



Multi-disciplinary Review - Multiple Functions of Agriculture

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Multiple Functions of Agriculture in OECD

- OECD COMMITTEE FOR AGRICULTURE AT MINISTERIAL LEVEL, MARCH 1998
 - (10.) Beyond its primary function of supplying food and fiber, agricultural activity can also shape the landscape, provide environmental benefits such as land conservation, the sustainable management of renewable natural resources and the preservation of bio-diversity, and contribute to the socio-economic viability of many rural areas.
 - The OECD began work on multifunctionality and a series of reports and working papers have been produced.
 - Multifunctionality: Towards an Analytical Framework (2001)
 - Multifunctionality: The Policy Implications (2003)
 - Farm Structure and Farm Characteristics – Links to Non-Commodity Outputs and Externalities (2004)
 - Multifunctionality in Agriculture: What Role for Private Initiatives? (2005)
 - Financing Agricultural Policies with Particular Reference to Public Good Provision and Multifunctionality: Which Level of Government? (2005)

- The key elements of multifunctionality are:
 - i) the existence of multiple commodity and non-commodity outputs that are jointly produced by agriculture;
 - ii) the fact that some of the non-commodity outputs exhibit the characteristics of externalities or public goods, with the result that markets for these goods do not exist or function poorly.
- Three questions are:
 - • Is there a strong degree of jointness between commodity and non-commodity outputs that can not be altered, for example, by changes in farming practices and technologies or by pursuing lower cost non-agricultural provision of non-commodity outputs?
 - • If so, is there some market failure associated with the non-commodity outputs?
 - • If so, have non-governmental options (such as market creation or voluntary provision) been explored as the most efficient strategy?

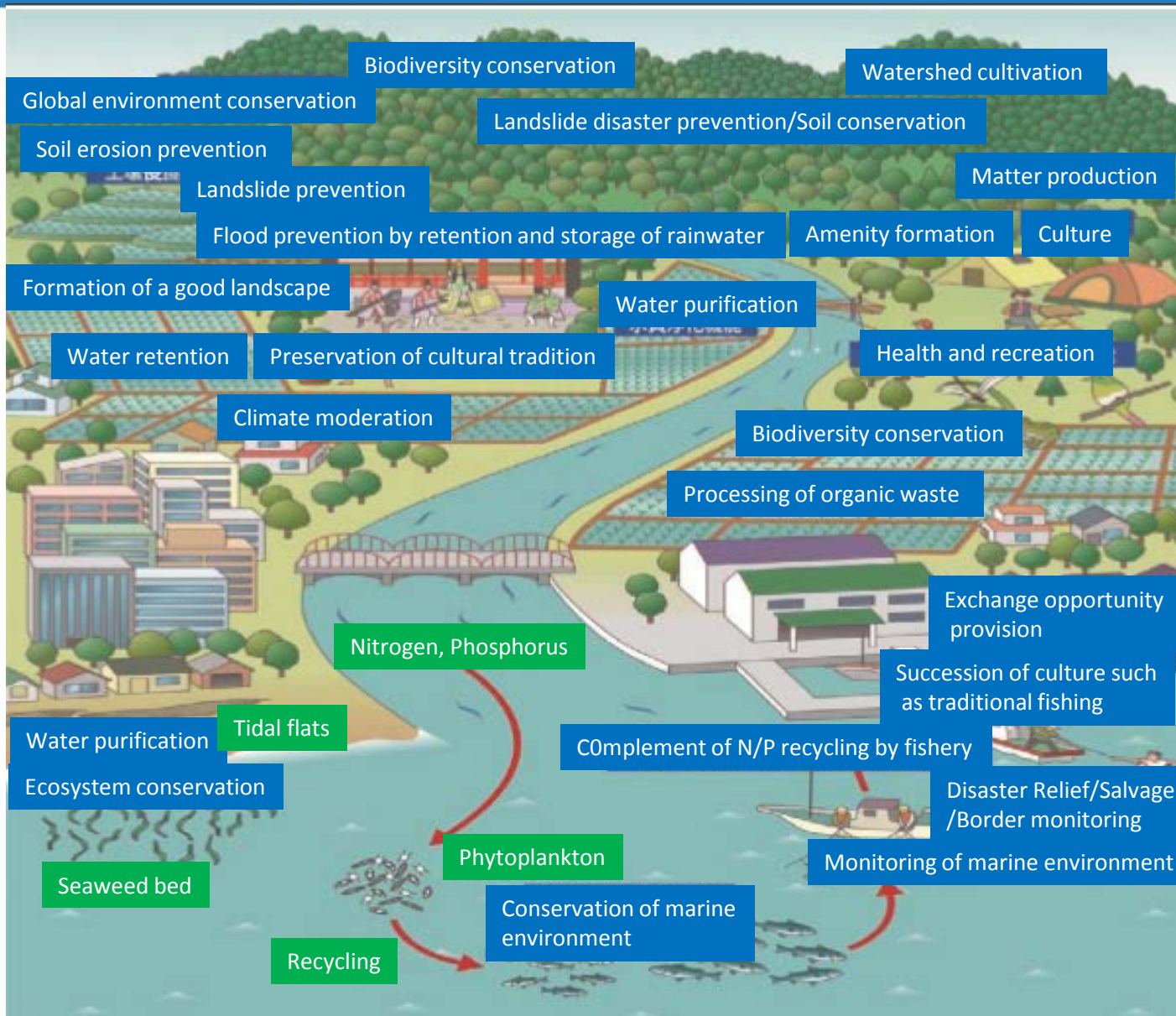
Multifunctional Roles of Agriculture in Japan

- Basic Law on Food, Agriculture and Rural Areas (1999)
(Fulfillment of **Multifunctional Roles**)

Article 3: In consideration of the importance of maintaining the stability of the people's lives and the national economy, the multiple roles that agriculture plays through stable production in rural areas, from the **conservation of national land, water resources, and the natural environment to the formation of a good landscape and maintenance of cultural tradition**, in addition to its conventional role as a primary food supplier (hereinafter referred to as 'multifunctional roles'), shall be fulfilled sufficiently for the future.



Multiple Functions of Agriculture, Forestry and Fisheries



Source:
MAFF

Multifunctional roles of agriculture

Function	Explanation
Flood prevention by retention and storage of rainwater	Paddy fields surrounded by furrows and water absorbent soil in dry fields are capable of temporarily storing water, which in turn prevents floods.
Landslide prevention	Production activities in rice terrace farming prevent landslides and slope collapse
Soil erosion prevention	Proper maintenance and management of paddy and dry fields prevents soil erosion
Watershed cultivation	Rainwater and agricultural water for paddy fields seep underground and in time returns to the river, and water that seeps further below cultivates underground watersheds
Processing of organic waste	Micro-organisms within paddy and dry fields such as bacteria decompose livestock waste and compost made from household waste. The decomposed material is eventually re-absorbed by crops.

Source: MAFF (2010)

Multifunctional roles of agriculture

Function	Explanation
Climate moderating effect	Crops growing on farmland absorb heat through transpiration and paddy fields absorb heat through water evaporation, resulting in lower climate temperatures.
Conservation of biodiversity	The linking of paddy fields to river through irrigation channels results in increased diversity of organisms compared to natural conditions.
Conservation of ecosystems	Proper and sustainable management of paddy and rice fields that facilitates harmonious coexistence with nature is capable of forming and maintaining secondary natural environments with ecosystems rich in plant, insect and animal life.
Preservation of cultural tradition	Japan features many annual events and festivals which trace their origins to prayers for rich harvests. Agriculture plays a role in transferring these traditions to future generations.
Formation of a good landscape	Agricultural activities combine farmland, old farmhouses, surrounding water sources and mountains to create attractive natural landscapes

Source: MAFF (2010)

Currency Evaluation of Multifunctionality of Agriculture in Japan

In November 2001, the Science Council of Japan reported for the regarding the evaluation of the multifunctionality of agriculture and forestry that was implemented by the MAFF. The report describes the actual contents and the mechanism of the multifunctionality of agriculture, and also describes the results of quantitative evaluation that was sampled based on the discussions such as the special committee of the Science Council of Japan.

Function	Assessment technique	Assessed value
Preventing floods	Alternation technique	3,498.8 billion yen/year
River flow stability	Alternation technique	1,463.3 billion yen/year
Underground water nourishment	Direct technique	53.7 billion yen/year
Preventing soil erosion (flow-out)	Alternation technique	331.8 billion yen/year
Preventing landslides	Direct technique	478.2 billion yen/year
Managing organic wastes	Alternation technique	12.3 billion yen/year
Climate modification	Direct technique	8.7 billion yen/year
Health recreation and serenity	Travel cost technique	2,375.8 billion yen/year

Source: Annual Report on Food, Agriculture and Rural Areas in Japan (2002, MAFF)

Shift from Multifunctionality to Ecosystem Service

FAO/Netherlands Conference on " *The Multifunctional Character of Agriculture and Land*" 12-17 September 1999



OECD Committee for Agriculture at Ministerial Level, March 1998
Multifunctionality: Towards an Analytical Framework (2001)
Multifunctionality: The Policy Implications (2003)



Millennium Ecosystem Assessment (MA) (2005)



The Economics of Ecosystems and Biodiversity (TEEB) (2010)
→ TEEB for Agriculture & Food: an interim report (2015)

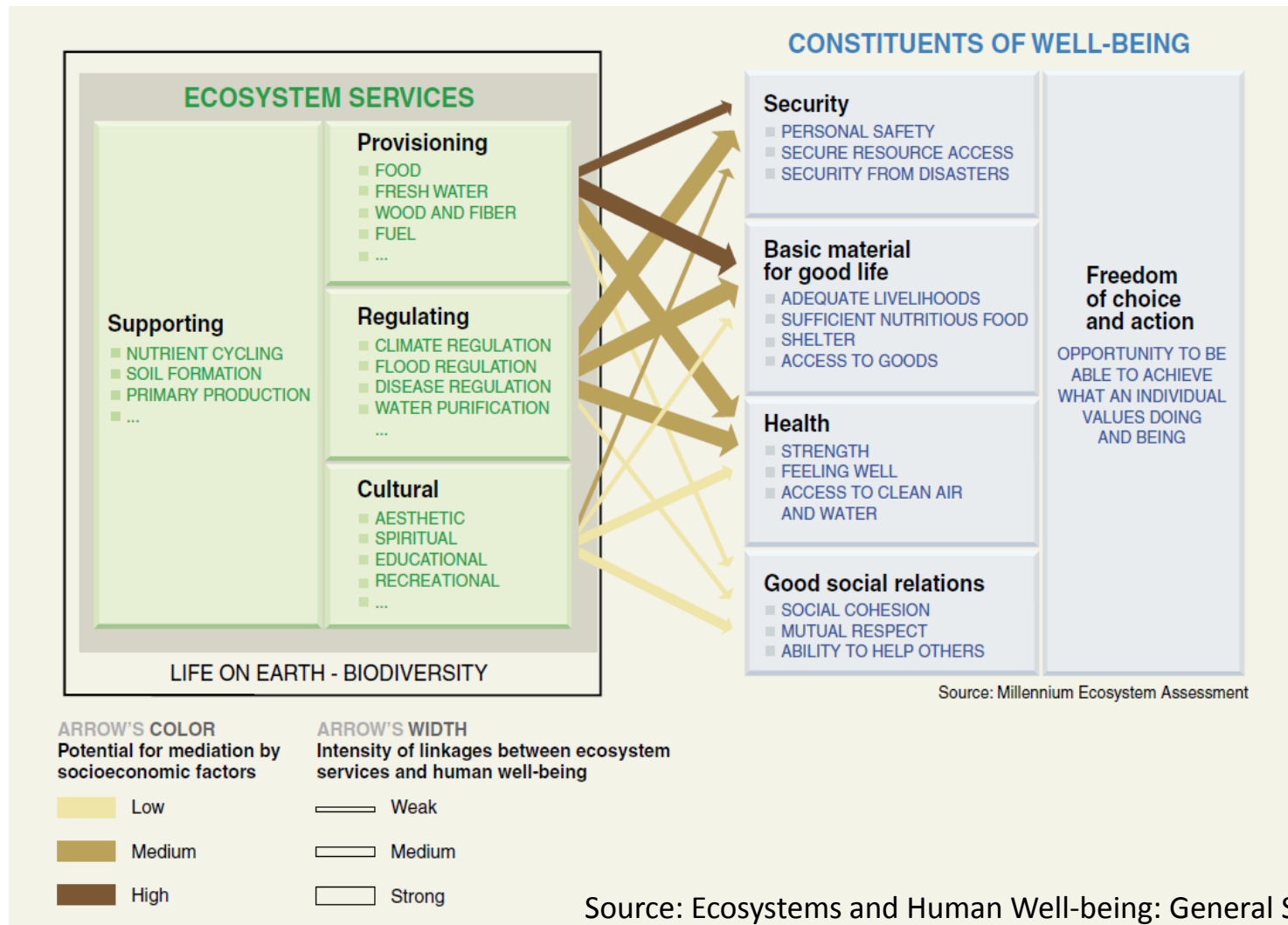


**The Common International Classification of Ecosystem Services (CICES)
Ver.4.3 (2013)**

Source: Daisuke Kunii(2016) Adjustment of Definition and Evaluation Methods of Multifunctionality of Agriculture and Ecosystem Services

Millennium Ecosystem Assessment (MA)

Linkages between Ecosystem Services and Human Well-being



The Economics of Ecosystems and Biodiversity (TEEB)

Table 3 Typology of ecosystem services in TEEB

	Main service types
	PROVISIONING SERVICES
1	Food (e.g. fish, game, fruit)
2	Water (e.g. for drinking, irrigation, cooling)
3	Raw Materials (e.g. fiber, timber, fuel wood, fodder, fertilizer)
4	Genetic resources (e.g. for crop-improvement and medicinal purposes)
5	Medicinal resources (e.g. biochemical products, models & test-organisms)
6	Ornamental resources (e.g. artisan work, decorative plants, pet animals, fashion)
	REGULATING SERVICES
7	Air quality regulation (e.g. capturing (fine)dust, chemicals, etc)
8	Climate regulation (incl. C-sequestration, influence of vegetation on rainfall, etc.)
9	Moderation of extreme events (eg. storm protection and flood prevention)
10	Regulation of water flows (e.g. natural drainage, irrigation and drought prevention)
11	Waste treatment (especially water purification)
12	Erosion prevention
13	Maintenance of soil fertility (incl. soil formation)
14	Pollination
15	Biological control (e.g. seed dispersal, pest and disease control)
	HABITAT SERVICES
16	Maintenance of life cycles of migratory species (incl. nursery service)
17	Maintenance of genetic diversity (especially in gene pool protection)
	CULTURAL & AMENITY SERVICES
18	Aesthetic information
19	Opportunities for recreation & tourism
20	Inspiration for culture, art and design
21	Spiritual experience
22	Information for cognitive development

Source: based on/adapted (mainly) from Costanza et al. (1997), De Groot et al. (2002), MA (2005a), Daily, Ehrlich, Mooney, et al. (2008). See Appendix 2 for details.

The Common International Classification of Ecosystem Services (CICES)

- CICES categorizes ecosystem service as provisioning, regulation & maintenance and cultural.
- CICES categorizes ecosystem service hierarchically into section, division, group and class, focusing on the final ecosystem service which man enjoys, based on the System of National Accounts valuation of benefits derived from ecosystem services

Table 1: CICES V4.3 at the 'three digit level'

Section	Division	Group	
Provisioning	Nutrition	Biomass	
		Water	
	Materials	Biomass, Fibre	
		Water	
	Energy	Biomass-based energy sources	
		Mechanical energy	
Regulation & Maintenance	Mediation of waste, toxics and other nuisances	Mediation by biota	
		Mediation by ecosystems	
	Mediation of flows	Mass flows	
		Liquid flows	
		Gaseous / air flows	
	Maintenance of physical, chemical, biological conditions	Lifecycle maintenance, habitat and gene pool protection	
		Pest and disease control	
		Soil formation and composition	
		Water conditions	
		Atmospheric composition and climate regulation	
	Cultural	Physical and intellectual interactions with ecosystems and land-/seascapes [environmental settings]	Physical and experiential interactions
			Intellectual and representational interactions
Spiritual, symbolic and other interactions with ecosystems and land-/seascapes [environmental settings]		Spiritual and/or emblematic	
		Other cultural outputs	

Multiple Functions of Forestry

Multi-functions of Forests is evaluated by Science Council of Japan in 2001. Evaluated currency value of multi-functions of forest is 70 trillion yen in annual, which amount is only assessable value of multi-functions.

- ❑ Biodiversity conservation
 - Genetic, species and ecosystem conservation
- ❑ Conservation of global environment
 - Mitigation of global warming, stabilization of global climate
- ❑ Prevention of natural disasters and soil conservation
 - Prevention of soil erosion, soil collapse and other soil disasters, avalanche, wind, snow
- ❑ Watershed conservation
 - Mitigation of flood, water resource conservation, water quantity control, water purification
- ❑ Amenity creation
 - Climate change mitigation, air purification, creation of comfortable environment
- ❑ Health and recreation
 - Medical treatment, rest, recreation
- ❑ Culture
 - Landscape, education, art, religion & ritual, traditional culture, conservation of local diversity
- ❑ Material production
 - Wood, food, industrial material, craft material



Multiple Functions of Fishing Industry and Fishing Communities

- ❑ Fishing ports are essential for fisheries as bases for landing catches, mooring fishing vessels, supplying fuel, food, etc., and repairing fishing vessels.
- ❑ The fishing industry and fishing communities demonstrate multiple functions including
 - conserving the natural environment,
 - ensuring security of the lives and properties of citizens through search and rescue, border patrol, etc.,
 - providing places for residence and for interaction between locals and city residents,
 - forming and maintaining local societies.
- ❑ As for their assessment value, even quantitatively assessed functions alone can be estimated at a total of 9.2052 trillion yen per year.

