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Japan's Farmland Policy for Photovoltaic Power Generation

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ABSTRACT

In 2012, the Japanese government launched a new program, under which those who generate electric power from natural energy sources, such as sunlight, are given the privilege to sell it to major electric power companies at favorable prices fixed by the government. This program, known as the feed-in tariff program, affected farmland use. While farmland conversion for construction of photovoltaic power panels was quite rare before 2012, such conversions accounted for more than 1,000 hectares every year after 2013. In addition, a new technology called "solar sharing" has emerged that allows photovoltaic power generation to coexist with agricultural production. In 2015, the Japanese government started a special program to promote solar sharing. However, because the technology of solar sharing has not been sufficiently established yet, the national aggregate acreage of solar sharing farmland remains at a negligible level.

Keywords: farmland conversion, feed-in tariff (FIT) program, photovoltaic power panel, provisional permission, solar sharing

INTRODUCTION

Because of government support, photovoltaic power generation is booming in Japan. The total output of photovoltaic power generation grew rapidly from 0.04 million kW in the fiscal year 2011 to 10.8 million kW in the 2017 fiscal year (a fiscal year starts on April 1 of a calendar year and ends on March 31 of the next calendar year). Farmers are catching on to this trend. By constructing photovoltaic power panels on farmlands, they are able to generate electric power; to do so, farmers need to follow the Japanese government's rules for changing land use. This paper describes the relationship between the Japanese government's support for photovoltaic power generation and the regulations it framed for farmland use.

THE STRUCTURE OF THE POWER INDUSTRY IN JAPAN

It would be useful to first provide a quick overview of the market structure of the Japanese electric power

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industry.

The Japanese government provides both protections and regulations for the electric power industry. The Japanese government divides the national electric market into the following ten regions: Hokkaido, Tohoku, Kanto, Tokai, Hokuriku, Kinki, Chugoku, Shikoku, Kyushu, and Okinawa. Each region has only one major electric power company: Hokkaido Electric Power Company for Hokkaido; Tohoku Electric Power Company for Tohoku; Tokyo Electric Power Company for Kanto; Chubu Electric Power Company for Tokai; Hokuriku Electric Power Company for Hokuriku; Kansai Electric Power Company for Kinki; Chugoku Electric Power Company for Chugoku; Shikoku Electric Power Company for Shikoku; Kyushu Electric Power Company for Kyushu; and Okinawa Electric Power Company for Okinawa. The Electricity Business Act gives the title of "General Electricity Transmission and Distribution Utility (GETDU)" only to these ten companiesi. GETDUs are engaged in all three major electricity businesses, that is, generation, distribution, and transmission of electric power. GETDUs are not allowed to refuse the supply of electricity to meet general demand in their service areas without justifiable grounds. This regional monopoly system of the Japanese electric power industry was established in 1951ii.

For years, not only the Japanese government, but also most of the European and North American governments employed similar regional monopoly systems for the electric power industry. This is because electric power is a daily necessity for the general public; further, economies of scale are possible in the technology for the distribution and transmission of electric power.

A possible problem arising out of a regional monopoly is that electric power companies may lose the incentive to improve the efficiency of their businesses because of the lack of market competition. Until around 1980, based on high economic growth in developed countries, citizens were more affordable to pay relatively high prices for public services such as electronic power. However, after developed countries entered a low economic growth period in the 1980s, citizens became more critical about the efficiency of public service companies. Thus, in the 1990s, the governments of some advanced countries, such as the UK and US, abandoned regional monopoly and introduced market competition in the electric power industry. Although this policy of marketization resulted in a decline in the electricity power charges, it also increased the risk of instability of electric power supply[iii]. Thus, there are various views about whether, and how much, the electric power industry should be marketed.

In the 1990s, Japan's choice was different from that faced by the UK and the US. Thus, by revising the Electricity Business Act in 1995, the Japanese government allowed outsiders to enter electric power generation. However, the Japanese government maintained (and continues to maintain) the GETDUs' regional monopoly on electricity distribution and transmission facilities, such as electric power lines and electric power substations. As a result, this revision in the Electricity Business Act did not lead to significant changes in the electric power industry.

REVISION OF ELECTRIC POWER POLICY AFTER NUCLEAR POWER PLANT

ACCIDENT

Thermal power generation enjoys a dominant share in Japan's electric power supply[iv]. This means that Japan relies heavily on fossil fuels, such as coal, oil, and natural gas. However, Japan has quite limited fossil fuel reserves. Indeed, because Japan's self-sufficiency in fossil fuels is almost zero, its position in international negotiations gets weakened. In contrast with fossil fuels, nuclear fuel can, theoretically, be reused in perpetuity[v]. In addition, a majority of the nuclear scientists assert that nuclear fuel is effective in slowing down the speed of global warming because its combustion does not produce any CO_2 emission. Thus, for years, the Japanese government had promoted nuclear electric power generation as the policy of the nation[vi].

However, the Fukushima Nuclear Power Plant accident in 2011 changed the situation. Since then, anti-nuclear power sentiment has become dominant among Japanese citizens. Accordingly, their expectations from natural energy, such as sunlight and wind, have gone up. Thus, the replacement of nuclear fuel by natural energy became the government's top agenda.

In 2012, to promote electric power generation through natural sources of energy, the Japanese government introduced the feed-in tariff (FIT) program, whereby GETDUs cannot refuse to purchase electric power generated through sources of natural energy at government-set prices; these are commonly called the 'FIT prices' charged to outsiders (FIT prices differ according to the electric horsepower)[vii]. The Calculation Committee for Procurement Price, a committee in the Ministry of Economy, Trade and Industry, is responsible for setting the FIT prices. The target of the FIT program was both common people and companies[viii]. The FIT program was established as limited time legislation of 7 years (until November 2019). It was natural that GETDUs tried to oppose the FIT program because the FIT program would deny their discretion in choosing the supplier of power generation. However, because citizens' sentiment against GETDUs was so bad after the Fukushima Nuclear Power Plant accident, GETDU could not reject the FIT program.

The FIT program stimulated electric power generation by using natural energy sources. For example, the aggregate volume of geothermal, photovoltaic, and wind power generation increased from 2.8 million kW in the fiscal year 2011 to 18.7 million kW in 2018ix. However, FIT prices were too high for the GETDUs to make profits. Thus, the GETDUs passed on the economic burden of the FIT program to the electric power users by charging them more. This means that the FIT program increased production costs of Japanese companies and the living costs of Japanese consumers.

In fact, the FIT program started as a short-term program that aimed to stimulate outsiders' starting up of electric power generation by using natural energy sources. The FIT program ended in November, 2019. Now it is up to the GETDUs to decide whether they should purchase electric power generated by natural energy from outsiders.[x]

PROBLEMS OF PHOTOVOLTIAC POWER GENERATION

Public opinion polls show that a majority of Japanese citizens have a favorable image of photovoltaic power generation.[xi] It is true that photovoltaic power panels produce neither CO2 emissions nor radioactive wastes while generating electric power.

However, photovoltaic power panels also cause some problems; for example, they produce large shadows and change the water flow at the surface after rainfall. The construction of photovoltaic power panels often leads to environmental destruction in neighboring areas by increasing the risk of flooding and diffused reflection. In addition, photovoltaic power panels contain toxic materials, such as Selenium. Thus, when photovoltaic power panels reach the end of their life, there is a risk of environmental destruction. Because the FIT program started in 2012 and most of the photovoltaic power panels are estimated to have a life of 20 years, Japan has not yet had to treat of a large number of defunct photovoltaic power panels; however, in 15 years' time, their treatment will be a serious problem.

Moreover, the risk of abnormal voltage pertains to photovoltaic power generation because the output can change unexpectedly because of the weather.

THE JAPANESE GOVERNMENT REGULATIONS ON FARMLAND CONVERSION

The urbanized lifestyle of Japanese citizens, including rural dwellers, leads them to avoid the manual labor involved in farming. Thus, it is natural for farmland owners to consider abandoning farming by converting their farmlands for constructing photovoltaic power panels. However, the Japanese government does not leave conversion of farmlands to its owners' discretion.

It should be noted that Japan's predominantly mountainous landscape poses a problem for land use and has triggered a tussle about the agricultural or non-agricultural uses of the limited high-quality land. The conditions that favor farming are: (1) flatness; (2) large well-shaped land block; (3) good access to roads; (4) presence of abundant sunlight; and (5) a good water drainage system. These five conditions are also favorable for urban land uses, such as construction of shopping centers, apartments, and public facilities.

Generally, the profit per acre in agriculture is potentially much lower than that in non-agricultural activities. Thus, it would appear that the most high-quality farmlands would inevitably be converted for non-agricultural purposes if there was no land use regulation. Farmlands have several economic externalities. First, farmlands have water retention function, which prevents flooding of rivers during periods of heavy rainfall. Second, they are a habitat for endangered species[xii]. Third, farmlands are the foundation of rural life. Moreover, it is difficult to restore a farmland once it has been converted for non-agricultural uses. Thus, it is reasonable for the government to set limits on farmland conversion.

While it is not necessary to protect all farmlands from conversion to non-agricultural uses, the conversions that do occur should be carried out in a well-planned manner. Ensuring proper planning for farmland conversion is one of the most essential aspects of farmland policy.

The system of controlling farmland conversion comprises many laws.[xiii] Among them, the

Agricultural Land Act is the most critical; the act classifies farmlands into three categories according to their quality: Type I (high quality); Type II (medium quality); and Type III (low quality). The criteria for the classification is complicated (and there remain ambiguity and unclearness) and no official statistics about how farmland is divided into three categories[xiv]. However, the author estimates that Type I accounts for more than four-fifths of the farmland and receives various agricultural subsidies, as well as favorable treatment while imposing asset taxes.[xv] Farmlands of Types I and II should be ideally protected from non-agricultural uses. In principle, only Type III farmlands can be converted for the construction of photovoltaic power panels.

THE JAPANESE GOVERNMENT'S PROVISIONAL PERMISSION PROGRAM FOR SOLAR SHARING

In the traditional approach, the construction of photovoltaic power panels on farmlands is tantamount to their conversion and the end of agricultural production. However, a new technology called "solar sharing" has emerged that allows photovoltaic power generation to coexist with agricultural production. Unlike ordinary photovoltaic power panels, solar-sharing photovoltaic power panels have vacant spaces that allow sunlight and rainfall to reach the ground surface. In addition, the photovoltaic power panels in solar sharing are supported by extremely long pillars (two meters or higher) to leave space for farming under the panels.

In theory, solar sharing is a smart way to generate electric power without sacrificing farming. However, in practice, there is a distinct possibility that the productivity of solar sharing (both agricultural production and electric power generation) may be too low to be economically sustainable. For example, agricultural productivity in a solar-sharing farmlands may be much lower than that in ordinary farmlands because photovoltaic power panels block a significant portion of sunlight and rainfall; further, the pillars for photovoltaic power panels hinder the operation of agricultural machinery. In addition, because the surface areas of solar-sharing photovoltaic power panels for solar sharing are small, the volume of electric power produced may be insufficient.

The technology of solar sharing is still in its initial stages. However, the Japanese government has high expectations from solar sharing. In 2015, the Japanese government launched a new farmland use permission program for solar sharing. If a farmer submits a solar sharing plan that satisfies the following two conditions, he or she will receive a provisional permission for constructing photovoltaic power panels for solar sharing on his farmland (the provisional permission is issued according to the Agricultural Land Act).

(i) The structure of sola-sharing photovoltaic power panels (including the pillars for supporting the panels) is flexible enough to allow farmland owners to remove them quickly if they are requested to do so.

(ii) The agricultural productivity (measured by yield per acre of the crop) in solar sharing is at least

80% of the average productivity for ordinary farmlands in the region.

This provisional permission is valid for three years. If the agricultural performance in the three years is too low to satisfy condition (ii) mentioned above, the farmer must quickly remove the photovoltaic power panels (including pillars) from his or her farmland. If the three-year performance satisfies condition (ii), he or she is allowed to have the provisional permission renewed for another three years (there is no limit on the number of renewals).

In contrast to the case of farmland conversion, this provisional permission can be given even for high-quality farmland (Type I) if used for solar sharing. This can be seen as a great shift from the Japanese government's traditional farmland policy that high-quality farmland should be protected from non-agricultural uses.

Considering that photovoltaic power panels can usually be used for 20 years, the three-year permission is too short. Thus, in 2018, the Japanese government took a second step to support solar sharing. Thus, if a plan for solar sharing satisfies at least one of the following three conditions, the provisional permission period should be for ten years instead of three.

(i) The person who farms the solar-sharing farmland holds the title of "certified farmer," and recognized by the municipal government as a rural community leader in enhancing the efficiency of agricultural operations[xvi].

(ii) The solar-sharing farmland has been so devastated that it is difficult to restart farming there by using ordinary farming technologies.

(iii) The solar-sharing farmland is categorized as either Type II or III.

THE TOTAL ACREAGE OF FARMLAND CONVERSION FOR PHOTOVOLTIAC POWER GENERATION AND SOLAR SHARING

Table 1. Total acreage of farmland conversion for photovoltiaic power generation and the total acreage of solar sharing farmland

(ha)

Fiscal year[a]	Farmland conversion for photovoltiac power generation[b]	Solar sharing farmland	
		New permission	Renewed permission
2011	0.7		
2012	263.9		
2013	1,351.4	19.4	
2014	2,267.6	60.5	
2015	1,580.8	71.9	0.12
2016	1,554.9	179.2	15.4
2017	1,249.5	82.1	53.2

Note a. Japanese fiscal year starts on April 1 in the calendar year and ends on March 31 in the next calendar year.

b. The Ministry of Agriculture, Forestry and Fisheries collects data on farmland conversion acreage according to major non-agricultural purposes. However, before 2011, photovoltaic power generation was not recognized as a major non-agricultural purpose.

Source: Ministry of Agriculture, Forestry and Fisheries.

Table 1 shows the year-wise record of farmland conversion for photovoltaic power generation. As can be seen, farmland conversion for photovoltaic power generation was almost zero before fiscal year 2012. After the FIT program started, it increased sharply to 2,267.6 hectares in 2014 and, then, gradually decreased to 1.249.5 hectares in 2017. The total acreage of farmlands in Japan is estimated at 4.8 million hectares[xvii]. Thus, the accumulated acreage of farmland conversion for photovoltaic power generation during fiscal years 2012–2017 is less than 0.2 % of the total farmland.

Considering that the FIT program ends in 2019, there is a possibility that farmland conversion for photovoltaic power generation would keep declining. However, it should also be noted that the tendency of Japanese citizens, including rural dwellers, to avoid the manual labor involved in farming keeps becoming more pronounced. If a farmer decides to abandon farming, farmland conversion for photovoltaic power generation remains an alternative.

Table 1 also shows that the total acreage of solar-sharing farmland is quite limited. It should be legitimate to conclude that solar sharing is still an unproven technology and, therefore, unprofitable for a majority of farmers.

CONCLUDING REMARKS

While the Japanese government initiated new farmland policies after the Fukushima Nuclear Power Station accident in 2011, the total acreage of farmland conversion to generate photovoltaic power and that of solar-sharing remains at a low level.

There are both pros and cons about the Japanese government's proposed move to further revise its farmland use regulations to promote photovoltaic power generation. It is true that Japan needs alternatives to nuclear energy. In that sense, farmland conversion for photovoltaic power generation and solar sharing seems to be a desirable policy. However, it should be also noted that farmland conversion for photovoltaic power generation and solar sharing has negative effects on the neighboring farmlands; further, as discussed in the fourth section, photovoltaic power generation may not be environmentally friendly. Thus, the Japanese government faces a dilemma.

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[i] Previously, General Electricity Transmission and Distribution Utilities were called General Electricity Utilities. They were renamed under the revision to the Electricity Business Act in 2016.

[ii] An exceptional case is Okinawa Electric Power Company, which was established in 1972 according to the US's handover of its sovereignty over Okinawa to Japan.

[iii] In 2003, the Great Lakes area suffered a large-size blackout. Some experts attribute this terrible accident to the US government's excessive liberalization of the electric power industry in the 1990s (for example, see the 2003 study by the Los Angeles Office of the Development Bank of Japan, "Hokubei Daiteiden Nikansuru Ichi Kosatsu (A Case Study on the Great Blackout in the Great Lakes area)."

[iv] According to the 2018 version of Japan's Energy White Paper (published by the Ministry of Economy, Trade and Industry), thermal power generation accounted for nearly four-fifths of Japan's total electric power generation in 2016. Even in 2010 (one year before the Fukushima accident), it was nearly two-thirds of the generation.

[v] The Japanese government had a plan of establishment up nuclear fuel cycle technology whereby used nuclear fuels are recycled. The government constructed two plants for recycling used nuclear fuel. However, both of them turned to be unworkable. As such the government's recycle plan came to nothing.

[vi] For example, see the 1990 Ministry of Environment report, "Global Warming Prevention Action Plan."

[vii] Natural energy in the FIT program includes biomass energy, hydropower, sunlight, terrestrial heat, and the velocity of the wind.

[viii] Transmission facilities to connect to a GETDU's power lines should be built by the electronic power generator. The government also provide subsidies for construction of solar panels.

[ix] The data on the total power generation by energy types are available at the homepage of the Ministry of Economy, Trade and Industry (https://www.enecho.meti.go.jp/statistics/electric_power/ep002/results_archive.html#h23).

[x] Under the FIT program, GETDUs and those who generate electric power conclude 10-year long contracts. While the FIT price changes every year, the selling/purchasing price of electric power remains unchanged for ten years. The termination of the FIT program does not affect the effectiveness of 10-year contracts concluded under it.

[xi] For example, according to the Japan Atomic Industrial Forum’s public-polls (conducted annually), sunlight was recognized as the most desirable energy source for electric power generation throughout the 2010s. The details of these public polls are available at https://www.jaif.or.jp/190319-1.

[xii] World Wildlife Fund Japan argues that Japanese farmland presents nest for various endangered species such as killifish and water strider. For more details, see the World the homepage of Wildlife Fund Japan at https://www.wwf.or.jp/activities/activity/209.html.

xiii Details of farmland conversion regulations are given in Godo, Y., “Regulation on Farmland Conversion in Japan”, FFTC Agricultural Policy Database (Food & Fertilizer Technology Center for the Asian and Pacific Region) October 8, 2013.

[xiv] For more details, see Godo, Y., “The Puzzle of Small farming in Japan, *Pacific Economic Papers, (Australian National University) No. 365, 2007.*

[xv] Municipal governments designate zones as Exclusively Agricultural Area (EAA) for provision of preferential treatment entailing agricultural subsidies and tax reduction. In principle, farmlands in EAA are regarded as Type I. The Ministry of Agriculture, Forestry and Fisheries estimates that EAAs comprise nearly 80 percent of total farmland area in Japan (http://www.maff.go.jp/j/nousin/noukei/totiriyo/tenyou_kisei/270403/pdf/sankou1.pdf).

[xvi] Certified farmers include not only natural persons, but also legal persons and farming groups.

[xvii] The aggregated acreage of farmland conversion for photovoltaic power generation during the fiscal years 2012–2017 was 8,268.1 hectares (calculated from Table 1). The Ministry of Agriculture, Forestry and Fisheries estimates the total acreage of cropland as 4.4 million hectares for 2019 (http://www.maff.go.jp/j/tokei/sihyo/data/10.html). However this acreage does not include idle farmland, where farmers gave up farming for more than a year. There are no official estimates for the total acreage of idle farmland for 2017. Fortunately, however, the Ministry of Agriculture, Forestry and Fisheries conducts the Agricultural Censuses every five years (this survey was based on farmland owners’ self-reports). The Ministry of Agriculture, Forestry and Fisheries estimates the total acreage of idle farmland as 0.4 million hectares for 2015. However, this estimate is alleged to have a downward bias. In addition, the Agricultural Censuses show an increasing trend of idle farmland. Thus, the total acreage of farmland in 2017 should be 4.8 (=4.4+0.4) million hectares or more