AGRICULTURAL LAND IS ATTRACTING ATTENTION AS A POTENTIAL CO_2 SINK

— EUROPEAN AND US TRENDS IN AGRICULTURAL CARBON STORAGE AND CARBON CREDITS —

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SUMMARY

- Agriculture has been attracting attention as a potential CO_2 sink. This is because changing farming methods to no-till farming and similar practices has the potential to store CO_2 absorbed by plants in the soil without returning it to the atmosphere.
- In Europe and the US, carbon storage in agricultural land is being promoted as government policy. In addition to subsidies, governments are poised to develop carbon credit schemes for this purpose in the future, and are currently aiming to establish certification systems. Meanwhile, voluntary carbon credit initiatives are already up and running in the private sector, and these are likely to serve as reference for the establishment of public systems.
- Hitherto, agriculture has prioritized its role of supplying food, and there have been few calls for the industry to contribute to addressing global warming. However, with food supply under threat from climate change, agriculture is now also being asked to contribute to the realization of sustainable food supply.

According to the Food and Agricultural Organization of the United Nations (FAO), the net greenhouse gas emissions from agriculture, forestry, and other land uses amount to 7.7 billion tons per year (Figure 1), accounting for approximately 16%[1] of all industrial emissions. The largest individual share of these emissions comes from the increased emissions from conversion of forest to agricultural and other uses, which accounts for 38% of the total emissions from agriculture, forestry, and other land uses, and agriculture is a source of CO_2 emissions.

Figure 1. Net global agricultural greenhouse gas emissions

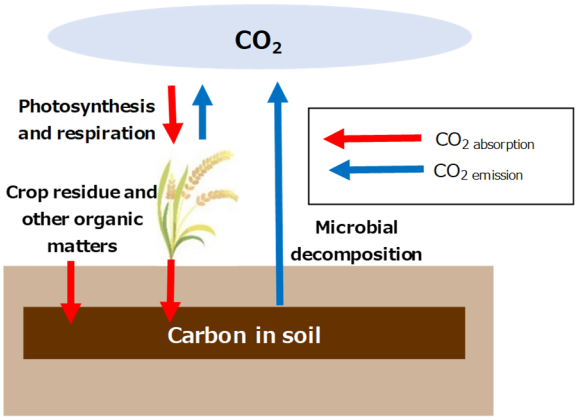
	Principal greenhouse gasses	2008	2018	
		Annual emissions (Million tons CO_2 equivalent)	Annual emissions (Million tons CO_2 equivalent)	Percentage content
Agriculture	-	5,814	6,293	82%
Enteric Fermentation	CH_4	1,988	2,099	27%
Energy Use	CO_2	806	946	12%
Manure left on Pasture	N_2O	794	875	11%
Synthetic fertilizers	N_2O	615	701	9%
Rice cultivation	CH_4	509	532	7%
Manure management	CH_4, N_2O	333	347	5%
Burning-Savanna	CH_4, N_2O	245	222	3%
Crop Residues	N_2O	191	221	3%
Manure applied to Soils	N_2O	180	190	2%
Cultivation of Organic Soils	N_2O	125	129	2%
Burning-Crop Residues	CH_4, N_2O	28	30	0%
Forestry and other land uses		1,422	1,372	18%
Forest land	CO_2	▲ 3,148	▲ 2,637	-34%
Net Forest conversion	CO_2	3,693	2,945	38%
Cropland	CO_2	641	676	9%
Burning-Biomass	CO_2, CH_4, N_2O	190	341	4%
Grassland	CO_2	46	47	1%
Agriculture, forestry and other land uses total	-	7,236	7,665	100%

Source: Prepared by MGSSI based on FAOSTAT data

[1] Proportion to the IPCC's calculation on the global total greenhouse gas emissions of 49 billion tons in 2010

However, in recent years, agriculture has been attracting attention as a potential source of CO_2 absorption (CO_2 sink). This is because if changes in farming methods make it possible for CO_2 taken in by plants to be stored in the soil and not returned to the atmosphere, agricultural land could become a carbon reservoir in the same way as forests (Figure 2). At this point, only forests are counted as a CO_2 sink in the inventory of greenhouse gasses [2]. However, the capacity of forests to absorb CO_2 tends to decline due to the aging of trees and other factors. Because this presents a hurdle to achieving greenhouse gas reduction targets, governments around the world are actively moving to add agricultural land to the sink menu.

Figure 2. CO_2 absorption and emission



Source: Prepared by MGSSI

This report introduces policies for promoting carbon storage in agricultural land in the EU and the US, and considers the future direction of agriculture.

1. PROGRESS IN CARBON STORAGE IN AGRICULTURAL LAND IN EUROPE AND THE US

1.1. The 4 per 1000 initiative

While carbon storage in agricultural land had already been a focus of attention since the time of the Kyoto Protocol, it gained wide recognition after the French government presented the “4 per 1000 (four per mil)” initiative at the 21st session of the Conference of Parties to the United Nations Framework Convention on Climate Change (COP21) held in Paris in 2015.

The aim of this initiative is to increase the amount of carbon in agricultural soil. At 1.5 trillion tons (carbon equivalent), equal to two to three times the carbon present as CO_2 in the atmosphere, the amount of carbon contained in the soil across the world is prodigious. The proposal is called the “4 per 1000” initiative because it is calculated that increasing the amount of carbon present in the soil by 0.4% each year could offset the annual increase in atmospheric CO_2 caused by anthropogenic emissions.

However, it is not easy to increase the amount of carbon in the soil through farming. According to Dr. Rattan Lal, recipient of the 2020 World Food Prize, who established a soil management method to increase the amount of carbon stored in agricultural soil, 450 billion tons of carbon have been lost from the soil through farming by humans since the dawn of history, far exceeding the 270 billion tons of carbon emitted by the burning of fossil fuels since 1850. Since the practice of farming itself continuously depletes the carbon in soil in the first place, continuing with conventional farming methods would make it difficult even to halt the depletion, let alone to increase the carbon content by 0.4% annually. Given this situation, it is currently expected that there will need to be a radical overhaul of conventional farming practices and a change to new methods in order to store carbon in agricultural soil.

1.2. A method for storing carbon in agricultural soil (no-till farming)

The most promising of these new methods is the no-till farming technique. No-till farming is a method of cultivating crops leaving the stubble, straw, and other residue of the preceding crop on the surface of the field, omitting the processes of tillage and soil preparation that are normally performed when growing crops. No-till farming and similar farming practices that naturally conserve the soil are referred to as “conservation agriculture” or “regenerative agriculture” in Europe and the US.

[2] Data summarizing the annual volume of greenhouse gasses emitted and absorbed by country

No-till farming is already in widespread use in the US, which is the world's largest corn producing country, due to the fact that it contributes to increased food production and labor saving, as shown in Figure 3. No-till farming is also recommended in the EU, which is one of the world's major wheat producing regions, as it aims to make the switch to low-resource, low-energy input agriculture.

Figure 3. Principal features of no-till farming

Advantages	Increased food production	Prevents soil erosion due to wind, etc. in dry areas.
		Because roots and other organic matter that become a source of carbon are left in the soil after harvesting, the soil enhances the diversity of organisms that live in agricultural soil, such as earthworms. In addition, the soil is improved as an environment suitable for plant growth, and it becomes more resistant to the growth of pathogens and to drought and other environmental impacts.
		Yields are expected to improve and increase in the medium to long term.
	Energy saving	Saves time and labor and no farm equipment is required.
	Environment	Stores carbon.
Disadvantages	Initial yield reduction	Slower growth and reduced yields are seen in the early stages following introduction.
	Weeding work	Time and effort for weeding increases (however use of clean-energy weeding robots is expected to solve this issue).

Source: Prepared by MGSSI

Given this situation, no-till farming is now seen as a promising method for carbon storage. Compared to tillage, it is harder for untilled soil to take in air, which reduces the rate of decomposition of microorganisms. As a result, the return to the atmosphere of carbon absorbed by plants through the process of photosynthesis is suppressed, and more carbon will be retained in the soil. Although microbial activity is expected to increase in the future accompanying a rise in temperature due to global warming, it will still be possible to suppress the release of carbon.

2. AGRICULTURAL POLICIES PROMOTING CARBON STORAGE IN THE EU AND US

2.1. The trend in the EU

In the EU, discussions are currently underway concerning the next Common Agricultural Policy (CAP) reform scheduled to be implemented from 2023. The CAP is a common agricultural policy adopted by all the EU member states. While subsidies have hitherto been provided for environmentally friendly agricultural practices under the CAP, in the policy reform, a new subsidy for "carbon farming," which refers to carbon storage in agricultural land, is scheduled to be added. The list of specific agricultural practices published by the EU in January this year[3] also includes "conservation agriculture," which refers to no-till farming.

Meanwhile, in its "Farm to Fork" strategy launched in May 2020, the European Commission presented carbon storage in agricultural land as a "new business model" for farmers. The specific details of this business model are scheduled to be announced in the third quarter of 2021, but for the time being, it is assumed that farmers who adopt carbon storage will be able to earn new income from carbon credit transactions. In the EU, carbon credit trading schemes are associated with the Emissions Trading System (ETS), and it will be interesting to see if the ETS will be applied to transactions involving carbon storage in agricultural land.

2.2. The trend in the US

In the US, moves are underway to provide financial incentives for carbon storage in agricultural land, as in the EU. This is referred to as the "carbon bank" concept advocated by the new Biden administration. Under this scheme, the government will subsidize farmers who adopt carbon storage by purchasing carbon credits from them. When a nationwide US ETS is established in the future, the carbon credits will be traded in that system, and the financial

[3] https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/key_policies/documents/factsheet-agri-practices-under-ecoscheme_en.pdf

burden will be reduced by involving private funding. It seems that the background to this proposal is the fact that no-till farming is already widespread among major farmers in the Midwest, and the American Farm Bureau Federation is calling strongly for these farmers to be able to enjoy greater economic benefits.

3. EVALUATION AND CERTIFICATION OF CARBON CREDITS IS AN IMMEDIATE POLICY ISSUE

3.1. The challenge of properly evaluating and certifying carbon content

In order to provide financial incentives for carbon storage in agricultural land, either in the form of subsidies or emissions trading, it is necessary to properly evaluate and certify the amount of carbon in the soil. However, because of the circumstances peculiar to agriculture, unlike in other industries, it is difficult to evaluate and certify the amount of carbon stored in soil.

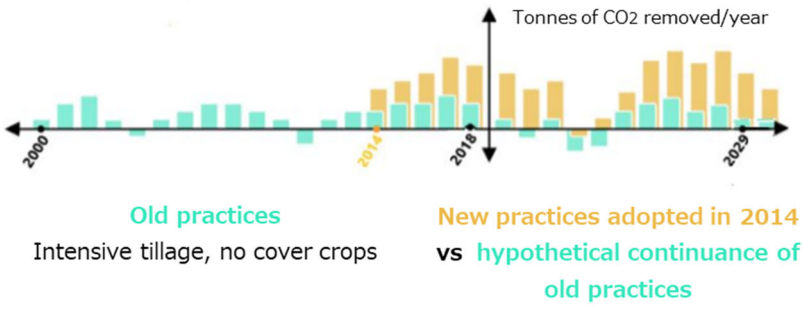
In itself, the process of measuring the carbon in soil is technically possible. However, the activity of microorganisms in the soil can change on a daily basis depending on the weather and temperature, with the result, for example, that even if no-till farming is practiced, the carbon content of the soil might not necessarily increase. When a natural disaster such as a flood occurs, the stored carbon may be washed out and lost. At the same time, the condition of the soil and the types of microorganisms it contains differ from region to region, which complicates matters even further. Therefore, the immediate issue is how to evaluate and certify stored carbon.

Under these circumstances, the EU has listed precision agriculture along with “carbon farming” as targets for subsidies for the environmentally friendly agricultural practices mentioned above. It seems that the intention is to promote data-driven agriculture using sensors and other means in order to gather and analyze data to be used as the basis of evaluation and certification. Similarly, in the US, the Agriculture Innovation Agenda announced in February 2020 by the Department of Agriculture calls for the use of digital tools with a view to introducing a credit system for carbon storage in agricultural land.

3.2. Preliminary voluntary market initiatives

Meanwhile, at the private sector level, there are already cases of carbon credits being traded based on the evaluation and certification of the amount of carbon storage in accordance with independent rules. Nori, a startup established in Seattle in 2017, operates a carbon credit marketplace, and because of the high transparency of its transactions, the company is expected to grow. Nori independently certifies the credits awarded for the efforts made by farmers to store carbon, and the farmers can sell those credits to companies and other purchasers through Nori to earn additional income[4]. The company estimates carbon content using the US Department of Agriculture’s COMET-Farm platform, which is a system used to calculate the US national greenhouse gas inventory. Specifically, the mechanism consists of estimating the baseline carbon content (shown in green in Figure 4) for the next ten years based on data such as the types and yields of farmland and crops submitted by farmers for at least the past three years, comparing this with the actual carbon amount each year (shown in yellow in Figure 4), and crediting the farmer for the amount by which the carbon content has increased above the baseline.

Figure 4. Estimation of carbon storage content using Nori's evaluation and certification methodology



Source: Nori "Croplands Methodology"

[4] Currently traded at US$15 per tonne of CO_2. There is a 15% commission on transactions.

The high level of attention being paid to carbon storage in agricultural land among private companies can be seen in the announcement by Nestlé and other companies in the food and agriculture industries of the formation of a consortium to enter the voluntary carbon market, as well as the fact that companies such as Bayer and Microsoft are also launching unique initiatives (Figure 5).

Figure 5. Carbon credit initiatives for agricultural carbon storage by leading companies

Company	Announcement/ Launch date	Details
Nestle, Corteva, General Mills, Danone, Cargill, ADM, Bunge, Nutrien, Syngenta, and several others	May 2019	Established the Ecosystem Services Market Consortium (ESMC), a non-profit organization with plans to launch a voluntary carbon market and start registering farmers by 2022.
Bayer	July 2020	Plans to purchase credits from Brazilian and US farmers adopting carbon storage practices.
Microsoft	July 2020	Has committed to becoming "carbon negative", and will issue carbon credits in partnership with agribusiness and food giant Land O'Lakes.

Source: Prepared by MGSSI

A problem with voluntary emissions trading is that participation is limited to a very few large-scale farmers, and the evaluation and certification methods used are unlikely to be applicable to the various types of farmers. However, these schemes are likely to serve as reference when considering public evaluation and certification methods in the future.

4. AGRICULTURE UNDER PRESSURE TO SHIFT TOWARDS SUSTAINABLE FOOD SUPPLY

Despite the fact that agriculture is a source of greenhouse gas emissions, as mentioned at the beginning of this report, there has not hitherto been a strong demand for the industry to contribute to addressing global warming because it has been deemed an inevitable consequence of the need to supply food. However, the fact that droughts and other natural disasters are expected to occur more frequently due to climate change has raised concerns about the food supply itself. Agriculture is also under pressure to make changes to curb global warming in order to realize sustainable food production.

In this respect, as already mentioned, the conversion to no-till farming will not only contribute to the environment through carbon storage in agricultural land, but is also expected to have the effect of increasing food production in the medium to long term, and the practice is expected to become more widespread. In addition, if a certification mechanism is established and a trading scheme is created, the creditworthiness of the carbon credits in circulation will increase. This will grow the demand from industry, raise the price of credits, and can also result in an increase in income for the farmers who adopt no-till farming. That is what US and EU agricultural policy is aiming for, and it is possible that it will become a new scheme for supporting farmers through private funding in place of subsidies.

While initiatives such as no-till farming and carbon credit schemes designed to encourage it are ongoing in Europe and the US, it may be difficult to apply such initiatives across-the-board in other regions with different soil environments and weather conditions. In fact, there are also moves underway in Japan towards applying carbon credits to carbon storage in agricultural land, but as yet, no-till farming is envisaged[5]. However, issues

[5] In 2020, the method of storing carbon using biochar was certified for emissions trading under Japan's domestic carbon credit scheme J-Credit. The main reason that no-till farming is not envisaged in Japan is that it has never been widely used, but it also seems that there is a different view about carbon storage in Japan from that in Europe and the US. The main focus of carbon storage in Europe and the US is on changing farming methods so as not to return the carbon absorbed by plants to the atmosphere (not to release the carbon from the soil), whereas in Japan, the focus is on physically adding external material such as compost and biochar as sources of carbon to the soil.

such as improving the environment, ensuring a stable supply of food, and raising the income of farmers are common worldwide. In particular, in emerging countries, where environmental problems are growing in severity accompanying economic development, it is becoming increasingly important to increase food production to feed ever-growing populations. While on the contrary, the farmers whose job is to perform that role are poor. For that reason, suppot is indispensable to help them raise their incomes. Going forward, it may be worth considering applying these European and US-style schemes to agriculture in emerging countries in order to help them solve these societal issues.