009.

Expectations for a decrease in N₂O emissions from the Japanese livestock industry

Ajinomoto Co., Inc. applied to the Offsetting Credit (J-VER) Scheme, in order to obtain carbon offset credits for feed-use amino acid-added low-protein feed as a technology to reduce N₂O emissions from pig farming. At present, the feed, which is recognized as a greenhouse gas reduction technology in the agriculture and fisheries fields, is under examination for credit certification. If certified under the J-VER Scheme, amino acid-added low-protein feed will become more popular in the Japanese livestock industry and help reduce greenhouse gas emissions from the industry.

1. The Japanese Verified Emissions Reduction Certification Scheme (Offsetting Credit [J-VER] Scheme) was announced by the Ministry of the Environment in November 2008. Under this scheme, the Ministry gives official carbon offset credits for the reductions of greenhouse gas emissions achieved by businesses (e.g. hog farmers), and the businesses can sell these credits to make a profit.