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Public goods and externalities

AGRI-ENVIRONMENTAL POLICY MEASURES IN JAPAN

Tetsuya Uetake

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Abstract

**PUBLIC GOODS AND EXTERNALITIES:
AGRI-ENVIRONMENTAL POLICY MEASURES IN JAPAN**

Tetsuya Uetake, OECD

Agriculture is a provider of commodities such as food, feed, fibre and fuel and, it can also bring both positive and negative impacts on the environment such as biodiversity, water and soil quality. These environmental externalities from agricultural activities may also have characteristics of non-rivalry and non-excludability. When they have these characteristics, they can be defined as agri-environmental public goods. Agri-environmental public goods need not necessarily be desirable; that is, they may cause harm and can be defined as agri-environmental public bads.

Public Goods and Externalities: Agri-environmental Policy Measures in Japan aims to improve understanding of the best policy measures to provide agri-environmental public goods and reduce agri-environmental public bads by looking at the experiences of Japan. This report provides information to contribute to policy design that addresses the provision of agri-environmental public goods, including the reduction of agri-environmental public bads. It is one of five country case studies (Australia, the Netherlands, United Kingdom, and United States) which provide input into the main OECD book, *Public goods and externalities: Agri-environmental policy measures in selected OECD countries*.

***Keywords*:** Public goods, externalities, agri-environmental policies, Japan

***JEL classification*:** Q52, Q53, Q54, Q56, Q57, Q58

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The OECD project on public goods associated with agriculture was carried out under the auspices of the OECD Joint Working Party on Agriculture and the Environment (JWPAE), of the Committee for Agriculture and the Environment Policy Committee. This project was led by Tetsuya Uetake (OECD Trade and Agriculture Directorate). The JWPAE endorsed the report for declassification in June 2014.

Table of contents

Tables

Figures

Executive summary

There are nine agri-environmental public goods which are targeted by Japanese policies: agricultural landscapes, biodiversity, water quality, water quantity, soil quality, climate change – carbon storage, climate change – greenhouse gas emissions, air quality and resilience to natural disasters (flooding, snow damage, fire, etc.).

Most Japanese agri-environmental public goods are jointly produced by food and agricultural activities. For example, the Japanese agricultural landscape is the result of a long history of human interaction with nature: groundwater recharge and flood prevention are made possible through the maintenance of paddy fields and irrigation systems.

Japanese agri-environmental public goods are under-provided in most cases. The limited available data suggests there is a strong demand for agri-environmental public goods, but that in many cases the supply of these goods suffers from progressively poorer conditions. However, the extent of such market failure for each agri-environmental public goods is not clear. The situation can change depending on the region. As such, priorities and the extent of intervention can vary depending on the market failure depending on the agri-environmental public goods.

Good policy mixes are necessary to ensure the provision of agri-environmental public goods. To achieve environmental targets in Japan, positive incentives and technical assistance are generally used, while for some agri-environmental public goods (water quality, soil quality, and air quality), regulatory measures are used and farmers are required to meet reference levels at their own cost. Although multiple policy measures are implemented, co-ordination among policy measures is not yet sufficient, and it is not clear to what extent one policy measure tries to address the issues at hand, and to what extent other policy measures do so.

The costs associated with the provision of agri-environmental public goods require more attention. In many cases, reference levels and environmental targets are not clearly set. Most financial incentives set reference levels in accordance with current farming practices, which means that the government is required to pay farmers to adopt sustainable farming practices. However, in some cases, it would be better to have a discussion before government intervention concerning the extent to which farmers on the one hand and governments/society on the other should bear the costs.

Some innovative approaches undertaken by local governments and private companies such as payments for ecosystem services by private sectors and public-private partnerships should be explored as they can improve the cost-effectiveness of agri-environmental policies.

Much effort is necessary to establish better agri-environmental indicators. This would make it possible to ascertain the level of necessary government intervention and identify good policy measures to target the appropriate drivers that would enable an adequate amount of agri-environmental public goods to be produced. This would also allow for the monitoring and evaluation of agri-environmental policy measures.

1. Introduction

Agriculture has played a central role in Japanese tradition and culture and provides many agri-environmental public goods, such as agricultural landscapes, biodiversity, and flood prevention. In 2009, it accounted for 13% of Japan's total land area (OECD, 2013a), with farms operating across a diverse range of climates. Most agricultural land is located in the Asian monsoonal zone, which is favourable to rice production although annual precipitation varies greatly between regions and seasons. The increasing frequency of extreme events, however, has exacerbated the risk of floods and landslides in many areas (OECD, 2002; 2008; 2010a).

Ensuring the provision of agri-environmental public goods is one of several objectives set out in the 1999 Food, Agriculture and Rural Areas Basic Act. Many agri-environmental policies are implemented in Japan, but to date there has been little holistic research covering a broad range of agri-environmental policies, including regulations and payments that target various kinds of agri-environmental public goods. This paper reviews Japanese agri-environmental policies and seeks to ascertain the following.

- What kind of agri-environmental public goods are targeted in Japan?
- How are these agri-environmental public goods provided for in the Japanese agricultural system?
- Does supply meet demand, i.e. does market failure associated with agri-environmental public goods exist?
- Where market failure exists, who should bear the costs for providing agri-environmental public goods? To what extent should farmers bear the costs, and to what extent should society? How does Japan set agri-environmental targets and reference levels?
- What policy measures are implemented for agri-environmental public goods in Japan and which policy measures target which agri-environmental public goods?

Section 2 summarises the main agri-environmental public goods targeted in Japan; Section 3 discusses the provision mechanisms of these public goods; Section 4 examines market failure of these goods; Section 5 provides a reference level framework in Japan to identify to what extent costs should be borne by farmers or society; Section 6 shows how Japanese agri-environmental policies are organised; and Section 7 concludes the discussion.

2. Agri-environmental public goods targeted in Japan

The 1999 Food, Agriculture and Rural Areas Basic Act sets out the main objectives of Japanese agricultural policy. Ensuring the provision of agri-environmental public goods is one of them. Examples of such goods include the conservation of national land, water resources, the natural environment, formation of good landscape, and respect for cultural traditions (Article 3). Other agri-environmental public goods (both providing positive ones and reducing negative ones) are also targeted by various agri-

environmental policies in Japan. This study identifies the nine agri-environmental public goods that are targeted by these different policies (Table 1).[1]

Table 1. Main agri-environmental public goods targeted in Japan

Agricultural landscapes	Climate change – carbon storage
Biodiversity	Climate change – greenhouse gas emissions
Water quality	Air quality
Water quantity/availability	Resilience to natural disaster
Soil quality and protection	

The first of these targeted goods are **agricultural landscapes** and **biodiversity**, both of which are highly appreciated in Japan and which have largely developed within an environment influenced by humans (e.g. farmland and secondary forests). These are referred to as *Satoyanma*. And have been developed and maintained sustainably over a long period of time (MOE and UNU-IAS, 2010). An example of a Satoyama are paddy fields, which play a key role in providing landscapes and buffer for water flows and contribute to food security (OECD, 2010a). However, farmland area in Japan has decreased considerably over the last 20 years due to its conversion to non-agricultural use. The government implemented the *Satoyama Initiative* in an attempt to preserve these landscapes (Box 1).

Box 1. *Satoyama* landscape and *Satoyama* Initiative

Satoyama landscape refers to mixed community forests, arable fields, orchards, paddy fields, irrigation ponds and ditches, and the villages and farmsteads themselves (MOE, 2009, OECD, 2010a). Because of a mosaic of different kinds of lands (e.g. woodland, grassland) and environments, the *satoyama* landscape can provide a transition between different ecosystems and habitats for wildlife. It can also provide disaster prevention and watershed protection (OECD, 2010a).

In 2008, the *Satoyama Initiative* was launched and, in 2010, the Ministry of the Environment of Japan (MOE) and the United Nations University Institute of Advanced Studies (UNU-IAS) jointly initiated the International Partnership for the *Satoyama* Initiative at the Tenth Meeting of the Conference of the Parties (COP10) to the Convention on Biological Diversity. The Initiative proposes a vision for resource management and land use that achieves a balance between economic production and conservation of biodiversity and ecosystem services (OECD, 2010a).

According to MOE, areas classified as *satoyama* make up approximately 40% of Japan's land area (MOE, 2008). The Japanese often have a deep emotional attachment to the *satoyama* landscape and it has been a source of inspiration, imagination and creativity in Japanese culture. In addition, a 2009 survey of paddy fields revealed that traditional *satoyama* landscapes provide habitat for about 40% of total fresh water fish species and about 80% of frog species (MAFF, 2009).

Japanese agriculture has strong linkages to **water quality** and **quantity** because of the large amounts of water used, especially in paddy fields. Japanese agriculture has both positive and negative impacts on water quality. Paddy fields have a function of denitrification and require less fertilisation as compared to vegetable fields and orchards (Mishima et al., 1999; Kumazawa, 2002; Babiker et al., 2004; Yoshida et al., 2010). As a result, nitrogen leaching into surface water and groundwater from paddy fields is low,

1. Although social public goods (e.g. rural vitality, food security) are important policy targets in Japan, this study will focus on agri-environmental public goods. This is because the purpose of this study is to contribute to the development of better agri-environmental policies, and dealing with social public goods would include a broader discussion beyond the field of agri-environmental policies.

contributing to better water quality (OECD, 2008). Moreover, paddy fields using an irrigation system that recycles water can lower nutrient pollution (Feng et al., 2004; Takeda and Fukushima, 2004; Shiratani et al., 2004). However, eutrophication, which is partially due to agriculture, of lakes and coastal areas is a public concern in some closed water bodies.

Agriculture has an impact on water quantity and availability. In 2008, it accounted for 66% of total water use (OECD, 2013a) due primarily to the dominance of paddy rice cultivation (Kobayashi, 2006). However, paddy fields can recharge groundwater, with a study estimating that about 20% of groundwater in Japan is recharged by paddy fields (Mitsubishi Research Institute, 2001).

Agriculture also impacts on **soil quality**. Soil has characteristics of both private and public goods. Soil is under private control. Enhancing soil quality and functionality is considered a basic farming skill in Japan that brings private benefits to farmers. However, farmers have a short-term incentive to maximise productivity through the heavy use of pesticides and fertilisers, or inappropriate farming practices which can reduce soil quality and functionality. Some agricultural soils are contaminated with risks for human health, although soil erosion, a big problem in some OECD countries, is not widespread in Japan since paddy fields can prevent soil erosion (Takagi, 2003; Yoshisako et al., 2009). Maintaining good soil quality can also contribute to biodiversity, water and air quality, and carbon storage. Preventing soil pollution and keeping good soil quality can bring public benefits, both present and future.

Agriculture impacts on air quality and climate change, so that maintaining good **air quality** and **stabilising climate change** is also of public interest. Odours from livestock and burning straw can reduce air quality. Most public goods have characteristics of local public goods. Minimising contamination from various sources can be achieved by adopting specific farming management practices (Cooper et al., 2009). Although agriculture is a net contributor to greenhouse gas emissions, a wide range of agricultural practices can promote **carbon storage** and reduce **greenhouse gas emissions**. To enhance the function of carbon storage and further reduce greenhouse gas emissions, several agri-environmental policies have been recently introduced in Japan.

Intensive rainfall and a steep topography are characteristic of Japan, with the result that heavy rains can lead to rapid water flows in rivers and to serious flooding. Agriculture, however, can contribute to **preventing natural disasters;** paddy fields, for example, can retain water and contribute to flood prevention. Forest and paddy fields (along with their irrigation canals) also allow water percolation to recharge groundwater (OECD, 2009), as well as prevent landslides (Yamamoto, 2003). Paddy fields and irrigation canals can be used to extinguish fires and act as a buffer, as well as melt snow and thus mitigating potential snow damage.

3. Farming practices and agri-environmental public goods

Most agri-environmental public goods are jointly produced with food and agricultural activities. The Agency for Cultural Affairs (ACF) estimates that over 90% of national cultural assets are closely related to agriculture or rural activities (OECD, 2008). Most regions in Japan are in the Asian monsoonal zone that receives abundant precipitation favourable to paddy farming. As a result, two-thirds of farmland outside Hokkaido are paddy fields, and indeed most agri-environmental public goods in Japan are associated with paddy farming (OECD, 2009), and about 70% of paddy fields

landscape are terraced paddy fields, *tanada* (ACA, 2003). The importance of Japanese paddy fields is internationally recognised and the Food and Agriculture Organization of the United Nations (FAO) registered paddy fields in Noto Peninsula within the Globally Important Agricultural Heritage Systems (Box 2). Other farmlands include grain, potato and vegetable fields, orchards and pastures. They also provide local agri-environmental public goods such as landscape and biodiversity.

Box 2. Globally Important Agricultural Heritage Systems (GIAHS) and paddy fields in Noto Peninsula

Globally Important Agricultural Heritage Systems (GIAHS) are "[r]emarkable land use systems and landscapes which are rich in globally significant biological diversity evolving from the co-adaption of community with its environment and its needs and aspirations for sustainable development." FAO launched the Global Partnership Initiative on conservation and adaptive management of GIAHS in 2002 during the World Summit on Sustainable Development in order to enhance recognition and support of traditional agricultural systems (GIAHS).

In 2011, Noto's Satoyama and Satoumi were selected as GIAHS sites by the FAO, the first in Japan. They are located in the Noto Peninsula, Ishikawa Prefecture, in central Honshu (the main island of Japan). Noto Peninsula is characterised by a mosaic of socio-ecological production-managed systems and provides many environmental services. However, the loss of biodiversity and climate change brings huge challenges to natural resources. The communities of Noto are working together to sustainably maintain *Satoyama* and *Satoumi* (marine-coastal ecosystems comprising seashore, rocky shore, tidal flats and seaweed/eelgrass beds). They work together to enhance understanding and raise awareness of the importance of socio-ecological production landscapes for human well-being and to support Japan's cultural heritage.

Sources: GIAHS, www.giahs.org/giahs-home/en/
Ishikawa Prefecture, www.pref.ishikawa.jp/satoyama/noto-giahs/f-lang/english/index.html

In addition to agriculture, facilities related to agriculture (e.g. irrigation systems) also provide various public goods, such as resilience to natural disaster as noted above, and which results that irrigation systems, for example, are targeted as necessary to preserve. Traditionally, farmers and local people contribute to providing agri-environmental public goods. However, as the number of farmers decreases and local communities shrink this is becoming increasingly difficult. The management of these agri-environmental public goods and common resources is a main concern in Japanese agriculture (Box 3).

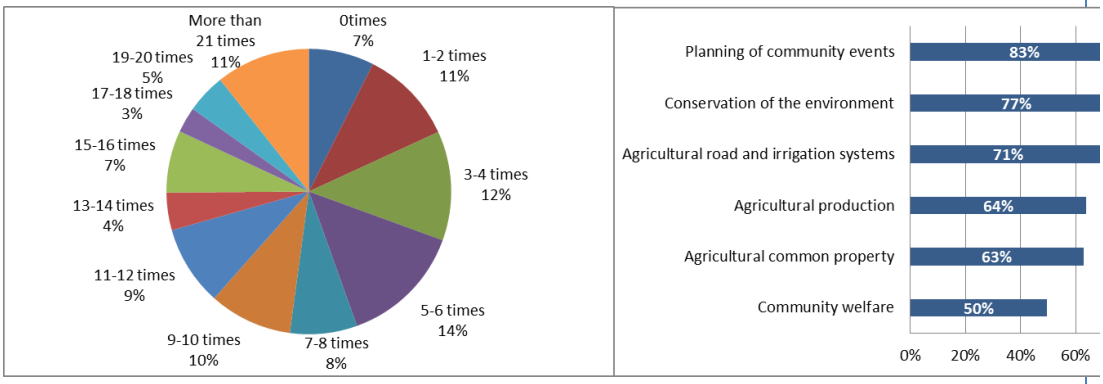
Box 3. Rural communities in Japan

The advent of irrigation in Japan led to the development of rice farming throughout the country. Today, small fragmented land holdings share irrigation facilities as a non-excludable common property. Co-ordination and co-operation are needed amongst farmers to ensure the distribution of water to all plots, planting, water management, and insect extermination. This co-dependence builds close-knit rural communities (*Shuraku*) and creates strong social capital (e.g. close personal ties, mutual trust) and which is reinforced when farmers and non-farmers voluntarily cooperate with each other. The rural community functions as a self-governing body which manages common agricultural properties and co-operates in agricultural production, in addition to holding ceremonies, developing and maintaining voluntary police and fire brigades, and ensuring social security (OECD, 2009).

The 2010 agricultural census indicated that 92.5% of agricultural communities (*Nogyo Shuraku*) hold community meetings more than once a year, and more than half had meetings more than seven times a year. Matters such as planning of community events and conservation of the environment are discussed (Figure 1).

However, there have been significant changes in rural areas in the past decades. A decreasing population due to ageing and city migration has led to fewer rural communities. These changes have accelerated in recent years. Around 5 000 rural communities became non-functioning (i.e. no longer able to manage common property) between 1990 and 2000. The share of non-farm households in rural communities is increasing (OECD, 2009).

Figure 1. Times agricultural communities' meetings hold and subjects discussed



Source: MAFF (2010a), *2010 World Agriculture and Forestry Census*, MAFF, Tokyo.

Figure 2. Provision mechanisms of agri-environmental public goods in Japan

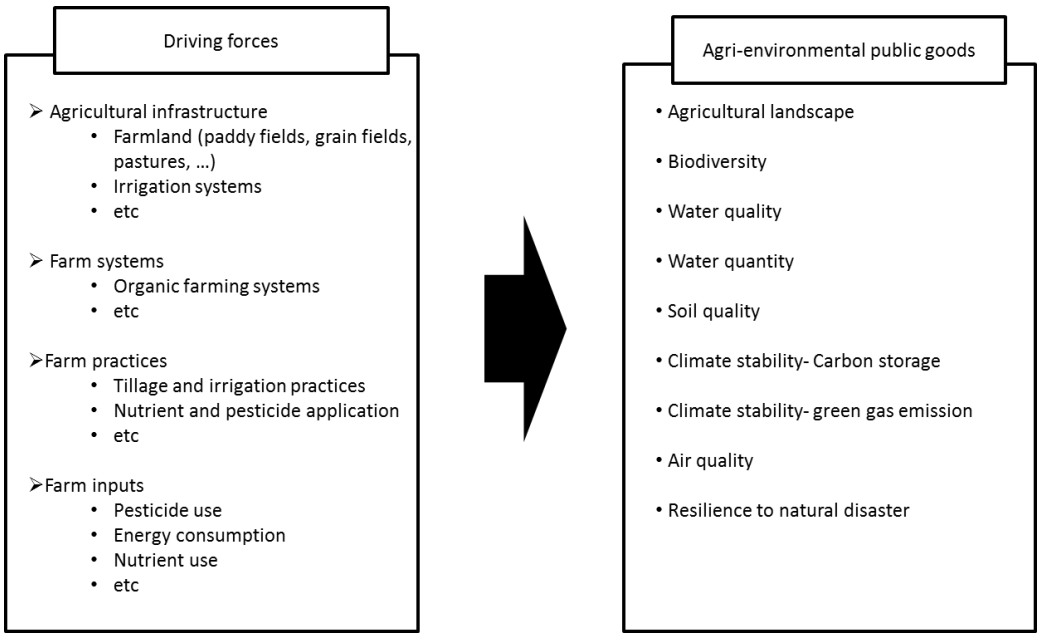


Figure 2 is a simple framework of provision mechanisms of Japanese agri-environmental public goods. In addition to farmland and irrigation systems (agricultural infrastructures), farm systems, farming practices and farm inputs (e.g. pesticide use) also affect the environment. Thus, in order to provide a sufficient amount of agri-environmental public goods, analysis of factors which directly and indirectly affect the status of agri-environmental public goods is necessary. Broadly speaking, policy measures target drivers (input-based or means) and agri-environmental public goods (output-based or ends). Input-based instruments directly regulate the levels or characteristics of farm inputs (e.g. pesticides, fertilisers and fuels), or prescribe the specific practices which affect the flow of agri-environmental public goods (e.g. specific technologies used, such as nutrient or pesticide best-management practices). Performance-based instruments focus on the flow of agri-environmental public goods from the farm, such as the quality of water and soil (OECD, 2010b). Japanese agri-environmental policies target the driving forces (input-based instruments) and not

performance-based instruments. Before developing and discussing policies, it is necessary to examine whether agri-environmental public goods are under or overprovided in Japan and the need for government to intervene.

4. Market failure for agri-environmental public goods

Markets for agri-environmental public goods are, generally speaking, under-developed, therefore making it difficult for famers to produce an adequate amount of such goods (OECD, 1992, 1999, 2013b; Ribaudo et al., 2008). Previous discussions have almost always assumed that government intervention was necessary even when in fact this was not the case. Indeed, in theory, where it is difficult to produce an adequate amount of agri-environmental public goods because of free-riders, farmers can nevertheless provide the right amount of these goods incidentally. There are other costs to government intervention which must be outweighed by the benefits. Only when there is evidence of market failure should government intervention be necessary.

It is difficult to estimate the scale of demand and supply of agri-environmental public goods because of the absence of markets. In reality, instead of data which directly estimate the amount of agri-environmental public goods, some proxies are used in practice. This section provides recent examples of efforts to address this issue in Japan.

4.1. Demand for agri-environmental public goods

Proxy indicators

One approach to estimate demand for agri-environmental public goods is to look at representative indicators or expressions of behaviour (using proxy indicators). For instance, the Japanese government undertook a public-opinion poll in 2008 to understand public attitudes towards agriculture and the environment. The poll revealed that 48.9% of respondents expected that agriculture and rural areas should preserve biodiversity and provide landscapes; 29.6% that water resources should be preserved and natural disasters such as landslide and flood be prevented; 18.2% expected traditional culture to be preserved; and 8.3% expected some recreational role be provided (CAO, 2008).

This same poll showed that about 85% of respondents believed Japanese agricultural policies should emphasise the role of preserving land and the environment, and not focus solely on economic efficiency. This percentage increased from the 1996 poll, when it was at 56.2% (CAO, 2008). The poll also examined willingness to participate in rural community activities, such as farming and environmental preservation activities. Nineteen per cent of respondents expressed a strong interest in participating, with 60.8% wanting to participate if given the opportunity (Table 2). These numbers show there is a strong demand for agri-environmental public goods in Japan; however, they are not sufficient to justify public intervention.

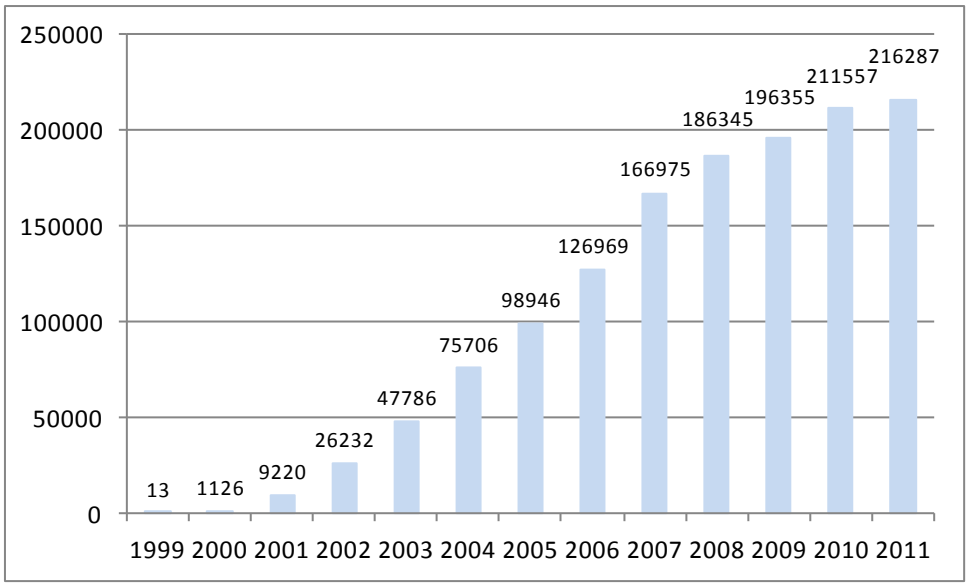
Table 2. Willingness to participate in rural community activities in Japan

Total number of respondents	Actively want to participate	If there are opportunities	Do not want to participate	Others	Do not know
3 144	19%	60.8%	12.9%	2.3%	6%

Source: CAO (2008), *Public-Opinion Poll regarding the Role of Food, Agriculture and Rural areas* (in Japanese), Cabinet Office, Government of Japan (CAO), A Public-Opinion Poll Report in September, 2008, Tokyo. www8.cao.go.jp/survey/h20/h20-shokuryou/index.html.

What kind of proxy indicators should be used is still under discussion in Japan, and no consensus has been established. Nevertheless, some proxy indicators are currently used in Japanese agri-environmental policies. For example, the number of "eco-farmers"[2] is used as one indicator for biodiversity in the 2012 National Biodiversity Strategy (National Biodiversity Strategy, 2012). The number of such farmers has increased (Figure 3), which may reflect the increasing demand by consumers for eco-friendly farming and biodiversity

Figure 3. Number of eco-farmers



Source: MAFF (2012a), *Current Situation of Registered Eco-Farmers* (in Japanese), MAFF, Tokyo. www.maff.go.jp/j/seisan/kankyo/hozen_type/h_eco/.

Monetary valuation

The other approach to estimating demand for agri-environmental public goods is to apply monetary valuation methodologies in order to reveal social preference as stated preference methods and revealed preference methods can elicit demand (function) for

2. "Eco-Farmers" are officially certified as environmentally-friendly farmers. They have the obligation to introduce techniques that use compost for soil conditioning and to reduce the use of agricultural chemicals, based on the Act for Establishment and Extension of Agricultural Practices that Facilitate the Sustainable Development of Agriculture (SDA).

public goods. Several studies examine the willingness-to-pay (WTP) for agri-environmental public goods in Japan. Yoshida et al. (1997) examined the WTP for public benefits associated with Japanese farmland and forestry (e.g. biodiversity, landscape) at the national level by using the contingent valuation method (CVM). They estimated that the WTP per household was about JPY 100 000 and the total WTP for the entire country was about JPY four trillion. Yoshida (1999) examined the WTP for public benefits of agriculture in hilly and mountainous areas, and estimated that the WTP per household was about JPY 70 000 and the total WTP for the entire country was about JPY 3.2 trillion. Several local governments have estimated the WTP for agri-environmental public goods at the prefecture level. For instance, Okinawa Prefecture estimated that a household in Okinawa was willing to pay about JPY 56 000 for agri-environmental public goods in Okinawa (Okinawa Prefecture, 1998). However, these values change depending on the methodologies, questions and procedures (Diamond and Hausman, 1994; Cooper et al., 2009) and careful interpretation of these numbers is therefore necessary.

The focus in Japan appears to be on estimating benefits, but this needs to be balanced by estimates of the environmental damages associated with agriculture; the valuation of these damages is not well advanced (OECD, 2009). Moreover, due to the difficulty of estimating the demand for agri-environmental public goods, many numbers are aggregated and it is not clear to what extent there is a demand for each agri-environmental public good identified in this study. As a result, the application of monetary valuation in policy design is very limited in Japan (Box 4 presents a recent effort by a local government).

Box 4. An example of the application of monetary valuation in agri-environmental policy design: Environmental payments in Shiga Prefecture

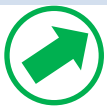
Shiga Prefecture is one of 47 prefectures in Japan and is home to the country's largest lake, Lake Biwa. The prefectural government has tried to reduce the flow of chemicals into this lake, with an initial target of reducing emissions from point sources, such as sewage facilities and manufacturers, by a series of aggressive regulations. Consequently, the share of these point sources in total emissions gradually decreased. This required policy measures to tackle non-point sources, especially agriculture (OECD, 2013b), and it was to this end that the prefectural government introduced agri-environmental payments to farmers who reduced their chemical inputs by 50% (Yoshida, 2006).

The introduction of such payments was based on the research undertaken in 2003 to estimate the WTP of citizens. This research examined whether if by using conjoint methods the total WTP exceeded the costs of the programme. The total WTP of citizens to reduce the use of chemical inputs was estimated at about JPY 380 million, which was more than the estimated policy costs (JPY 200 – 300 million). The payments were thus considered to bring larger benefits than costs, and were introduced in 2004 (Yoshida, 2006).

4.2. Supply of agri-environmental public goods

Assessing the scale of supply for agri-environmental public goods is also a challenge due to lack of appropriate data. Table 3 summarises the trends of agri-environmental public goods at the national level. Overall, with the exception of climate change (greenhouse gas emissions) and air quality, many indicators suggest that the provision of agri-environmental public goods is decreasing or not improving in Japan. These numbers need to be interpreted with caution because most such goods are local public goods (e.g. agricultural landscape, resilience to natural disaster), and heterogeneities must be taken into consideration. For instance, although paddy fields can provide biodiversity, some paddy field may have negative impacts on the environment due to intensive use of pesticides and fertilisers. In this case, farming may have negative impacts, rather than bringing benefits.

Table 3. Trends of agri-environmental public goods in Japan[1]

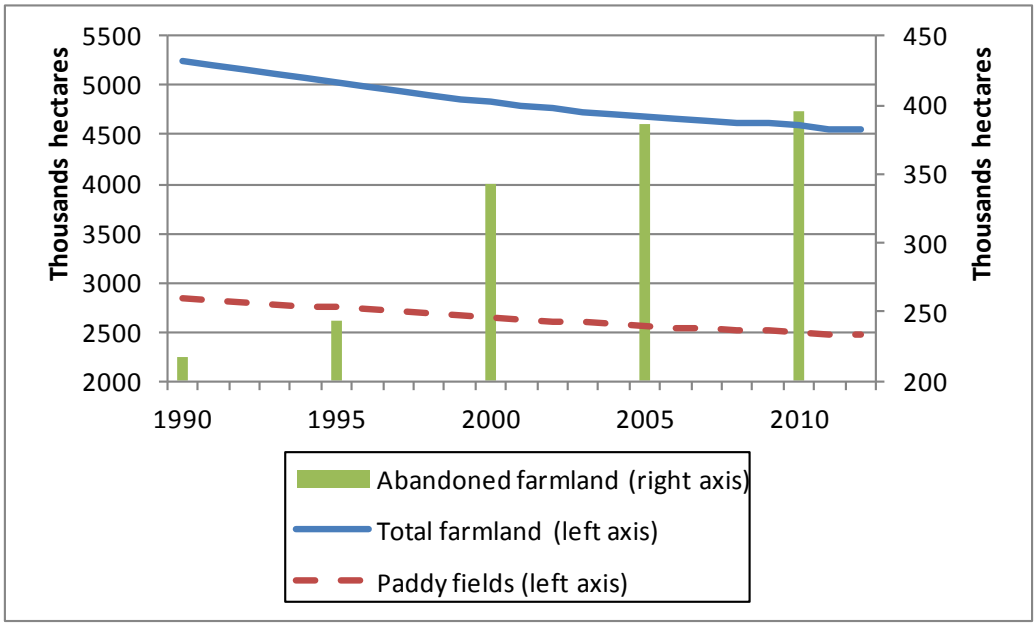
	Trends	Related Indicators		Sources
Agricultural landscapes		• Farmland • Abandoned farmland	• -12% (1990/92-2010/12) • 1.8 times (217 000ha (1990)-396 000ha (2010))	• MAFF(2012b) • MAFF(2011a)
Biodiversity		• Conversion of farmland to urban use etc • Share of freshwater fish species listed on the national red list	• 39 290 ha in the past 10 years (2003-2012) • 36 % (2007) to 42% (2013)	• MAFF(2012b) • MOE (2013)
Water quality		• Gross nitrogen balance per hectare • Gross phosphorus balance per hectare • Total sales of agricultural pesticides	• -7% (from 90/92 to 99/01), but +8%(from 99/01-07/09) • -18% (from 90/92 to 99/01), and -8%(from 99/01-07/09) • -16% (from 19990-2000) and -21% (from 2000-2009)	• OECD(2013a) • OECD(2013a) • OECD(2013a)
Water quantity/ availability		• Water retaining capacity (paddy fields) • Total agricultural water withdrawals	• -22% (from 1990/92 to 2009/11) • -7% (from 1990 to 2008)	• OECD Secretariat • OECD(2013a)
Soil quality and protection		• Gross nitrogen balance per hectare • Gross phosphorus balance per hectare • Areas that need for treatments of agricultural land soil pollution (cadmium, copper and arsenic)	• -7% (from 90/92 to 99/01), but +8%(from 99/01-07/09) • -18% (from 90/92 to 99/01), and -8%(from 99/01-07/09) • 2 690 ha(1990) to 1 348 ha (2000) to 851 (2010)	• OECD(2013a) • OECD(2013a) • MOE (2012a)
Climate change – carbon storage		-	-	-
Climate change – greenhouse gas emissions		• Total GHG emissions from agriculture • Methane emissions from agriculture • Methane emissions from rice cultivation • Nitrous oxide emissions from agriculture • Direct on-farm energy consumption	• -18% (from 1990 to 2010) • -19% (from 1990 to 2010) -22% (from 1990 to 2010) • -17% (from 1990 to 2010) • -24% (from 1990 to 2010)	• OECD(2013a) • OECD(2013a) • OECD(2013a) • OECD(2013a) • OECD(2013a)
Air quality		• Number of complaints related to offensive livestock odours • Shares of livestock farms with adequate manure treatment facilities	• -18% (1885 (1996) to 1539 (2011)) • 51% (2003) to 99.98% (2011)	• MOE (2012b) • MAFF(2013a)
Resilience to natural disaster		• Farmland • Abandoned farmland • Irrigation systems exceeding their lifespans	• -12% (1990/92-2010/12) • 1.8 times (217 000ha (1990)-396 000ha (2010)) • 4 300km (1987) to 12 800km (2009)	• MAFF(2012b) • MAFF(2011a) • MAFF(2012c)

Note:  (decreasing).  (increasing).  (both increasing and decreasing data).  (no data).

1. The interpretation of this Table needs caution, because most agri-environmental public goods are local public goods (e.g. agricultural landscape, resilience to natural disaster), and we have to take heterogeneities into consideration.

With these limitations in mind, each indicator for the supply of agri-environmental public goods is examined below. The decline in farmland area is reducing the capacity of agriculture to provide various ecosystem services. This affects mainly agricultural landscapes and resilience to natural disaster (Table 3). Total farmland and paddy field area decreased by 12% between 1990-92 and 2010-12 respectively, and abandoned land expanded 1.8 times between 1990 and 2010 (Figure 4). As a result, there is a risk of losing traditional *Satoyama* **landscapes**. Agricultural intensification and modernisation also negatively affect landscapes (Takeuchi, 2001; ACF, 2003). The reduction of farmland (especially paddy fields) and ageing irrigation systems reduce the capacity to provide **resilience to natural disaster**, including resilience to flooding, snow damage, and fire. Risks of landslide are also increasing due to the increase of abandoned land. Research in Japan indicates that the rate of landslide occurrence is three to four times higher on abandoned land than on cultivated land (OECD, 2002; Yamamoto, 2003). Taking more than a third of the paddy fields out of rice production and leaving much of it idle has negative implications for providing agri-environmental public goods (Jones and Kimura, 2013).

Figure 4. Farmland in Japan



Source: Abandoned farmland; MAFF (2011a), Current Situation of Abandoned Farmland (in Japanese), MAFF, Tokyo. www.maff.go.jp/j/nousin/tikei/houkiti/pdf/genjou_1103r.pdf:
Total farmland and paddy fields: MAFF (2012b), Cultivated and Planted Area Survey (in Japanese), MAFF, Tokyo.

Providing **ecosystem and biodiversity services** also faces challenges. Some farming systems and rural landscapes, notably less intensive rice paddy fields and traditional *Satoyama* landscapes, provide key habitats for flora and fauna (Fujioka and Yoshida, 2001; Sprague, 2001; Maeda, 2005). Therefore, the conversion of agricultural land to other uses is a threat to certain wild species. In the past, farmland has been converted to transport infrastructure, urban use, forest, and some farmland has been abandoned.

Agricultural land reclamation and intensification have adversely impacted biodiversity (Fujioka and Yoshida, 2001; Maeda, 2001; Sprague, 2001). The

reclamation of wetlands and tidal flats for farming has led to substantial losses and the deterioration of certain habitats (OECD, 2002; BirdLife International, 2003). Agricultural pollution of some water bodies is also harming aquatic habitats (OECD, 2002; BirdLife International, 2003). The modernisation of some paddy systems, including lining waterways and ponds with concrete, field consolidation and removing field interconnections, has reduced the abundance of aquatic species and the birds that feed on them. Many common species in agricultural landscapes (e.g. freshwater fish, grassland plants) are now listed on national and prefectural red lists, suggesting that biodiversity of agricultural landscapes is under threat (OECD, 2010a).

Improving **water quality** remains a key challenge in some areas. The water quality (eutrophication) of lakes and coastal areas has shown no significant improvement (OECD, 2002, 2008, 2009). Although farm nitrogen and phosphorus surpluses have declined from 1990 to 2009, absolute levels per hectare remain among the highest across OECD countries for both nitrogen and phosphorus (OECD, 2013a). Most agricultural nutrient pollution originate from the horticultural and livestock sectors (OECD, 2008), and in some cases agricultural nutrient pollution leads to "red tides," or algal blooms, with adverse impact on marine life (Okaichi, 2004).

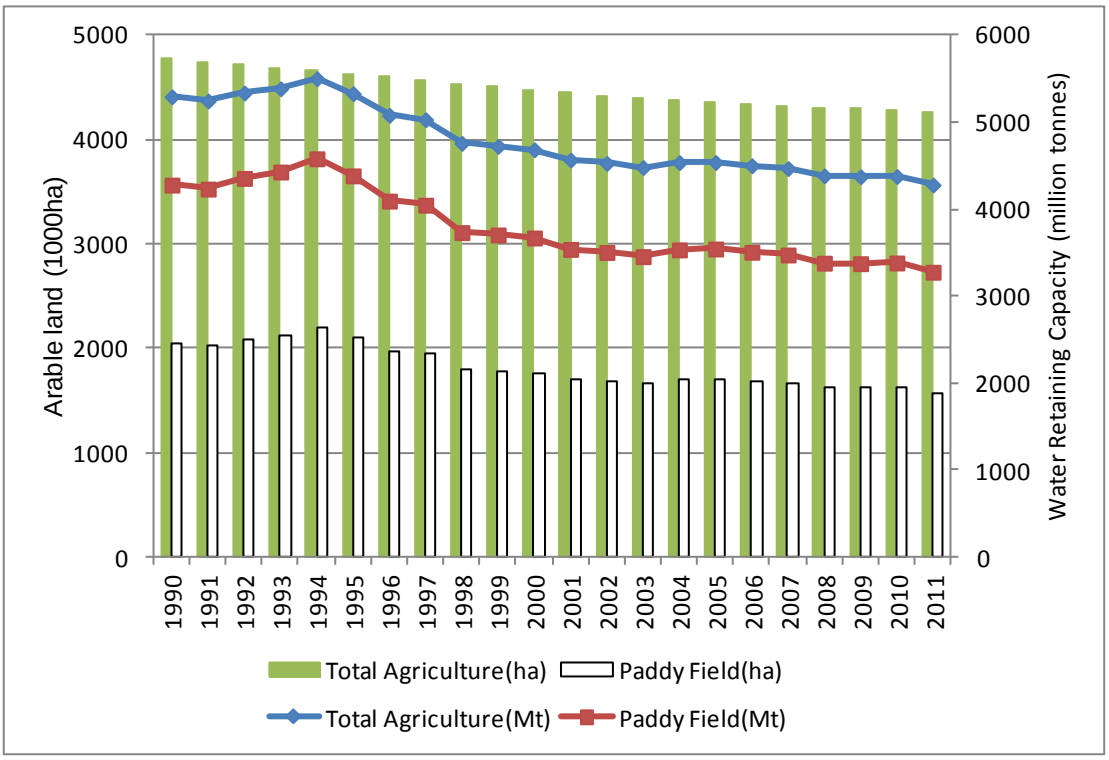
Water pollution from pesticides has eased, with a 34% reduction in pesticide sales between 1990 and 2009 (OECD, 2013a). This decrease was most likely associated with reduced volumes of crop production and increased numbers of farmers adopting environmentally beneficial practices, including organic farms (OECD, 2008). The intensity of pesticide use remains high, however, by OECD standards, due in part to pressure on land and labour and to Japan's humid temperate climate (OECD, 2002, 2009, 2013a). The prevalence of small farms is also associated with the high intensity of pesticide use. Small part-time farmers use more chemical fertilisers and pesticides as a substitute for labour and land than is the case on larger farms. In 2010, fertiliser use per 0.1 hectare was 35% less on large farms (more than ten hectares) than on small farms (less than 0.5 hectare), while pesticide use was 29% less (Jones and Kimura, 2013).

The **water retaining capacity** of paddy fields is declining. From 1990-92 to 2009-11, it declined by about 22% (Figure 5), due mainly to the diminishing number of paddy fields and this may lead to an increase in the risk of soil erosion and flooding (OECD, 2002).

Soil quality has improved in some areas. The number of areas where treatment of agricultural land for soil pollution is needed, i.e. where the amount of cadmium, copper or arsenic exceeds regulation criteria, has declined continuously. Some lands, however, have nutrient surplus which carries a risk of deteriorating soil quality (OECD, 2013a).

Greenhouse gas emissions from agriculture have been decreasing. Agricultural greenhouse gases (GHGs) declined by 18% between 1990 and 2010, accounting for 2% of total GHGs (2008-10) (OECD, 2013a). Much of the reduction in agricultural GHGs has been due to lower methane (methane emissions from agriculture declined by 19% between 1990 and 2010, and methane emissions from rice cultivation declined by 22% for the same period) and nitrous oxide emissions (nitrous oxide from agriculture declined by 17% between 1990 and 2010) following the decrease in rice production, fertiliser use and livestock numbers (OECD, 2013a).

Figure 5. National water retaining capacity of agriculture in Japan



Source: OECD Secretariat, based on OECD (2008), *Environmental Performance of Agriculture in OECD countries since 1990*, OECD Publishing, Paris, and FAOSTAT.

Air quality associated with agriculture has improved. Since the 1970s, the number of complaints related to offensive livestock odours has significantly declined (Segawa, 2004; OECD, 2008; MOE, 2012b). By 2011, almost 100% of livestock farms met management standards for manure treatment facilities (MAFF, 2011b).

Although this paper has reviewed data for the provision of agri-environmental public goods, in many cases monitoring data is insufficient (OECD, 2008). For instance, although water quality of rivers, lakes, coasts, and groundwater, which includes those in agricultural zones, has been monitored for more than 30 years, farmland and non-farmland are intermingled, and the agricultural sector's share in water pollution cannot be identified precisely (OECD, 2008). Moreover, aggregated data cannot provide details pertaining to each local situation. For instance, some paddy fields may be able to provide agri-environmental public goods such as water recharge and biodiversity because of appropriate management, but others may have negative impacts on the environment due to inappropriate usage of fertilisers and pesticides. Improving agri-environmental data and monitoring in a cost-effective way is an important challenge for Japan.

4.3. Drivers causing changes in Japanese agri-environmental public goods and market failure

Overall, while demand for many agri-environmental public goods is increasing, there is evidence that the amount of agri-environmental public goods provided is declining. This may imply that some agri-environmental public goods are undersupplied

in Japan. Whether there is under-oversupply or not should be examined based on the agri-environmental public good. For instance, most agricultural landscapes in general are local public goods, and thus demand and supply for them should be examined at a local scale. On the other hand, some exceptionally important landscapes, such as Noto's Satoyama and Satoumi selected as GIAHS, may need to be estimated at a wider scale.

Various factors, such as shrinking agricultural production, aging population and increasing areas of abandoned land, affect the supply of agri-environmental public goods as they impact the provision mechanism (Section 3). The aging of the rural population makes the management of community resources, difficult and the provision of associated agri-environmental public goods suffers (e.g. water quantity, resilience to flooding). Abandoned land harms landscape, and sometimes these spaces are illegally used to dump waste. Each year, much farmland is converted to non-agricultural use, such as housing, shopping areas and factories, due to land scarcity and Japan’s dense population (OECD, 2009). Urbanisation and intensification of agriculture with chemical fertilisers and pesticides can lead to a loss of biodiversity and the deterioration of water and soil quality.

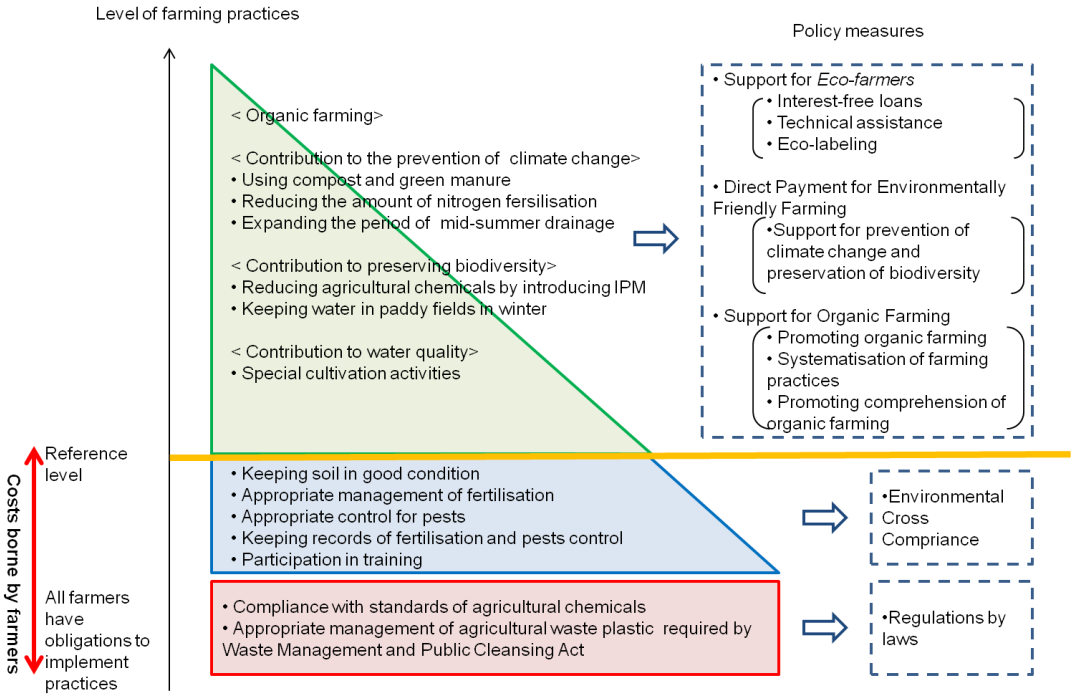
The biggest challenge to providing agri-environmental public goods is to give farmers the incentive to provide these goods even there is a lack of markets. If there are enough private benefits in providing agri-environmental public goods, farmers can provide these without public support. When in order to secure the provision of agri-environmental public goods, some form of public intervention is required, the Japanese government implements various agri-environmental policies. Since many factors that affect the provision of agri-environmental public goods are drivers (input-based or means), these policies target the means rather than the ends (agri-environmental public goods). Japanese agri-environmental policies are discussed in Section 6. It is necessary to examine first the extent to which farmers and society should each bear the costs of providing these goods.

5. Reference levels and agri-environmental targets of agri-environmental policies

Government intervention may be necessary in the case of market failure. However, questions remain as to the extent government should intervene. To consider this point, a framework on reference levels is useful (OECD, 2001).

Environmental reference levels are defined as the minimum level of environmental quality that farmers are obliged to provide at their own expense. Environmental targets are defined as the desired levels of environmental quality that go beyond the minimum requirements or minimum levels of environmental quality for the agricultural sector in a country (OECD, 2001). The MAFF applied this concept to summarise Japanese agri-environmental policies (Figure 6).

Figure 6. Reference levels and agri-environmental targets in Japan



Source: MAFF (2012d), *Policy Measures for Promoting Environmentally Friendly Agriculture* (in Japanese), Item 1, the 3rd Meeting for Examining Direct Payment for Environmentally Friendly Farming, June 25, 2012, MAFF, Tokyo. www.maff.go.jp/j/seisan/kankyo/kentokai/pdf/shiryou1_no3.pdf.

Figure 6 does not clearly show the extent to which farmers should bear the costs for providing each agri-environmental public goods. This discussion is still in progress and there are few studies in this field. To provide greater insight and stimulate discussion, this study tries to summarise reference levels and environmental targets for the nine agri-environmental public goods identified in this study. Table 4 provides a summary (Annex Table 1 provides a more detailed description of reference levels and agri-environmental targets).

There are both specified environmental targets and reference levels for water quality and soil quality. For these public goods, reference levels were set when pollution from various industries became a major problem in the 1960-70s. Not only farmers but other business operators are obliged to meet these requirements. Minimum regulations are generally set by acts based on scientific evidence.

Table 4. Summaries of reference levels and agri-environmental targets in Japan

	Agri-environmental public goods					
	Agricultural landscapes	**Biodiversity**	**Water quality**	**Water quantity/ availability**	**Soil quality and protection**	**Climate change- Carbon storage**
Environmental targets	Regional targeting under the Landscape Act	National Biodiversity Strategy 2012-2020 (national targeting)	Environmental standard (national targeting)	-	Principle for promoting soil quality under the Soil Quality Promotion Act (national targeting)	-
Reference level	Regional baseline under the Landscape Act	Current farming practices are equal to reference levels	Control of Water Pollution (national baseline)	Control of the River Act (national baseline)	Environmental standard and Agricultural Land Soil Pollution Prevention Law (national baseline)	Current farming practices are equal to reference levels

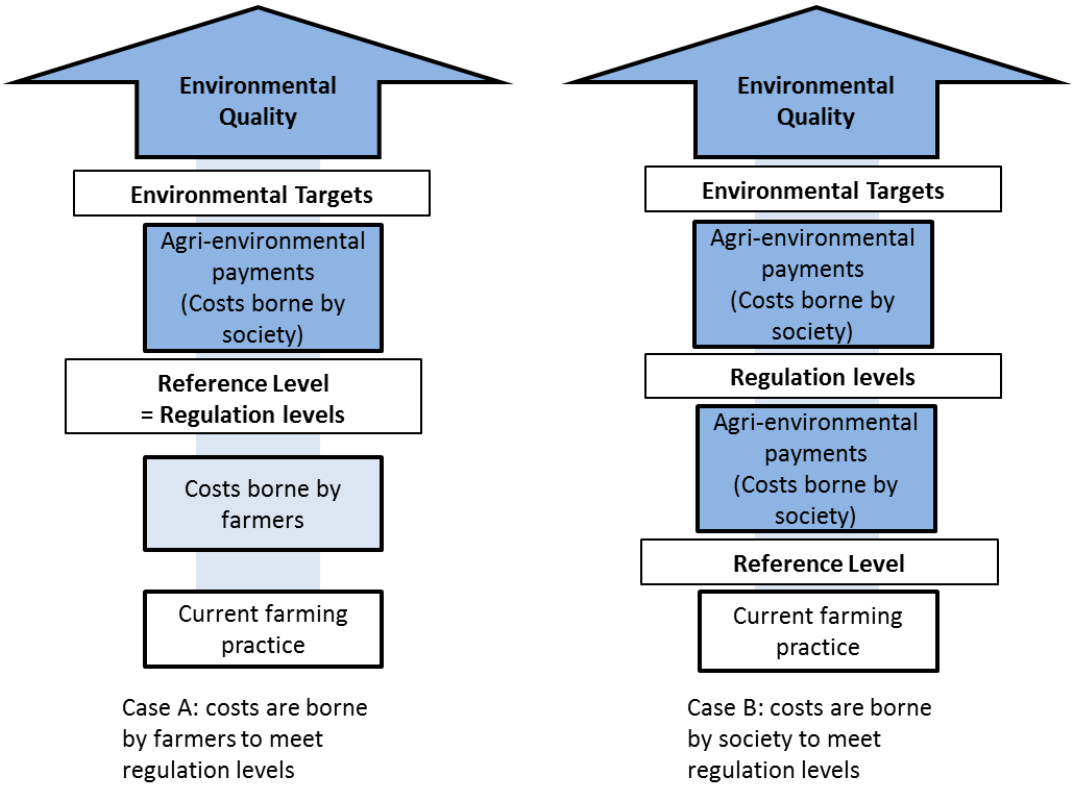
	Agri-environmental public goods				
	Climate change- Greenhouse gas emissions	**Air quality**	**Resilience to natural disaster**		
			flooding	**snow damage**	**fire**
Environmental targets	3.8% reduction by 2020 (compared to 2005) (national targeting)	Environmental standard (national targeting)	Priority Plan for Social Infrastructure Development (national targeting)	Regional targeting	Regional targeting
Reference level	Current farming practices are equal to reference levels	Regional baseline under the Control of Offensive Odours	Current farming practices are equal to reference levels	Current farming practices are equal to reference levels	Current farming practices are equal to reference levels

This study cannot identify specific reference levels for some agri-environmental public goods (biodiversity, climate change and resilience to natural disaster). This does not mean there are no reference levels, but that the current farming practices are the reference levels. In this case, if some programmes require farmers to improve the environment associated with agriculture in order to achieve environmental targets, governments may need to provide environmental payments since farmers have already achieved what they have to do (OECD, 2010b). In some cases, cross-compliance sets reference levels beyond the regulation level, and farmers must bear some of the costs to improve the environment in order to be eligible for "agricultural income support" payments. However, the enforcement of cross-compliance is not enough and most policies that require farmers to meet cross-compliance are not agricultural income support payment, but "agri-environmental" payments. OECD (2010c) distinguishes this compliance with agri-environmental payment and cross compliance for agricultural income support payment. "Cross" means making a bridge between "agricultural income support" payments and environmental requirements. In Japan, however, this "cross" does not necessarily exist, and only environmental requirements are related with "agri-environmental" payments.

When farmers emit pollution, the Polluter Pays Principal (PPP) applies and farmers are obliged to meet the reference level at their own expense. On the other hand, when farmers provide benefits (e.g. agricultural landscape, biodiversity), current farming practices tend to be equal to reference levels, and environmental payments (e.g. direct payments for environmentally-friendly farming) are used to achieve environmental targets.

Reference levels in Japan are not always equal to regulation levels. Sometimes regulation levels are set beyond the reference levels and governments provide payments to help farmers meet these (Case B of Figure 7). For instance, to improve water and air quality and mitigate environmental problems associated with livestock, the Japanese government requires farmers since 1999 to install facilities to manage livestock manure by financing facilities that recycle farm waste.

Figure 7. Reference levels and agri-environmental targets



Reference levels are based on historical and cultural background (e.g. some water use rights are customary rights developed over a long history of water battles), levels of pollution (e.g. water quality, soil quality), and so on. In addition to regulations and payments, technical assistance and extension are implemented to allow farmers to meet reference levels.

Regarding environmental targets, some agri-environmental public goods do not have explicit targets due to lack of appropriate data and knowledge (e.g. carbon storage). Although some agri-environmental public goods (e.g. air quality, resilience to flooding) have overall environmental targets which apply to all industries, there are no agricultural-specific targets. Environmental targets should ideally try to improve the environment; however, maintaining current situations (e.g. preserving *Satoyama*

landscape) could also be used as environmental targets given that most of agri-environmental situations continue to deteriorate.

Environmental targets are also based on historical and cultural backgrounds and international treaties, but compared to reference levels, political concerns and interests can be more directly reflected when targets are set.

In order to establish environmental targets and reference levels, councils composed of experts are often held in Japan. Following the publication of draft targets and taking into account comments from the public (public comments), environmental targets and reference levels are determined. In particular, when setting minimum standards which farmers are obliged to meet, discussions by experts are based on scientific evidence. Although overall frameworks tend to be set by laws, targets are often laid out in administrative documents.

Ideally, environmental targets should be output-based or directly related to the status of the agri-environmental public goods provided. In many cases, however, proxy indicators (e.g. targeted number of eco-farmers for biodiversity) are used. In some cases, there are no quantitative targets and, instead, qualitative targets are set (e.g. maintaining agricultural landscape). This makes it difficult to evaluate policy measures. Even if there are overall environmental targets (e.g. preserving biodiversity), it is not clear to what extent each policy measure (e.g. direct payments for environmentally-friendly farming) tries to address the targets, and to what extent other policy measures try to contribute to achieve these targets. Agri-environmental targets and reference levels are necessary to develop better policy measures and to identify better cost-sharing between farmers and society.

Once environmental targets and reference levels are set, policy intervention may be necessary to provide agri-environmental public goods. In the next section, current Japanese policy measures for agri-environmental public goods are reviewed.

6. Policy measures for agri-environmental public goods

The Japanese government attempts to promote environmentally-friendly farming to maintain and improve environmental services associated with agriculture. Regulations, payments and technical assistance are traditionally important agri-environmental policy measures (OECD, 2010d), but recently the government has started to adopt policy measures that target community-based activities or collective action (OECD, 2013b). Table 5 summarises the relative importance of agri-environmental policy measures. Environmental taxes, payments based on land retirement and outcomes, and tradable credits are not implemented or remain at a very early stage of pilot studies. This section examines 1) regulatory measures, 2) financial incentives, and 3) facilitative measures, and 4) how these measures target agri-environmental public goods in Japan.

Table 5. Overview of Agri-environmental Policy Measures in Japan

Measure/country	Importance
Regulatory measures	
Regulatory requirements	XX
Environmental taxes/charges	NA
Environmental cross-compliance	X
Financial incentives	
Payments based on farming practices	XXX
Payments based on land retirement	NA
Payments based on farm fixed assets	XX
Payments based on outcomes	NA
Tradable rights/permits	NA
Community based measures	XX
Facilitative measures	
Technical assistance/extension	XX

NA-not applied or marginal; X-low importance, XX-medium importance, XXX-high importance.

Source: OECD Secretariat based on OECD (2010d), "Policy Measures Addressing Agri-environmental Issues", *OECD Food, Agriculture and Fisheries Papers*, No. 24, OECD Publishing, Paris.

6.1. Regulatory measures

There are three types of regulatory measures: regulatory requirements, environmental taxes/charges, and environmental cross-compliance. Of these three types, environmental taxes/charges are not used in Japan. Regulatory measures are used for water quality, water quantity, soil quality and air quality, especially targeting livestock, while environmental cross-compliances are mainly used for biodiversity and carbon-storage. Most regulatory measures target specific agri-environmental public goods, rather than targeting multiple public goods.

Various regulations related to farming practices and related activities exist in Japan. Regulations under the Water Pollution Control Law set upper limits for agricultural pollution from, e.g. pig and cattle units, and the Offensive Odour Control Law covers odours from livestock. The Agricultural Land Soil Pollution Prevention Law regulates toxic substances in soils (cadmium, copper and arsenic) so as to prevent agricultural products which risk harming human health from being produced and to prevent agricultural production itself from being harmed. The River Act controls the withdrawal of water from rivers in order to maintain a downstream minimum flow for the conservation of aquatic ecosystems (Yamaoka, 2006). These regulations target specific agri-environmental public goods or outputs.

In addition, regulatory standards for manure management were established in 1999 under the law concerning Appropriate Treatment and Promotion of Utilisation of Livestock Manure (AATPULM) in order to improve water, soil and air quality affected by livestock manure. National and local governments finance facilities that recycle manure, and specify a mandatory standard for livestock manure management that applies to livestock farms operating more than a certain number of animals (10 for cattle or horses, 100 for pigs and 2 000 for poultry). As a result, the dumping of manure decreased from 9 million to 1 million tonnes between 1999 and 2004. About 90% of

manure (80 million tonnes) is now processed into fertiliser and 8% is purified, carbonated or burned to prevent environmental damage (OECD, 2009).

Cross-compliance is also used in Japan. Cross-compliance is the requirement that farmers meet specific criteria or fulfil conditions in order to be eligible to receive an agricultural income support payment (OECD, 2010c). In 2005, the Principles of Agricultural Production Practice harmonised with Environment was introduced in Japan; it lays out the necessary agricultural production practices that farmer should adopt for environmental preservation. Cross-compliance is linked to application of, for example, the Direct Payments for Environmentally-Friendly Farming. However, according to the definition of OECD (2010c), cross compliance is a requirement to be eligible to receive an agricultural income support payment, not to receive an agri-environmental payment.

6.2. Financial incentives

Financial incentives include payments, tradable rights/permits and community-based activities. Payments can be further classified as payment based on farming practices, on land retirement, on farm-fixed assets and/or on outcomes (OECD, 2010d). Payments based on farming practices and farm-fixed assets as well as community-based measures are mainly used in Japan. These financial incentives target various agri-environmental public goods, and unlike regulatory measures, a financial measure usually targets multiple agri-environmental public goods.

There are mainly two types of payments based on farming practices: the Direct Payment to Farmers in Hilly and Mountainous Areas (DPFHMA) and Direct Payments for Environmentally Friendly Farming (DPEFF). DPFHMA, introduced in 2000, addresses various agri-environmental public goods by promoting agriculture and reducing land abandonment in hilly and mountainous areas. Maintaining agricultural production in these areas is seen as a means to maintain the rural landscape and biodiversity, preserve water resources, and prevent landslides and flood. The direct payment provides an incentive to continue farming activities in such less-favoured areas.

DPEFF was introduced in 2011 to promote farming practices that are beneficial for preserving biodiversity and mitigating climate change. The DPEEF targets farming practices that have high environmental preservation effects, such as cover crops,[3] living mulches,[4] and winter-flooded paddy fields.[5] It targets biodiversity and climate change carbon storage. To be eligible, farmers must be certified by governors as "eco-farmers"; this involves reducing the use of chemical fertilisers and pesticides by half compared to conventional farming.

In addition to payments based on farming practices, payments based on farm-fixed assets are also used. The Act for the Establishment and Extension of Agricultural Practices that Facilitate the Sustainable Development of Agriculture (SDA) was

3. Planting crop to provide green manure, which helps to store CO2 in farmland and reduce nitrogen surplus.

4. Living mulches are cover crops interplanted with main crops to prevent soil erosion, store CO_2 in farmland and reduce nitrogen surplus.

5. By keeping paddy fields flooded even in winter, they can work as habitats for wildlife such as insects and birds. They can also contribute to water purification through a function of denitrification which paddy fields have.

introduced in 1999. To improve soil quality and reduce the use of chemical fertilisers and pesticides (and thus improve water quality), the certification system of "Eco-farmers" was established under this law and financial support (interest-free loans) is made available for eco-farmers who introduce facilities to improve farming practices.

AATPULM also includes payments based on farm fixed assets, in addition to regulating livestock manure management. National and local governments finance facilities that recycle farm waste, so as to help farmers meet a mandatory standard for livestock manure management. AATPULM addresses environmental problems such as odours and water quality and contributes to better soil quality through the utilisation of livestock manure.

In 2007, MAFF introduced Measures to Conserve and Improve Land, Water, and the Environment (MCILWE) to promote collective action for the provision of various kinds of agri-environmental public goods associated with irrigation systems. Irrigation systems can provide agricultural landscapes, biodiversity, water quality, water quantity and prevent natural disasters including flood, snow damage and fire. In order to keep providing these various services, MCILWE pays local action groups under contract with local municipalities for the maintenance work of drainage and irrigation canals. Around 19 000 local action groups carried out activities designated in the MCILWE in 2012, covering 1.46 million ha of farmland or 34% of total farmland in the agricultural promotion areas in Japan (MAFF, 2013b). In 2009, about 1.1 million farmers, 240 000 non-farmers and 13 000 organisations participate in collective actions (MAFF, 2010b).

From FY 2014, Japan implemented a new payment for multifunctionality and which is based on the former payment: MCILWE. Although the current MCILWE mainly targets the paddy field and irrigation systems, the new MCILWE targets the maintenance of farmland (not only paddy fields but also upland and pastures). The new payment for multifunctionality tries to provide a broad range of agri-environmental public goods (e.g. agricultural landscapes, biodiversity, resilience to natural disaster) by keeping farmland and managing associated natural resources through collaboration between farmers and non-farmers.

In 2008, the emissions trading scheme was launched in Japan, and as of 30 May, 2011 there were about 900 applications including 204 applications related to agriculture, forestry and fisheries (22% of the total applications) (MAFF, 2011c). Farmers can sell their credits by reducing CO_2 emissions through the introduction of, for example, heat pumps in the credit market where companies purchase the credit. This scheme has the possibility of contributing to climate change; however, the project is remains at the pilot stage.

In addition to these national programmes, some local governments have also introduced programmes to provide agri-environmental public goods such as biodiversity (e.g. Hyogo Prefecture's conservation of Oriental White Storks (Box 5)).

Box 5. An example of a local government policy: The re-introduction of Oriental White Storks in Hyogo

The Oriental White Stork Project in Toyooka City seeks to preserve the oriental white stork, which had become extinct in Japan because of intensive farming practices. To re-introduce storks, the Toyooka City launched a project in 1965 to breed storks under captivity. It successfully accomplished this goal by 1989 by using storks imported from Russia.

Toyooka City also introduced a payment for environmental services schemes in order to improve the natural habitat for storks. Farmers are paid to adapt extensive farming practices and to restore water in paddy fields even in winter; this makes paddy fields function as wetlands and helps the conservation of biodiversity. Farmers also use an eco-label for their products grown with reduced chemical pesticides (CBD, 2010; Shobayashi et al., 2011).

6.3. Facilitative measures

Facilitative measures include technical assistance, extension, R&D and labelling, and various measures are implemented for providing agri-environmental public goods in Japan.

Technical assistance has been mainly provided by agricultural extension workers. In 2011, there were 366 agricultural extension centres in Japan, and about 7 000 agricultural extension workers providing technical and management advices to farmers (MAFF, 2013c). Their extension services include assistance for promoting sustainable farming practices. For instance, they provide technical advice and knowledge to farmers (e.g. eco-farmers) and link farmers with other farmers and non-farmers (e.g. NGOs, research institutes) so as to achieve sustainable agriculture. Some programmes (e.g. the Soil Fertility Enhancement Act) systematically incorporate advice of agricultural extension workers in their programmes to improve the environment associated with agriculture. MAFF has also established guidelines (e.g. livestock manure guidelines) to promote sustainable farming.

In 2002, the Biomass Nippon Strategy was introduced to promote the use of biomass energy and bio-based products derived from organic waste, such as food, plant and animal waste, as part of Japan's efforts to deal with climate change and achieve sustainable development. To further promote the use of local biomass, the Fundamental Law for the Promotion of Biomass was enacted in 2010 and the Biomass Industrial Strategy was developed in 2012. Based on these strategies, some facilitative measures have been implemented. For example, certain communities are designated as model areas for implementing projects for making full use of biomass. R&D is also promoted through financial assistance for private companies developing biomass-related technologies.

In addition, the Law on Promotion of Organic Agriculture was established in 2006, and governments promote R&D and extension services for organic farming, increase awareness of organic farming among consumers and establish organic farming promotion plans at prefectural and town/village levels. Regarding eco-labelling, MAFF established a guideline for organic agricultural products in 1992, and introduced a certification scheme by a registered organisation in 2000 to help consumers distinguish products grown without chemical fertilisers or pesticides from conventionally produced agricultural products. In addition to organic labelling, in order to promote activities for the biodiversity conservation, in 2008 MAFF started to recommend the use of a voluntary eco-label called the “living creature mark”, which expresses activities for the biodiversity conservation drawing organisms living in the local areas. It is applied to agriculture, forestry and marine products produced in a way that preserves local living

creatures (*e.g.* rice with an oriental white stork mark as in the case of Box 4). These brands may support local economies and are welcomed by consumers who recognise that rice grown in paddies where abundant fish and birds live is also safe and healthy for humans (OECD, 2010a).

6.4. Agri-environmental public goods and policy measures

Table 6 summarises agri-environmental policy measures and their targeted agri-environmental public goods. Many policy measures target multiple agri-environmental public goods and a number of policy measures are implemented for each agri-environmental public goods. This makes the table complex and difficult to understand the relationship between agri-environmental public goods and how policy measures target them.

Many regulatory measures target single objectives (e.g. water quality, soil quality, air quality), while many financial incentives and facilitative measures target multiple objectives. When regulatory measures target single objectives, they regulate environmental outputs (e.g. nitrogen and phosphorus balance) except the case of the River Act (which regulates farmers who can withdraw water from rivers). Water quality, soil quality and air quality are affected by various economic activities, not only by farming activities, so that rather than targeting drivers/means, policy measures target outputs/ends. Thus, it might be natural for policy measures to target single objectives.

On the other hand, financial incentives and facilitative measures target farming practices and related farm assets. As discussed, agricultural infrastructures (e.g. paddy fields, irrigation systems), farm systems (e.g. organic farming) and farming practices (e.g. irrigation practices) provide a wide range of agri-environmental public goods such as biodiversity and water quality. Therefore, if policy measures target these drivers, it is natural that policy measures target multiple objectives.

As a result, multiple policy measures are implemented for each agri-environmental public goods. For instance, water quality is basically regulated by the Control of Water Pollution (regulatory measure), and polluters, including farmers, are required to meet the reference level at their own cost (Polluter Pays Principle). Beyond the reference level to meet environmental targets, several policy measures are implemented to improve water quality and costs are borne by consumers or taxpayers (Beneficiary Pays Principle). In terms of farm inputs, to reduce the use of chemical fertiliser and pesticides, financial support (interest-free loans) is provided to certified "Eco-farmers" with technical extension services. Regarding farm systems, livestock farmers are required to introduce facilities that recycle manure so as to improve the livestock environment, including water quality, and governments provide financial support to help farmers to meet these requirements. MCILWE promotes the appropriate management of irrigation systems (agricultural infrastructure) through the promotion of community-based activities or collective action with the provision of financial assistance. These policy measures target specific farm inputs, farm systems and agricultural infrastructure so as to improve the water quality by approaching the issues from different angles. However, the complicated approaches make it difficult to identify to what extent each policy measure tries to improve water quality and to what extent other policy measures try to address this problem. Co-ordinated and effective policy mixes are necessary to achieve environmental targets in a cost-effective way.

One reason for the complex mix of policy measures and agri-environmental public goods is the Japanese conventional farming system in paddy fields which provides multiple agri-environmental public goods (e.g. agricultural landscapes, water quantity, and resilience to flooding) (Sakuyama, 2006). *Satoyama* landscape is a result of long history of agriculture, especially rice farming, and human-interactions with nature in Japan. Groundwater recharge and flood prevention are possible through the maintenance of paddy fields and irrigation systems. As a result, Japanese policy measures focus on promoting agriculture and reducing land abandonment (e.g. DPFHMA) and the maintenance of irrigation systems (e.g. MCILWE) (*input-based* policy measures). In other words, policy measures directly targeting the provision of agri-environmental public goods (*output-based* policy measures) have not been developed in Japan (Sakuyama, 2006). Implementing out-put based policy measures may include some challenges such as additional administrative costs for monitor and evaluate farm-level outcomes and lack of appropriate data. However, considering the fact that payments targeted to specific beneficiaries and outcomes have proven to be more effective in improving the environmental performance of agriculture in other OECD countries, the authorities should introduce such payments in Japan. The recent OECD Economics Department Working Paper on Japanese agriculture emphasised the importance of agri-environmental payments targeting explicit objectives (Jones and Kimura, 2013).

Another issue of Japanese agri-environmental policies are their limited scope. Japanese agri-environmental payments for *environmentally-friendly farming* (DPEFF) target only biodiversity and carbon storage despite the fact that other agri-environmental public goods are also important in Japan. It is also known that collective action is useful for the provision of agri-environmental public goods because they can tackle appropriate geographical areas and leverage resources among diverse participants (OECD, 2013b). However, in Japan, policy measures for collective action focus on the management of irrigation systems and do not promote other natural resource management by farmers and non-farmers (e.g. NGOs). Agri-environmental payments should target, for example, water quality (especially some closed water bodies; Box 4) or greenhouse gas mitigation. Policy measures for collective action should also target community activities that manage, for instance, agricultural landscapes (not only ones associated with paddy fields and irrigation systems), biodiversity and water quality. Since priorities of agri-environmental public goods and appropriate approaches vary depending on areas, flexible programmes that can take local situations into consideration would be necessary.

In most cases, data on agri-environmental public goods are not enough to monitor and evaluate agri-environmental policies in Japan. In particular, *ex post* analysis of agri-environmental policy measures is not sufficient. When developing policy measures, there is a complicated examination process including by the Diet and other ministries. Once policy measures are established, however, their effectiveness has been examined to a lesser extent compared than when they were developed. There has been little policy evaluation based on modelling exercises. Although collecting data imposes additional costs and the data may vary from national levels to regional or farmland-levels, more data would enable the monitoring and evaluation of agri-environmental policies and the introduction of evidence-based policy measures. Cost-effective data collection is a challenge for the implementation of Japanese agri-environmental policies.

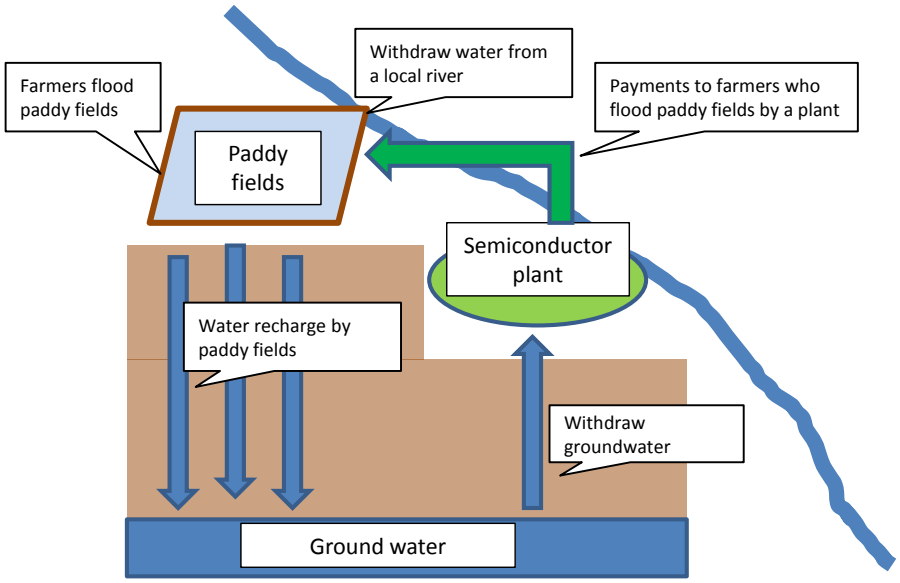
It is also necessary to explore possibilities of initiatives by private companies. There are cases in which private companies adopt payments for ecosystems services and help farmers provide agri-environmental public goods (Box 6). If these approaches are possible, direct intervention by governments may not be always necessary. Government roles can be limited to, for example, matching and information provision. Examining their role in the provision of agri-environmental public goods would be an important area of future studies.

Box 6. An example of private initiatives: Recharging groundwater by paddy fields in Kumamoto

Kumamoto City and the surrounding municipalities in Kyushu Island, with a population of about one million, depend on groundwater for 100% of its drinking water. In this area, one-third of the groundwater is recharged by paddy fields. However, the groundwater level has decreased due to decreased rice production and increased urbanisation.

A semiconductor plant began operation in Kumamoto in 2001. It pumps large quantities of groundwater, which has a negative impact on the groundwater resources of the area. To recharge groundwater, the company introduced a payment for ecosystem service (PES) scheme in collaboration with a local NGO, a local agricultural co-operative, land improvement districts, other local firms, and the Kumamoto City government. The semiconductor plant asks volunteer farmers to flood paddy fields after harvest so that water drawn from a local river permeates back into the ground. Through this scheme, groundwater has been successfully recharged (an estimated 11.6 million tonnes, more than the amount of water used by the plant, 9.8 million tonnes as of 2009). Farmers receive JPY 11 000 per 0.1 hectare if they participate in the scheme (Figure 8).

Figure 8. Scheme of groundwater recharge project by a private company



Sources:
Sony, www.sony.co.jp/SonyInfo/csr/eco/operations/biodiversity/groundwater.html
Ministry of the Environment (MOE), www.biodic.go.jp/biodiversity/shiraberu/policy/pes/en/water/water03.html.

Table 6. Agri-environmental Policy Measures in Japan

AE public goods	Measures									
	Regulatory			Financial incentives						Facilitative
	Regulatory requirements	Environmental taxes/ charges	Environmental cross-compliance	Payments based on farming practices	Payments based on land retirement	Payments based on farm fixed assets	Payments based on outcomes	Tradable rights /permits	Community based measures	Technical assistance/ extension/R&D/labelling/ standards/certification
Agricultural landscapes	Landscape Act (2004)			DPFHMA (2000)					MCILWE (2007)	
Biodiversity	Cartagena Protocol (2003) Invasive Alien Species Act (2004)		ECC (2005)	DPEFF (2011) DPFHMA (2000)		SDA (1999)			MCILWE (2007)	SDA (1999) LPOA (2006) Eco-labelling (1992)
Water quality	CWP (1970) AATPULM (1999)					SDA (1999) AATPULM (1999)			MCILWE (2007)	SDA (1999) LPOA (2006) Eco-labelling (1992) AATPULM (1999)
Water quantity/ availability	River Act (1896)			DPFHMA (2000)					MCILWE (2007)	
Soil quality and protection	ALSPPL (1971)					SDA (1999) AATPULM (1999)			MCILWE (2007)	SDA (1999) LPOA (2006) Eco-labelling (1992) SFEA (1984)
Climate change – carbon storage			ECC (2005)	DPEFF (2011)						
Climate change – greenhouse gas emissions								JCS(2008)		BIO (2002)
Air quality	COO (1972) AATPULM (1999)					AATPULM (1999)				AATPULM (1999)
Resilience to natural disaster				DPFHMA (2000)					MCILWE (2007)	

Note: Year denotes first year programme authorised. There are other subsidies provided for various agri-environmental public goods.
Acronyms: AATPULM – Act on the Appropriate Treatment and Promotion of Utilization of Livestock Manure, ALSPPL – Agricultural Land Soil Pollution Prevention Law, BIO – Biomass Nippon, COO – Control of Offensive Odours, CWP – Control of Water Pollution, DPEFF – Direct Payment for Environmentally Friendly Farming, DPFHMA – Direct Payments to Farmers in Hilly and Mountainous Areas, ECC – Environmental Cross Compliance, JCS – J-Credit Scheme, LPOA – Law on Promotion of Organic Agriculture, SDA – Establishment and Extension of Agricultural Practices that Facilitate the Sustainable Development of Agriculture, SFEA – Soil Fertility Enhancement Act, MCILWE – Measures to Conserve and Improve Land, Water, and the Environment.
Source: Matrix format is developed based on Ribaudo, M., L. Hansen, D. Hellerstein and C. Greene (2008), *The Use of Markets to Increase Private Investment in Environmental Stewardship*, United States Department of Agriculture, Economic Research Service, Economic Research Report Number 64, Washington D.C. and OECD (2010d), "Policy Measures Addressing Agrienvironmental Issues", *OECD Food, Agriculture and Fisheries Papers*, No. 24, OECD Publishing, Paris. .

7. Conclusion

This study reviews policy measures providing agri-environmental public goods in Japan. It is one of the first studies which attempts to synthesise a broad range of Japanese agri-environmental policies and agri-environmental public goods.

It has demonstrated that Japanese agri-environmental policies target mainly nine agri-environmental public goods, i.e. agricultural landscapes, biodiversity, water quality, water quantity, soil quality, climate change – carbon storage, climate change – greenhouse gas emissions, air quality and resilience to natural disasters (flooding, snow damage, fire, etc).

Most agri-environmental public goods in Japan are jointly produced by food and agricultural activities. *Satoyama* landscape is a result of a long history between agriculture and human-interactions with nature. Groundwater recharge and flood prevention are possible through the maintenance of paddy fields and irrigation systems. Appropriate management of farmland and irrigation systems are necessary for the provision of these goods. Therefore, in order to secure an adequate provision, policy measures have focused on managing drivers which affect the status of the provision of agri-environmental public goods (*input-based* policy measures), rather than directly targeting agri-environmental public goods (*output-based* policy measures).

Limited proxy data suggests there is strong demand for agri-environmental public goods, but in many cases supply for these goods suffer from declining situations. This implies that in many cases agri-environmental public goods are under-provided in Japan. However, the extent of market failure for each agri-environmental public goods is not clear. The situation may change depending on each region. It is easy to state that government intervention is necessary for public goods, but priorities and the extent of intervention can vary depending on the market failure for each agri-environmental public goods. Further analysis is necessary.

To achieve environmental targets in Japan, positive incentives and technical assistance are mainly used, while for some agri-environmental public goods (water quality, soil quality, and air quality) and programmes, regulatory measures are used to ask farmers to meet reference levels at their own cost. Best policy mixes should be discussed. Although multiple policy measures are implemented, co-ordination among policy measures is not yet sufficient, and it is not clear to what extent one policy measure tries to address the issue, and to what extent other policy measures do so. Agri-environmental policy measures should also target specific objectives (*output-based* policy measures) as in other OECD countries. In addition, considering the fact that many agri-environmental public goods cannot be provided just by a single farmer, promoting community-based activities, not just by payments but by extension and certification systems, could be worthwhile to be explored further. Community-based activities or collective action might be important not only for managing irrigation systems, but also for other related agricultural activities.

The discussion on costs associated with the provision of agri-environmental public goods needs more attention. In many cases, reference levels and environmental targets are not clearly set in Japan. Most financial incentives set reference levels as current farming practices so that governments are required to pay farmers to adopt sustainable farming practices. However, in some cases, before government intervention, it would be better to have a discussion concerning the extent to which farmers should bear the costs and the extent to which governments/society should bear the costs. In addition, some agri-environmental public goods have use values. In this case, it would be ideal to ask

beneficiaries of agri-environmental public goods (e.g. local citizens, private companies) to bear some costs for the provision.

This study also identifies some innovative approaches undertaken by local governments and private companies. This should be explored with greater depth so as to improve the cost-effectiveness of agri-environmental policies.

Last but not least, cost-effectiveness of agri-environmental policies relies on better indicators and data. Data for estimating the demand and the supply of agri-environmental indicators is still limited and it is difficult to evaluate how various agri-environmental policies can contribute to overcoming market failures associated with agri-environmental public goods. Much effort is necessary to establish better agri-environmental indicators in Japan. With more scientific data, it would be possible to identify good policy measures to target the appropriate drivers for providing adequate amount of agri-environmental public goods, and it would become possible to monitor and evaluate agri-environmental policy measures.

Annex Table 1. Reference levels and agri-environmental targets in Japan

1) Agricultural landscapes	
Environmental targets	No national targets. Regional targeting under the Landscape Act. As of March, 2013, there are five *landscape agricultural promotion regional development plans* developed by local governments, which outline regional plans for promoting agriculture in consistency with regional agricultural landscapes.
Reference level	No national baseline. Regional baseline under the Landscape Act
2) Biodiversity	
Environmental targets	The National Biodiversity Strategy 2012-2020 sets national targets. One of the goals of the strategy is "by 2020, agriculture, forestry and fisheries which secure the preservation of biodiversity will be sustainably implemented". The goal will be measured by using indicators such as total number of people who participate in local collective action related with MCILWE and number of eco-farmers.
Reference level	No national baseline. Current farming practices are equal to reference levels
3) Water quality	
Environmental targets	Environmental standard regarding water pollution (1966) includes standard about water for agricultural use. It sets national targets regarding hydrogen ion, biochemical oxygen demand (BOD), suspended solids (SS) and dissolved oxygen (DO) in rivers and lakes.
Reference level	By Control of Water Pollution, government set regulatory effluent standards for the concentration of harmful substances, which is applicable to effluents from specified facilities (including large-scale pig and cattle facilities, and horse stables). The standards related to agriculture include (national baseline): sum of the ammonium-nitrogen multiplied by 0.4, nitrite-nitrogen and nitrate-nitrogen (100mg/L), BOD (160mg/L, daily average: 120mg/L), COD (160mg/L, daily average: 120mg/L), total nitrogen (120mg/L, daily average: 60mg/L) and total phosphorus (16mg/L, daily average: 8mg/L). Livestock farmers have provisional standards.
4) Water quantity/ availability	
Environmental targets	No national targets for water quantity. Water Plan 21 (developed in 1999) set various targets on sustainable water supply including water for agricultural use. It targeted the sustainable water supply for agricultural use in 2010, however, the target has not been renewed even after the end of the targeted year (2010).
Reference level	Rights to use river water (including water for agriculture use) are controlled by the River Act (national baseline).
5) Soil quality and protection	
Environmental targets	Principle for promoting soil quality under the Soil Quality Promotion Act set national targets on soil quality in paddy fields, arable land and orchards.
Reference level	Environmental standard regarding soil quality and Agricultural Land Soil Pollution Prevention Law regulate harmful substances in soil, namely, cadmium (0.4 mg/kg (rice)), copper (125 mg/kg (soil)) and arsenic (15 mg/kg (soil)) (national baseline).
6) Carbon storage	
Environmental targets	No national target
Reference level	No national baseline. Current farming practices are equal to reference levels
7) Greenhouse gas emissions	
Environmental targets	3.8% reduction of greenhouse gas emission compared to the 2005 level by 2020 (national targets).
Reference level	No national baseline. Current farming practices are equal to reference levels
8) Air quality	
Environmental targets	Environmental standard regarding air pollution sets overall national targets for air quality, including targets on SO_2, CO_2 and NO_2.
Reference level	No national baseline. Regional baseline under the Control of Offensive Odours
9) Resilience to flooding	
Environmental targets	2012 Priority Plan for Social Infrastructure Development includes national targets for prevention of flooding, but not specific to flood prevention function of paddy fields.
Reference level	No national baseline. Current farming practices are equal to reference levels
10) Resilience to snow damage	
Environmental targets	No national targets. Regional targeting
Reference level	No national baseline. Current farming practices are equal to reference levels
11) Resilience to fire	
Environmental targets	No national targets. Regional targeting
Reference level	No national baseline. Current farming practices are equal to reference levels

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