Organisation for Economic Co-operation and Development
Organisation de Coopération et de Développement Économiques

ENVIRONMENTAL PERFORMANCE OF AGRICULTURE IN OECD COUNTRIES SINCE 1990:

Japan Country Section

This country section is an extract from chapter 3 of the OECD publication (2008) ***Environmental Performance of Agriculture in OECD countries since 1990***, which is available at the OECD website indicated below.

This text should be cited as follows: OECD (2008), *Environmental Performance of Agriculture in OECD countries since 1990*, Paris, France

A summary version of this report is published as ***Environmental Performance of Agriculture: At a Glance***, see the OECD website which also contains the agri-environmental indicator time series database at: http://www.oecd.org/tad/env/indicators

TABLE OF CONTENTS OF THE COMPLETE REPORT

BACKGROUND TO THE COUNTRY SECTIONS

Structure

This chapter provides an analysis of the trends of environmental conditions related to agriculture for each of the 30 OECD member countries since 1990, including an overview of the European Union, and the supporting agri-environmental database can be accessed at *www.oecd.org/tad/env/indicators*. Valuable input for each country section was provided by member countries, in addition to other sources noted below. The country sections are introduced by a figure showing the national agri-environmental and economic profile over the period 2002-04, followed by the text, structured as follows:

- ***Agricultural sector trends and policy context:*** The policy description in this section draws on various OECD policy databases, including the *Inventory of Policy Measures Addressing Environmental Issues in Agriculture* (*www.oecd.org/tad/env*) and the Producer and Consumer Support Estimates (*www.oecd.org/tad.support/pse*).
- ***Environmental performance of agriculture:*** The review of environmental performance draws on the country responses to the OECD agri-environmental questionnaires (unpublished) provided by countries and the OECD agri-environmental database supporting Chapter 1 (see website above).
- ***Overall agri-environmental performance:*** This section gives a summary overview and concluding comments.
- ***Bibliography:*** The OECD Secretariat, with the help of member countries, has made an extensive search of the literature for each country section. While this largely draws on literature available in English and French, in many cases member countries provided translation of relevant literature in other languages.

At the end of each country section a standardised page is provided consisting of three figures. The first figure, which is the same for every country, compares respective national performance against the OECD overall average for the period since 1990. The other two figures focus on specific agri-environmental themes important to each respective country.

Additional information is also provided for each country on the OECD agri-environmental indicator website (see address above) concerning:

- Details of national agri-environmental indicator programmes.
- National databases relevant to agri-environmental indicators.
- Websites relevant to the national agri-environmental indicators (*e.g.* Ministries of Agriculture)
- A translation of the country section into the respective national language, while all 30 countries are available in English and French.

Coverage, caveats and limitations

A number of issues concerning the coverage, caveats and limitations need to be borne in mind when reading the country sections, especially in relation to making comparisons with other countries:

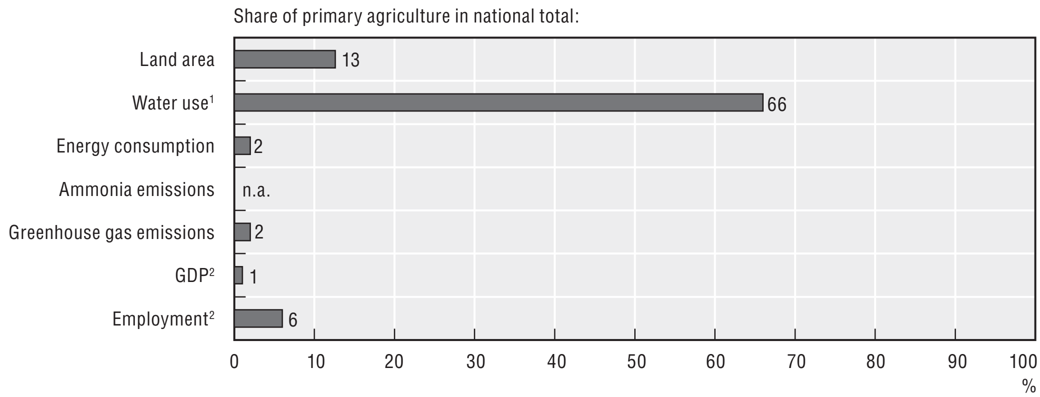
Coverage: The analysis is confined to examination of agri-environmental trends. The influence on these trends of policy and market developments, as well as structural changes in the industry, are outside the scope of these sections. Moreover, the country sections do not examine the impacts of changes in environmental conditions on agriculture (*e.g.* native and non-native wild species, droughts and floods, climate change); the impact of genetically modified organisms on the environment; or human health and welfare consequences of the interaction between agriculture and the environment.

Definitions and methodologies for calculating indicators are standardised in most cases but not all, in particular those for biodiversity and farm management. For some indicators, such as greenhouse gas emissions (GHGs), the OECD and the UNFCCC are working toward further improvement, such as by incorporating agricultural carbon sequestration into a net GHG balance.

- ***Data availability, quality and comparability*** are as far as possible complete, consistent and harmonised across the various indicators and countries. But deficiencies remain such as the absence of data series (*e.g.* biodiversity), variability in coverage (*e.g.* pesticide use), and differences related to data collection methods (*e.g.* the use of surveys, census and models).
- ***Spatial aggregation*** of indicators is given at the national level, but for some indicators (*e.g.* water quality) this can mask significant variations at the regional level, although where available the text provides information on regionally disaggregated data.
- ***Trends and ranges in indicators***, rather than absolute levels, enable comparisons to be made across countries in many cases, especially as local site specific conditions can vary considerably. But absolute levels are of significance where: limits are defined by governments (*e.g.* nitrates in water); targets agreed under national and international agreements (*e.g.* ammonia emissions); or where the contribution to global pollution is important (*e.g.* greenhouse gases).
- ***Agriculture's contribution to specific environmental impacts*** is sometimes difficult to isolate, especially for areas such as soil and water quality, where the impact of other economic activities is important (*e.g.* forestry) or the "natural" state of the environment itself contributes to pollutant loadings (*e.g.* water may contain high levels of naturally occurring salts), or invasive species that may have upset the "natural" state of biodiversity.
- ***Environmental improvement or deterioration*** is in most individual indicator cases clearly revealed by the direction of change in the indicators but is more difficult when considering a set of indicators. For example, the greater uptake of conservation tillage can lower soil erosion rates and energy consumption (from less ploughing), but at the same time may result in an increase in the use of herbicides to combat weeds.
- ***Baselines, threshold levels or targets for indicators*** are generally not appropriate to assess indicator trends as these may vary between countries and regions due to difference in environmental and climatic conditions, as well as national regulations. But for some indicators threshold levels are used to assess indicator change (*e.g.* drinking water standards) or internationally agreed targets compared against indicators trends (*e.g.* ammonia emissions and methyl bromide use).

3.15. JAPAN

Figure 3.15.1. **National agri-environmental and economic profile, 2002-04: Japan**



StatLink http://dx.doi.org/10.1787/300560776606

1. Data refer to the year 2001.
2. Data refer to the year 2004.

Source: OECD Secretariat. For full details of these indicators, see Chapter 1 of the *Main Report*.

3.15.1. Agricultural sector trends and policy context

Agriculture's contribution to the economy is small. The agricultural sector currently accounts for about 1% of GDP and 6% of employment [1] (Figure 3.15.1). With a high GDP per capita and one of the most densely populated countries in the OECD, Japan is a major net importer of agricultural products.

Rice accounts for 55% of total agricultural land providing 25% of gross farm output value. Horticultural and arable crops account for 68% of farm output value with livestock providing a further 28%. Average farm size is less than 2 hectares, small relative to other OECD countries, and agricultural income accounts for only around 13% of total farm household income [2]. Agriculture makes intensive use of purchased inputs by OECD standards, but the total volume of farm production and farm inputs between 1990-92 to 2002-04 has decreased (Figure 3.15.2). Use of inorganic fertilisers has declined by –18% for nitrogen fertilisers and by –27% for phosphorus fertilisers; pesticide use declined by –27%; on-farm energy use by –5%; water use by –3%, while the volume of farm production also decreased by –11%, mainly due to lower crop production –17%, compared to the reduction in livestock –6% [1].

Agricultural support is almost twice the OECD average. Support (as measured by the OECD's Producer Support Estimate) has changed little, declining from 64% of farm receipts in the mid-1980s to 58% in 2002-04, compared to the OECD average of 30%. Almost all support (90%) is output and input linked, and primarily provided through administered prices, supply control and trade measures, with the rate of support highest for rice, cereals, and dairy products [3].

 ENVIRONMENTAL PERFORMANCE OF AGRICULTURE IN OECD COUNTRIES SINCE 1990 – ISBN 978-92-64-04092-2 – © OECD 2008

Japan provides budgetary payments to address agri-environmental issues. Expenditure on agri-environmental programmes more than doubled over the 1990s, but representing 10% of total payments to farmers. Adoption of sustainable agricultural practices is encouraged by concessionary loans, tax relief to farmers to help reduce chemical fertiliser and synthetic chemical pesticide use, and also a mandatory code of practice for pesticide application. Direct payments to farmers in hilly and mountainous areas aim to prevent abandonment of farming and maintain a range of ecosystem services associated with farming in these areas. Tax exemptions, low-interest loans, regulatory standards and other policy instruments are also used to address agri-environmental issues. In 1999 regulatory standards for manure management were established under the law concerning *Appropriate Treatment and Promotion of Utilisation of Livestock Manure* [4]. National and local governments finance facilities that recycle farm waste, such as manure, and in some cases set targets to reduce farm nutrient pollution of water [5].

Agri-environmental linkages are impacted by economy wide and taxation measures, as well as international environmental agreements. Regulations under the 1970 *Water Pollution Control Law* set upper limits for agricultural pollution, such as from pig and cattle units, and the 1972 *Offensive Odour Control Law* covers livestock. The River Act controls the withdrawal of water from rivers so as to maintain a downstream minimum flow for the conservation of aquatic ecosystems [6]. Farmers, and some other users, are exempt from fuel taxes equivalent to around JPN 3 billion (USD 26 million) in 2006 [3, 5, 7]. Irrigation and drainage infrastructure is part-financed by farmers and from national and local governments budgets [5, 8]. Around JPN 345 (USD 3.1) billion of irrigation finance was from national government annually between 2002 and 2006 [3]. Irrigation systems are managed by *Land Improvement Districts* (LIDs) which are voluntary community-based organisations with the purpose of undertaking the construction, improvement and management of irrigation/ drainage facilities and farmland improvement including farm consolidation, with 7 000 LIDs managing on average 500 hectares in 2000 [8, 9, 10]. The *Land Improvement Law* was amended in 2001, such that part government financed projects, for example, irrigation and drainage infrastructure, are implemented with consideration for their impact on biodiversity, while some local governments have also introduced programmes to protect biodiversity on farmland (*e.g.* Hyogo Prefecture's conservation of Oriental White Storks, *Ciconia boyciana* [11]). Agriculture is also impacted under international environmental agreements including commitments to lower: methyl bromide use (*Montreal Protocol*) and greenhouse gases (*Kyoto Protocol*).

3.15.2. Environmental performance of agriculture

The key agri-environmental challenges relate to pressure on water quality and natural resources, and enhancement of the sector's capacity to provide ecosystem services. The relatively high intensity of farm production has led to water pollution. Changes in farmland use have increased pressure to improve natural resource management, especially flood and landslide mitigation, and biodiversity. Some other agri-environmental issues are also significant including soil erosion, water use in certain areas, and air emissions.

Over 70% of land is mountainous, and with a high population density pressure on land is intense. Agriculture accounted for 13% of the total land area in 2002-04, down from 16% in the early 1990s. Because of the dominance of paddy rice cultivation, agriculture accounts for 66% of total water use [8]. Farming operates across a diverse range of climates, but many regions are in the Asian monsoonal zone favourable to rice production with abundant precipitation. Precipitation varies greatly by year, season and region, with floods occurring in many areas and water shortages in some regions [12]. Heavy rain and steep topography have caused frequent floods and landslides in many areas at considerable human and economic cost [5].

Soil erosion is not a widespread problem, but is of concern in certain regions [13], with about 40% of farmland situated in river basins where gradients are steep [14]. Many watersheds are interspersed by forested land and paddy fields which limit sediment discharge. But soil erosion is a concern in some areas, although soil conservation measures are being developed to address these concerns [13]. The risk of increased erosion rates is possible if trends in the abandonment of farming in hill areas continue, especially paddy fields, although there is currently little data to analyse soil erosion trends.

Water pollution originating from agricultural nutrients remains a key challenge [5]. The water quality (eutrophication) of lakes and coastal areas has shown no significant improvement, but there is little information on agriculture's share in nutrient loadings of water bodies [5]. Indirect evidence shows that farm nitrogen and phosphorus surpluses have declined over the period 1990-92 to 2002-04, but absolute levels per hectare remain among the highest across OECD countries, for both nitrogen and phosphorus (Figure 3.15.2). Similarly the very high accumulation of surplus phosphorus in farmed soils raises the likely future risk of eutrophication of water in view of the long time lags in involved in phosphorus transport through soils [15]. Despite a reduction in phosphorus surplus over the past 15 years, Japan has the highest intensity of phosphorus surplus per hectare of agricultural land across OECD countries, nearly 5 times above the OECD average (Figure 3.15.2).

Farming is one of the major sources of nitrate contamination of groundwater in certain areas [16, 17,], with 5% of wells exceeding the environmental quality standard in 1999 [18]. There are also concerns of water contamination from livestock pathogens, including livestock hormones and certain pesticides acting as an endocrine-disruptor to human and wildlife reproductive systems in aquatic ecosystems, but these were detected in only limited samples at low concentrations in a nationwide survey from 1999 to 2000 [19, 20]. Farming is also identified as a source of pollution (eutrophication) leading to "red tides", algal blooms, with adverse impacts on marine life [21].

The horticultural and livestock sectors are the origin of most agricultural nutrient pollution. Overall fertiliser use declined since 1990, mainly because of the decrease in rice production. Rice production accounts for about a third of the total volume of inorganic fertiliser use but it is applied at a lower rate per hectare on paddy fields than for horticultural crops [15, 22]. Nitrogen leaching into surface water and groundwater from paddy fields is low compared to vegetable fields and orchards, due mainly to the low rate of fertilisation and partly to denitrification, a process characteristic of submerged soils [16, 18, 23]. Although denitrification does lead to the release of nitrous oxide, that is a powerful greenhouse gas, the amounts are very small compared to the amounts released from dry land farming. Moreover, for paddy field watersheds using a recycling irrigation system (although the area and number is unknown) this lowers nutrient pollution [24, 25, 26].

While production of livestock has declined over the last decade, there has been a trend towards larger operating units, especially for pigs and dairy cows [4, 27], leading to increased localised levels of livestock effluents [15, 23, 28]. However, there has recently been an increase in the number of livestock farms equipped with manure treatment facilities,

 ENVIRONMENTAL PERFORMANCE OF AGRICULTURE IN OECD COUNTRIES SINCE 1990 – ISBN 978-92-64-04092-2 – © OECD 2008

rising from 5 000 to 6 000 farms between 2000 and 2003, reaching nearly 90% of the government's target for this period [29]. But the number of farms under nutrient management plans was only 20% in 2000-03, and the efficiency of nutrient use efficiency (output/input) is among the lowest across OECD countries.

The pressure on water pollution from pesticides has eased, with a 27% reduction in pesticide use between 1990 and 2003 (Figure 3.15.2). The decrease in pesticide use over this period was most likely associated with the 19% reduction in the volume of crop production and to a limited extent the expansion in the number of farmers adopting environmentally beneficial practices, including organic farms. The intensity of pesticide use, however, remains high by OECD standards, due in part to the pressure on land and labour and to the humid temperate climate [5]. Incidents of human poisoning from pesticides have been reduced drastically since the 1960s [5], and recent national monitoring data for surface water (river, lakes and coastal areas) reveals that the number of samples above national drinking water standards for pesticides was less than 0.1% [30].

Some regions are experiencing water shortages leading to growing competition for water resources. For regions where competition for water resources is intensifying this is exacerbated by the frequent incidence of water shortages in recent years [4, 19], although shortages can be addressed through voluntary and regulatory reallocation of water [31, 32]. Projections suggest that demand for irrigation water for dryland crop production may expand [33]. Given that agriculture is the major user of water resources, including a 31% share in national use of groundwater in 2002 [1, 8], reducing future pressure on the demand for water will in part depend on promoting the efficient use of water by agriculture [4]. Even so, agricultural water use declined by 3% between 1990-92 and 2001-03 (Figure 3.15.2).

Air pollution linked to farming has declined over the period since 1990. With about 80% of agricultural ***ammonia emissions*** accounted for by livestock, the decrease in livestock production, as well as fertiliser use, suggests emissions have also declined, but they are not regularly monitored [34]. Since the 1970s the number of complaints related to offensive livestock odours has significantly declined [38]. For ***methyl bromide*** use (an ozone depleting substance) Japan is a major OECD user and reduced its use by over 70% by 2003, as agreed by the phase-out schedule under the *Montreal Protocol*, which seeks to eliminate all use by 2005. In 2005 "*Critical Use Exemption*" (CUE), which allows farmers additional time to find substitutes, was agreed up to 449 tonnes (ozone depleting potential) under the *Protocol*. Growers of melons, peppers, watermelons and field ginger account for over 80% of the 2005 CUE quantity [36].

Agricultural greenhouse gases (GHGs), declined by14% between 1990 and 2004, accounting for 2% of total GHGs (2002-04) [37]. This compares to an increase in GHG emissions for the economy as a whole of 10% over the same period relative to a *Kyoto Protocol* target agreed by Japan to reduce total emissions by 6% in the commitment period from 2008 to 2012. Much of the reduction in agricultural GHGs has been due to lower methane and nitrous oxide emissions following the decrease in rice production, fertiliser use and livestock numbers [40]. The reduction in ***direct on-farm energy consumption*** by 5% between 1990 and 2004 has also played a role in lowering GHG emissions, while ***carbon sequestration*** may have risen where farmland was converted to forest or other vegetative growth.

The decline in farmland is reducing agriculture's capacity to provide ecosystem services. Agriculture can supply certain ecosystem services depending on their management, and according to Japanese research rice paddy fields provide a higher level of ecosystem service than other land use types [32]. But due to the decrease in the area farmed by 9% between 1990-92 and 2002-04, especially the 17% reduction in the paddy field area, provision of these ecosystem services has been impaired. For example, agricultural water retaining capacity declined by around 15% from 1990-92 to 2000-02 (Figure 3.15.3) [1]. Consequently soil erosion and flooding risks increased [5]. Farmland accounts for 20% of the area classified as a landslide hazard zone, consequently landslide risks are low on farmland. Research in Japan indicates that the rate of landslide occurrence is 3 to 4 times higher on abandoned farmland than on cultivated land [5, 38]. In addition, in some areas agriculture's groundwater recharge capacity has decreased with the reduction in the paddy rice area [6, 31].

Agricultural land reclamation and intensification have adversely impacted biodiversity. Despite the net reduction of agricultural land area, the reclamation of wetlands and tidal flats for farming has led to substantial losses and deterioration of certain habitats over the past 20 years [5, 39]. Conversion of land from other uses to agriculture continues but has declined from over 10 000 to 4 000 hectares/annum over the past decade [1]. Agricultural pollution of some water bodies is also harming aquatic habitats [5, 39]. 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 [40, 41, 42].

The conversion of agricultural land to other uses is a threat to certain wild species. The net reduction in farmland over the 1990s has been converted to transport infrastructure, urban use, forest and left to revert to a "natural" state [1]. Some farming systems and rural landscapes, notably less intensive rice paddy fields and traditional "Satochi" landscapes [39] (these contain a mix of habitats *e.g.* forests, paddy fields, dryland crops, and orchards), provide key habitats for flora and fauna [40, 41, 44], hence their loss is of concern for the conservation of wildlife species. But the extent and changes in the area of "Satochi" landscapes is unclear. Based on a 2003 Ministry of Agriculture survey of paddy fields, they were found to provide habitat for one-third of total fresh water fish species and dragonflies, a quarter of reptiles and amphibians, about one-fifth of birds and 14% of plants [6, 31, 40]. Moreover, a major share of endangered species are also found in paddy fields. But where farmland is converted to forest or left to a "natural" state, the overall impact on biodiversity is unknown [40].

Reduction in agricultural land area is considered to impair the value of landscapes. The Agency for Cultural Affairs estimates that over 90% of national cultural assets are closely related to agriculture or rural activities [1], although the extent to which the value of these assets are being reduced with the decrease in farmland is unknown. There is evidence of a greater homogeneity of "Satochi" landscapes mainly because of agricultural intensification [43], but there are little data available to monitor the process [45].

3.15.3. Overall agri-environmental performance

Overall pressure on the environment has been reduced with the contraction of agriculture. But the reduction in agricultural activity has also reduced the sector's capacity to provide ecosystem services. Projections suggest that the contraction of agriculture is set to continue over the next 10 years, which will lower the pressure on the environment [46]. The decrease in the area farmed and uptake of sustainable farming practices has led to lower fertiliser and pesticide use and greenhouse gas emissions. With the more moderate

 ENVIRONMENTAL PERFORMANCE OF AGRICULTURE IN OECD COUNTRIES SINCE 1990 – ISBN 978-92-64-04092-2 – © OECD 2008

reduction in livestock and horticultural production, however, plus further intensification and enlargement of production units this has been a major source of water and air pollution in some regions.

The intensity of pesticide and fertiliser use and nutrient surpluses are high by average OECD standards [5], while the share of farms under nutrient management plans is low and nutrient use efficiency among the lowest across OECD countries. Farmer exemption from energy and fuel taxes can act as a disincentive to use energy and fuel efficiently. Efforts to limit agricultural water pollution have been slow compared to controlling pollution from industrial and urban sources [5]. The decrease in farmland has reduced the sector's capacity to provide a range of ecosystem services, especially flood and landslide mitigation, groundwater recharge and biodiversity conservation.

The lack of monitoring data impairs evaluation of Japan's agri-environmental performance. Water quality of rivers, lakes, coasts, and groundwater throughout Japan, which includes those in agricultural zones has been monitored for more than 30 years, but since farmland and non-farmland are intermingled, the agricultural sector's share in water pollution has not been identified precisely. In addition, monitoring data are also lacking for soil erosion and ammonia emissions, but recent initiatives are beginning to address this deficiency [47]. Little is known of the relative costs and benefits of using agricultural land to provide ecosystem services, especially paddy rice fields, compared to other land use types.

Recent policy initiatives strengthen existing agri-environmental programmes. *Principles of the Environmental Policy in Agriculture, Forestry and Fisheries* (2003), provides a new framework for agri-environmental policies, with a shift to cross compliance measures targeted to environmental beneficial practices, more clearly defined policy goals and provision of a policy evaluation framework [3, 47]. The *Biomass Nippon Strategy* (2006) establishes a set of programmes aimed at recycling more than 80% of biomass waste (which includes livestock manure) and utilisation of more than 25% of unused biomass (carbon equivalent terms) by 2010 [29, 48]. The development of social structures, such as water user associations involves all stakeholders, not just farmers, in addressing environmental issues [49, 50], and is being strengthened through the 2005 *Basic Plan for Food, Agriculture and Rural Areas*, which also aims to further advance environmental objectives in agricultural policies [51].

A number of recent measures are aiming to address climate change in agriculture. The *Strategy for Preventing Global Warming* (2007) focuses on measures for mitigation, adaptation and international co-operation [52]. Concerning mitigation the *Strategy* includes measures such as, *Forest Sink*, *Utilisation of Biomass*, and the *Voluntary Action Plan of the Food Industry*, which are to be accelerated. The government's *Boosting the Production of Biofuel in Japan* (2007) sets a goal for producing 50 000 kl of biofuel domestically per annum by 2011, and in the mid-to long-term aiming to significantly increase production of biofuel in Japan, utilising cellulose materials compatible with food production [53]. Regarding adaptation measures, studies on the damage to agricultural production due to global warming have been completed, such as the *Report on adaptation measures by items and the roadmap*. For international co-operation this will be promoted based on mitigation and adaptation technologies.

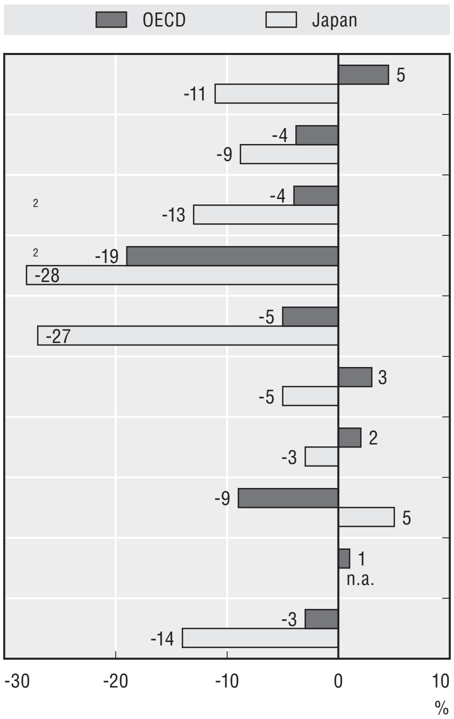
The Strategy for Biodiversity Conservation (2007) is being developed as guidelines to promote biodiversity conservation in the agriculture, forestry and fisheries sectors [54]. These guidelines take into account that agriculture, forestry and fisheries are essential activities that provide food and raw materials as well as habitats for many species, utilizing natural cyclical functions. For example, some endangered birds are under rehabilitation on agricultural land.

There are also signs that more farmers are adopting sustainable practices [14, 55], as the number of "Eco-farmers" (farmers whose sustainable farming plan is certified by the prefectural government) had increased to some 127 000 by March 2007, or about 7% of all farms (Figure 3.15.4). But these positive developments in agri-environmental policy evolution have to be evaluated in the context of high output-related farm support measures [3].

ENVIRONMENTAL PERFORMANCE OF AGRICULTURE IN OECD COUNTRIES SINCE 1990 – ISBN 978-92-64-04092-2 – © OECD 2008

Figure 3.15.2. **National agri-environmental performance compared to the OECD average**

Percentage change 1990-92 to 2002-04[1]



Absolute and economy-wide change/level

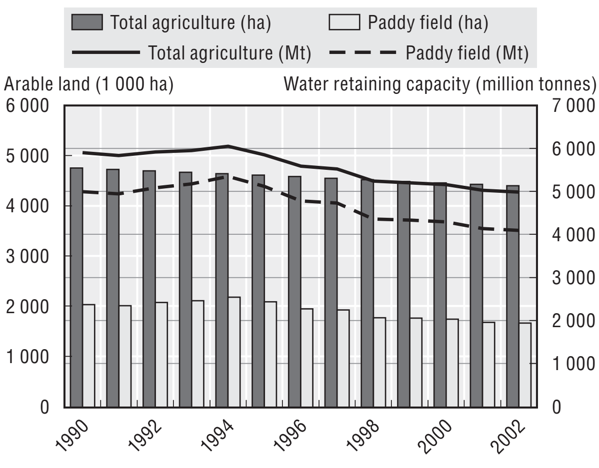
Variable	Unit		Japan	**OECD**
Agricultural production volume	Index (1999-01 = 100)	1990-92 to 2002-04	89	105
Agricultural land area	000 hectares	1990-92 to 2002-04	–457	–48 901
Agricultural nitrogen (N) balance	Kg N/hectare	2002-04	171	74
Agricultural phosphorus (P) balance	Kg P/hectare	2002-04	51	10
Agricultural pesticide use	Tonnes	1990-92 to 2001-03	–23 900	–46 762
Direct on-farm energy consumption	000 tonnes of oil equivalent	1990-92 to 2002-04	–339	+1 997
Agricultural water use	Million m^3	1990-92 to 2001-03	–1 790	+8 102
Irrigation water application rates	Megalitres/ha of irrigated land	2001-03	21.3	8.4
Agricultural ammonia emissions	000 tonnes	1990-92 to 2001-03	n.a.	+115
Agricultural greenhouse gas emissions	000 tonnes CO_2 equivalent	1990-92 to 2002-04	–4 611	–30 462

n.a.: Data not available. Zero equals value between –0.5% to < +0.5%.

1. For agricultural water use, pesticide use, irrigation water application rates, and agricultural ammonia emissions the % change is over the period 1990-92 to 2001-03.
2. Percentage change in nitrogen and phosphorus balances in tonnes.

Source: OECD Secretariat. For full details of these indicators, see Chapter 1 of the *Main Report*.

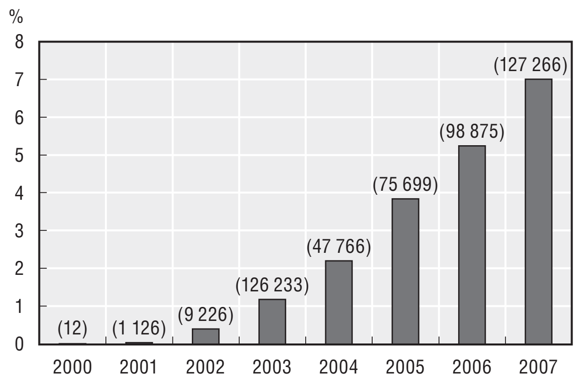
Figure 3.15.3. **National water retaining capacity of agriculture**



Source: Ministry of Agriculture, Forestry and Fisheries, Japan.

Figure 3.15.4. **Share of eco-farmers in the total number of farmers**

As a % of the total number of farmers



() Number of eco-farmers.

"Eco-farmers" are certified by a governor as environmentally-friendly farmers. The obligation of eco-farmers is to make a plan to introduce techniques for using compost for soil conditioning and reducing the use of agricultural chemicals based on the Law for Promoting the Introduction of Sustainable Agricultural Practices.

Source: Ministry of Agriculture, Forestry and Fisheries, Japan.

StatLink http://dx.doi.org/10.1787/300566438140

Bibliography

[1] Japanese response to the OECD Agri-environmental Indicator Questionnaire, unpublished.

[2] JIAC (2004), *Japan Agrinfo News Letter*, Vol. 21, No. 8, April 2004, *www.jiac.or.jp/agrinfo/0404_2_2.html*.

[3] OECD (2005), *Agricultural Policies in OECD Countries: Monitoring and Evaluation 2005*, Paris, France, *www.oecd.org/agr/policy*.

[4] OECD (2004), *Agriculture, Trade and the Environment: The Dairy Sector*, Paris, France.

[5] OECD (2002), *Environmental Performance Reviews: Japan*, Paris, France.

[6] Yamaoka, K. (2006), "Paddy field Characteristics in Water Use: Experiences in Asia", in OECD, *Water and Agriculture: Sustainability, Markets and Policies*, Paris, France, *www.oecd.org/tad/env*.

[7] IEA (2003), *Energy Policies of IEA Countries – Japan 2003 Review*, International Energy Agency, Paris, France, *www.iea.org*.

[8] Kobayashi, H. (2006), "Japanese Water Management Systems from an Economic Perspective: The Agricultural Sector", in OECD, *Water and Agriculture: Sustainability, Markets and Policies*, Paris, France, *www.oecd.org/tad/env*.

[9] Tanaka, Y. and Y. Sato (2005), "Farmers managed irrigation districts in Japan: Assessing how fairness may contribute to sustainability", *Agricultural Water Management*, Vol. 77, pp. 196-209.

[10] Sakakibara, E. (2003), *Structural Reform in Japan: Breaking the Iron Triangle*, Brookings Institution Press, Washington DC, United States.

[11] Japan for Sustainability, *Creating a Homeland for Storks: Species Protection Activities in Hyogo*, Newsletter 42, 28 February, *www.japanfs.org/en/japan/profiles.html*.

[12] UN (2002), *Johannesburg Summit 2002, Japan Country Profile*, submission to UN by Japan under Agenda 21, *www.un.org/esa/agenda21/natlinfo/countr/japan/index.htm*.

[13] Takagi, A. (2003), "The Occurrence and Prediction of Erosion and Sediment Discharge in Agricultural Areas in Japan", in OECD, *Agricultural Impacts on Soil Erosion and Soil Biodiversity: Developing Indicators for Policy Analysis*, Paris, France, *www.oecd.org/tad/env/indicators*.

[14] Ministry of Agriculture, Forestry and Fisheries (2003), *Annual Report on Food, Agriculture and Rural Areas in Japan FY 2003 (Summary)*, provisional English translation, Tokyo, Japan, *www.maff.go.jp/eindex.html#3*.

[15] Mishima S., S. Itahashi, R. Kimura and T. Inoue (2003), "Trends of phosphate fertiliser demand and phosphate balance in farmland soils in Japan", *Soil Science and Plant Nutrition*, Vol. 49, No. 1, pp. 39-45.

[16] Babiker, I.S., M.A.A. Mohamed, H. Terao, K. Kato and K. Ohta (2004), "Assessment of groundwater contamination by nitrate leaching from intensive vegetable cultivation using geographical information system", *Environmental International*, Vol. 29. pp. 1009-1017.

[17] Nishio, M. (2002), *Effect of intensive fertiliser use on groundwater quality*, Extension Bulletin, Food and Fertilizer Technology Centre, Chinese Taipei, *www.fftc.agnet.org/library/list/pub/eb.html*.

[18] Kumazawa, K. (2002), "Nitrogen fertilisation and nitrate pollution in groundwater in Japan: Present status and measures for sustainable agriculture", *Nutrient Cycling in Agroecosystems*, Vol. 63, pp. 129-137.

[19] Ministry of Health, Labour and Welfare (1999), "Securing Safe and Tasty Water", Vol. 1, Part 2, Chapter 6, Section 6, in *Annual Reports on Health and Welfare 1998-1999 Social Security and National Life*, Tokyo, Japan, *www.mhlw.go.jp/english/wp/wp-hw/vol1/p2c6s6.html*.

[20] Kunikane, S., M. Ando, T. Aizawa and Y. Kanegaki (2004), "A nationwide survey of endocrine disrupting chemicals in source and drinking waters in Japan", *Journal of Water and Environment Technology*, Vol. 2, No. 1, pp. 17-22.

[21] Okaichi, T. (ed.) (2004), *Red Tides*, Terra Scientific Publishing Company/Kluwer Academie Publishers, Japan.

[22] Mishima, S. (2000), "Recent Trend of Nitrogen Flow Associated with Agricultural Production in Japan", *Soil Science and Plant Nutrition*, Vol. 47, No. 1, pp. 157-166.

[23] Mishima S., N. Matsumoto and K. Oda (1999), "Nitrogen Flow Associated with Agricultural Practices and Environmental Risk in Japan", *Soil Science and Plant Nutrition*, Vol. 45, No. 4, pp. 881-889.

[24] Feng, Y.W., I. Yoshinaga, E. Shiratani, T. Hitomi and H. Hasebe (2004), "Characteristics and behaviour of nutrients in a paddy field area equipped with a recycling irrigation system", *Agricultural Water Management*, Vol. 68, pp. 47-60.

[25] Takeda, I. and A. Fukushima (2004), "Phosphorus purification in a paddy field watershed using a circular irrigation system and the role of iron compounds", *Water Research*, Vol. 38, pp. 4065-4074.

[26] Shiratani, E., I. Yoshinaga, Y. Feng and H. Hasebe (2004), "Scenario analysis for reduction of the effluent load from an agricultural area by recycling the run-off water", *Water Science and Technology*, Vol. 49, No. 3, pp. 55-62.

[27] OECD (2003), *Agriculture, Trade and the Environment: The Pig Sector*, Paris, France.

[28] Woli, K.P., T. Nagumo, K. Kuramochi and R. Hatano (2004), "Evaluating river water quality through land use analysis and N budget approaches in livestock farming areas", *Science of the Total Environment*, Vol. 329, pp. 61-74.

[29] Yokoi, Y. (2005), "Evaluation of Agri-environmental Policies in Japan", in OECD, *Evaluating Agri-environmental Policies: Design, Practice and Results*, Paris, France, *www.oecd.org/tad/env*.

[30] Ministry of Environment website database (in Japanese) *www.env.go.jp/water/mizu.html*.

[31] Yamaoka, K. (2003), "The Relationship between Water Use in Paddy Fields and Positive Externalities: Japanese Perspective and Proposal", in OECD, *Agricultural Impacts on Water Use and Water Quality: Developing Indicators for Policy Analysis*, Paris, France, *www.oecd.org/tad/env/indicators*.

[32] The Japanese Institute of Irrigation and Drainage (2003), *A message from Japan and Asia to the World Water Discussions: Mutually Recognizing Diversity of Irrigation in Arid and Humid Regions*, a paper prepared for the 3rd World Water Forum, Tokyo, Japan.

[33] Nishimura, K. (2004), *Role of Land Improvement Districts*, International Network on Participatory Irrigation Management, Washington DC, United States, *www.inpim.org/leftlinks/FAQ/Documents/lidrole*.

[34] Murano. K. and O. Oishi (2000), "Emission, Concentration Variation, and Dry and Wet Deposition of Reduced Nitrogen Compounds (NH_x) in Japan", *Global Environmental Research*, Vol. 4 (1), pp. 13-23.

[35] Kamigawara, K. (2003), *Odor Regulation and Odor Measurement in Japan*, Japanese Ministry of Environment, Tokyo, Japan, *http://www.env.go.jp/en/lar/odor_measure/*.

[36] United Nations Environment Programme (2005), *Japan National Management Strategy for Phase-out of Critical Uses of Methyl Bromide*, presented by the Japanese Ministry of Agriculture, Forestry and Fisheries, Tokyo, Japan to the UNEP Ozone Secretariat, *http://hq.unep.org/ozone/Information_for_the_Parties/Decisions/Dec_ExI_4-3/japan.pdf*.

[37] The Government of Japan (2006), *Japan's Fourth National Communication: Under the United Nations Framework Convention on Climate Change*, Tokyo, Japan, *http://unfccc.int/national_reports/annex_i_natcom/submitted_natcom/items/3625.php*.

[38] Yamamoto, A. (2003), "Prevention of Landslide Disasters by Farming Activities in Monsoon Asia", in OECD, *Agriculture and Land Conservation: Developing Indicators for Policy Analysis*, Paris, France, *www.oecd.org/tad/env/indicators*.

[39] BirdLife International (2003), "Japanese Wetlands", pp. 153-156 in *Saving Asia's Threatened Birds*, Cambridge, United Kingdom, *www.birdlife.net/action/science/species/asia_strategy/asia_strategy.html*.

[40] Sprague, D.S. (2003), "Monitoring Habitat Change in Japanese Agricultural Systems", in OECD, *Agriculture and Biodiversity: Developing Indicators for Policy Analysis*, Paris, France, *www.oecd.org/tad/env/indicators*.

[41] Fujioka, M. and H. Yoshida (2001), "The Potential and Problems of Agricultural Ecosystems for Birds in Japan", *Global Environmental Research*, Vol. 5, No. 2, pp. 151-161.

[42] Maeda, T. (2001), "Patterns of bird abundance and habitat use in rice fields of the Kanto Plain, central Japan", *Ecological Research*, Vol. 16, pp. 569-585.

[43] Takeuchi, K. (2001), "Nature conservation strategies for the 'Satoyama' and 'Satochi', habitats for secondary nature in Japan", *Global Environmental Research*, Vol. 5, No. 2, pp. 193-198.

[44] Maeda, T. (2005), "Bird use of rice field strips of varying width in the Kanto Plain of central Japan", *Agriculture, Ecosystems and Environment*, Vol. 105, pp. 347-351.

[45] Kurashige, Y. (2003), "Agricultural Land Management and Agricultural Landscape", in OECD, *Agriculture Impacts on Landscapes: Developing Indicators for Policy Analysis*, Paris, France, *www.oecd.org/tad/env/indicators*.

[46] OECD (2004), *Agricultural Commodities Outlook Database*, Paris, France, *www.oecd.org/tad*.

[47] Ministry of Agriculture, Forestry and Fisheries (2003), *Principles of the Environmental Policy in Agriculture, Forestry and Fisheries: Encouraging Transition to an Environmentally Conscious Agriculture, Forestry and Fisheries*, Tokyo, Japan (available in Japanese only, but summary available in English), *www.maff.go.jp/kankyo/kihonhousin/outline_e.pdf*.

[48] Ministry of Agriculture, Forestry and Fisheries (2006), *Biomass Nippon Strategy*, Tokyo, Japan, *www.maff.go.jp/j/biomass/pdf/h18_senryaku.pdf*.

[49] Goda, M. (2003), "Social and Economic Implications of Maintaining Paddy Fields in Japan", in OECD, *Agriculture and Land Conservation: Developing Indicators for Policy Analysis*, Paris, France, *www.oecd.org/tad/env/indicators*.

[50] Renault, D. and T. Facon (2004), *Beyond drops for crops: The System approach for water value assessment in rice-based production systems*, paper presented to the FAO Rice Conference, Rome, Italy, 12-13 February, *www.fao.org/rice2004/en/pdf/renault.pdf*.

[51] Ministry of Agriculture, Forestry and Fisheries (2005), *Basic Plan for Food, Agriculture and Rural Areas*, Tokyo, Japan (available in Japanese only), *www.maff.go.jp/keikaku/20050325/20050325honbun.pdf*

[52] Ministry of Agriculture, Forestry and Fisheries (2007), *Strategy for Preventing Global Warming*, Tokyo, Japan, *www.maff.go.jp/kankyo/ondanka/senryak.pdf*.

[53] Ministry of Agriculture, Forestry and Fisheries (2007), *Boosting the Production of Biofuel in Japan*, Tokyo, Japan, *www.maff.go.jp/j/biomass/b_energy/pdf/kakudai01.pdf*.

[54] Ministry of Agriculture, Forestry and Fisheries (2007), *Strategy for Biodiversity Conservation*, Tokyo, Japan, *www.maff.go.jp/kankyo/senryaku/pdf/honbun.pdf*.

[55] Yokoi, Y. (2003), "Organic Agriculture in Japan: Development of a Labelling Scheme and Production Policies", in OECD, *Organic Agriculture: Sustainability, Markets and Policies*, Paris, France, *www.oecd.org/tad/env*.