Distribution of Burdens for Providing Agri-environmental Public Goods and Application of Reference Level Framework

Tetsuya UETAKE

OECD Trade and Agricultural Directorate, France
tetsuya.uetake@oecd.org

Selected Paper prepared for presentation at the 140th EAAE Seminar,
"Theories and Empirical Applications on Policy and Governance of Agri-food Value Chains,"
Perugia, Italy, December 13-15, 2013

Copyright 2013 by Tetsuya UETAKE. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.

Distribution of Burdens for Providing Agri-environmental Public Goods and Application of Reference Level Framework

Tetsuya UETAKE[1]
OECD Trade and Agricultural Directorate, France
Email: tetsuya.uetake@oecd.org

Abstract

To secure the provision of agri-environmental public goods such as biodiversity, in many cases, government intervention is necessary. Government intervention means taxpayers cover parts of the costs for the provision. Thus, it is necessary to examine the distribution of burdens for the provision among stakeholders. Environmental reference levels are defined as the minimum level of environmental quality that farmers are obliged to provide at their own expense. By applying the reference level framework established by OECD to some cases in some countries (Australia, Japan, the Netherlands, the United Kingdom and the United States) this paper examines the distribution of burdens for providing agri-environmental public goods. This paper found several patterns of the reference levels. They should be clearly defined so as to clarify the extent to which farmers and other stakeholders should bear the costs.

Keywords: Public goods, reference levels, environmental targets, distribution of burdens, agriculture

1. Introduction

Agriculture is a provider of food, feed, fibre, fuel and, to a certain extent, public goods, which have both positive and negative impacts on natural assets such as biodiversity, water and soil quality. In order to secure the provision of agri-environmental public goods, some form of public intervention may be required (Cooper et al., 2009; OECD, 2010a). Indeed, various agri-environmental policies (e.g. regulation, payments) are implemented in many countries (Vojtech, 2010).

Government intervention means taxpayers cover parts of the costs for the provision of agri-environmental public goods. Thus, it is necessary to examine the distribution of burdens for the provision of agri-environmental public goods among stakeholders (farmers, consumers, taxpayers, etc). However, the discussion on this point has been limited.

Regarding this, the OECD developed a reference level framework, which decides a point up to which farmers are obliged to meet the environmental quality by their own costs (OECD, 2001). This framework of reference level is useful to consider to what extent government should intervene and to what extent farmers should bear the costs of providing agri-environmental public goods. However, there are few studies that examined how countries set reference levels and how costs associated with the provision of agri-environmental public goods are distributed among the people or organisations concerned.

This study applies the reference level framework to some cases in Australia, Japan, the Netherlands, the United Kingdom and the United States, and discuss how the framework work and help to stimulate the discussion on the distribution of burdens for providing agri-environmental public goods.

The structure of the paper is as follows: in Section 2, the paper presents the reference level framework. In Section 3, the paper applies the reference level framework to some cases in the studied countries. In

1 . Note the views expressed in this article are the author's personal ones and do not necessarily reflect those of the OECD or its member countries.

Section 4, the paper further elaborates the reference level framework and provides some new applications. Section 5 summarises the findings and discusses the costs sharing and the reference levels. Lastly, in Section 6, conclusion and policy implications are drawn.

2. Reference Level Framework

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 desired (voluntary) levels of environmental quality that go beyond the minimum requirements or minimum (mandatory) levels of environmental quality for the agricultural sector in a country (OECD, 2001, 2010a).

If agricultural activities provide agri-environmental public goods more than the reference level, this can be seen as providing benefits for which farmers or the landowners may need to be compensated. When agricultural activities push the level of environmental services below the reference level, then farmers are required to restore the reference level by their own costs (the Polluter-Pays-Principle) (OECD, 1997).

Figure 1 illustrates the relationship between environmental targets and reference levels by using four different cases (where X represents the level of environmental quality corresponding to environmental targets [X^T]; reference levels [X^R]; and current farming practices [X^C]). All cases (A to D) represent an identical environmental outcome and allocation of farm resources as the environmental target, X^T, is the same. What differs among these cases is the distribution of costs associated with achieving the defined environmental target (i.e. who pays or who is charged) (OECD, 2001, 2010a).

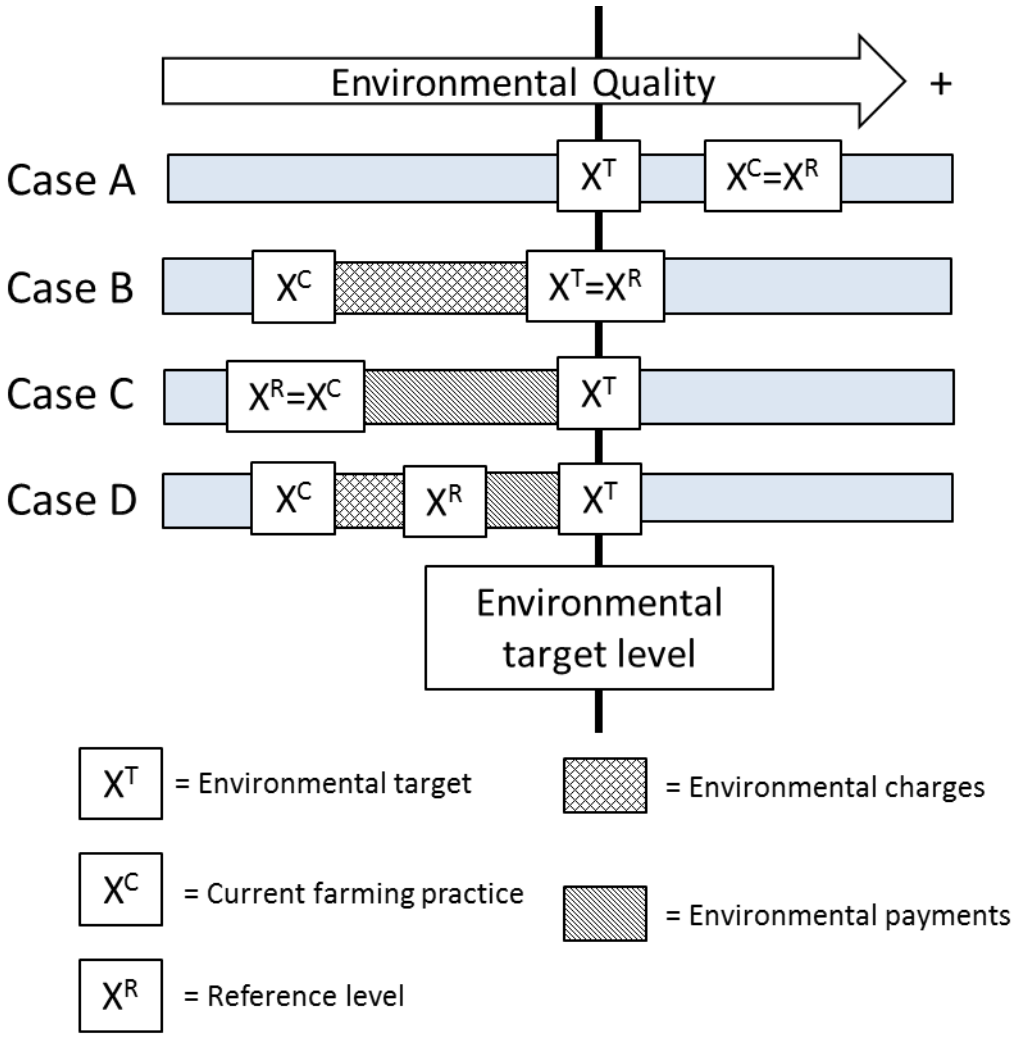
- ***Case A*** represents a situation where current farming practices provide a level of environmental quality corresponding to a reference level (X^C=X^R) above the environmental target (X^T). Thus, farmers are already using the farming practices required for achieving the socially desired environmental outcome. With X^T and X^R achieved at zero opportunity costs, *no policy action* is needed. In such a case, the reference level X^T would normally be achieved through current farming practices X^C ("good farming practices") with costs borne by farmers, and partly by consumers who buy agricultural products.

- ***Case B*** represents a situation where current farming practices (X^C) provide environmental performance below the reference level defined at the level of the environmental target (X^T=X^R). In this case, farmers are emitting pollution (X^C<X^R), and they need to adopt farming practices required to achieve the desired environmental target level (X^T) *at their own expense* (the Polluter-Pays-Principle). If not, the government may charge a tax or penalty to induce compliance.

- ***Case C*** represents a situation where current farming practices achieve environmental performance corresponding to the chosen reference level (X^C=X^R) that is below the target level (X^T). In this case, farmers *may need to be compensated* for changing from current farming practices (X^C) to practices required to achieve the environmental target (X^T).

- ***Case D*** represents a situation similar to Case C, where current farming practices (X^C) provide environmental performance below the environmental target level (X^T), but with the reference level above the environmental performance level of current farming practices (X^C) and below the environmental target (X^T). For improving their environmental performance, farmers need to adopt appropriate farming practices *at their own expense* up to the reference level (X^R) – if not, the government may charge a tax or penalty. Requirements for farmers to further improve their environmental performance beyond X^R to reach the environmental target X^T may need to be remunerated.

Figure 1. Environmental targets and reference levels



Source: Adapted from OECD (2001).

It is known that the definitions of reference levels and environmental targets vary between countries (OECD, 2010a); however, there have been few studies which examine how reference levels and environmental targets are defined in each country.

3. Application of Reference Level Framework

Following the framework of the Figure 1, this study applies the reference levels to some cases in the studied countries. Case A (good farming practices) does not need government intervention, thus, the study focuses on the remaining three cases. There are several examples in the studied OECD countries that belong to Case B (Environmental charges), Case C (Environmental payments) and Case D (Environmental charges and payments).

Case B is where the Polluter-Pays-Principle applies. In this case, to improve the environmental quality, farmers have to bear costs up to a reference level, and the reference level is defined at the level of the environmental target ($X^T=X^R$). There are many regulations which require farmers to bear costs to reduce

negative impacts on the environment (e.g. pesticide control, water quality control). However, among cases examined in this study, there are few cases where the reference level is defined at the level of the environmental target ($X^T=X^R$). An example is about air quality control related to nuisance odours and disposal of effluent in Australia. This is managed largely through planning restrictions by locating intensive animal industries away from human population centres on a state-by-state basis. In this case, livestock farmers have to achieve the environmental targets at their own expense. In most cases, beyond the reference level, environmental targets are set ($X^T>X^R$), and to achieve the environmental targets, other policy measures (e.g. environmental payments) are implemented together with environmental charges.

Case C is where farmers are remunerated for their provision of agri-environmental public goods. This study identifies that most cases of carbon storage apply to this case (e.g. Japan, the Netherlands and the United Kingdom). As carbon storage is a relatively new issue, based on current farming practices ($X^C=X^R$), governments are seeking the way to improve the capacity of carbon storage by promoting the adaption of specific farming practices through environmental payments ($X^T>X^R$).

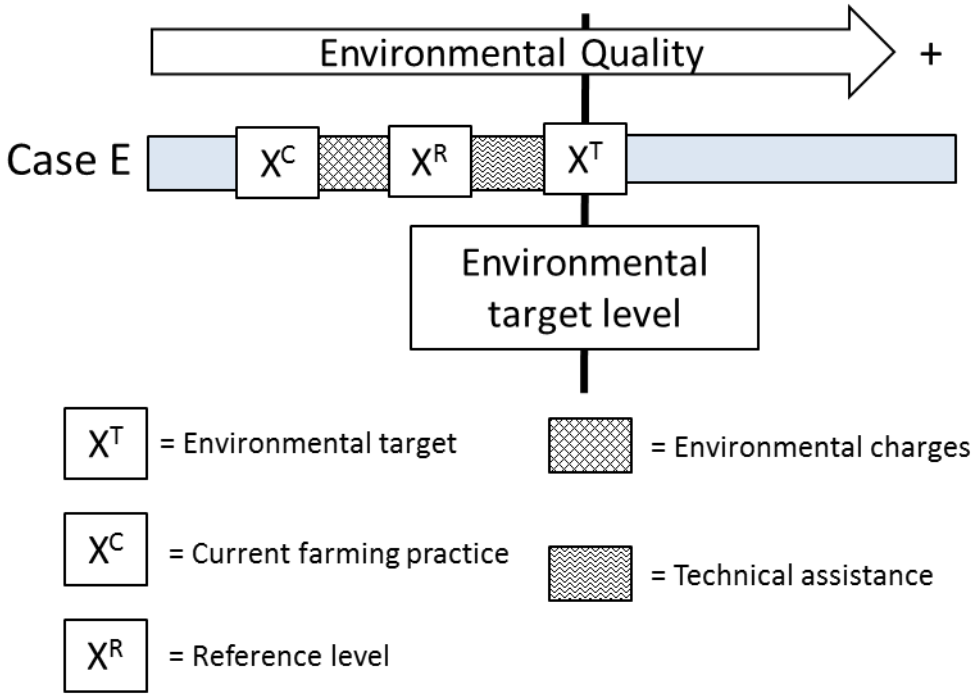
Some cases of agri-environmental public goods apply to Case D (Environmental charges and payments). Endangered species in the United States is regulated by federal and state laws. Although the United States provide significant protections to private property, evolving law and policy have diminished property right allowing land use activities harmful to endangered species. Landowners have to bear the private opportunity costs of the forgone land uses or of activities to mitigate impacts, which define reference levels for wildlife. In addition, to further expand and protect habitat for endangered species, the United States provides financial assistance (e.g. Environmental Quality Incentives Program (EQIP), Conservation Reserve Program (CRP) and the recently implemented Conservation Stewardship Program (CSP)) to achieve environmental targets.

4. Elaboration of Reference Level Framework

Reference levels and technical assistance

In addition to the above four cases identified by the OECD study (OECD, 2001), this study identifies the ***Case E*** (Environmental charges and technical assistance) where technical assistance through extension services are used instead of agri-environmental payments. There are several cases where technical assistance is mainly used to achieve environmental targets. What is the relationship between technical assistance and reference levels? Figure 2 is a simple model that explains this point. It represents a situation similar to Case D of the Figure 1, where current farming practices (X^C) provide environmental performance below the environmental target level (X^T), but with the reference level above the environmental performance level of current farming practices (X^C) and below the environmental target (X^T). For improving their environmental performance, farmers need to adopt appropriate farming practices *at their own expense* up to the reference level (X^R) – if not, the government may charge a tax or penalty. This is same for the Case D. However, instead of environmental payments, technical assistance is used to further improve environmental performance of farmers beyond the reference level (X^R) to reach the environmental target (X^T). Pannell (2008) argues that technical assistance and extension is useful when there are private benefits to farmers as well as public benefits. According to him, even if governments persuade farmers to adopt environmentally friendly farming practices, farmers may not do so if these practices require farmers to bear additional costs.

Figure 2. Environmental charges, technical assistance and reference levels



For instance, water quality on point source pollution associated with agriculture in Japan is the Case E. To meet the reference levels set by the Water Pollution Control Law, livestock farmers are obliged to meet the requirements to prevent water pollution bearing the costs. However, environmental targets on water quality are set beyond this reference level by the Environmental Standards based on the Basic Environment Law. The Environmental Standards are the ideal level for protecting human health and preserving the environment in Japan, and they are administrative goals. Currently, to achieve the goals on water quality, technical assistance and extension services are mainly adopted to promote voluntary activities of farmers to enhance water quality[2].

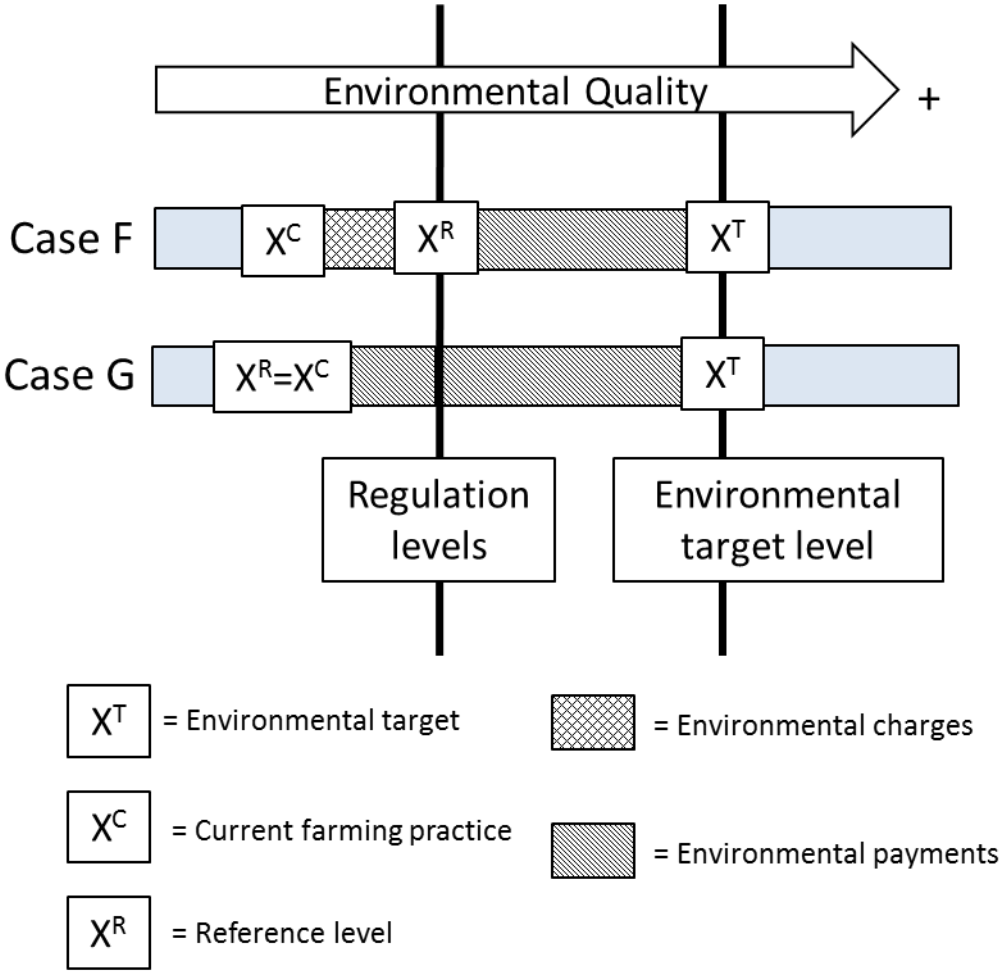
Reference level and regulations

Farmers are often required to achieve reference levels by meeting regulations. Typically, regulation levels and reference levels are equal and farmers adopt necessary treatment to mitigate negative impacts on the environment (***Case F*** of Figure 3). However, reference levels are not always equal to regulation levels. In some cases, regulation levels are set beyond current farming practices to improve the environment, and to help farmers meet these new regulation levels, governments provide some transitional support including payments. For instance, in Japan, the Netherland, and the United Kingdom, to mitigate environmental problems associated with livestock and improve water, soil and air quality, farmers are required to install suitable facilities to store livestock manure and slurry. Relevant governments provide technical advice and assistance, and in some cases provide financial assistance, to help farmers meet the enhanced standards. In this case, regulation levels are set beyond the reference levels so that costs for meeting regulation levels are

2. There are a few environmental payment programmes which partly address water quality improvement, such as Act on the Appropriate Treatment and Promotion of Utilization of Livestock Manure. But the main objective of this programme is to address livestock environmental problems such as odours and contribute to better soil quality through the utilization of livestock manure.

borne by society (***Case G*** of Figure 3). However, it must be noted that these government support should be transitory and the reference level should be increased up to the regulation levels gradually.

Figure 3. Reference levels and regulation levels



Reference level and beneficiaries

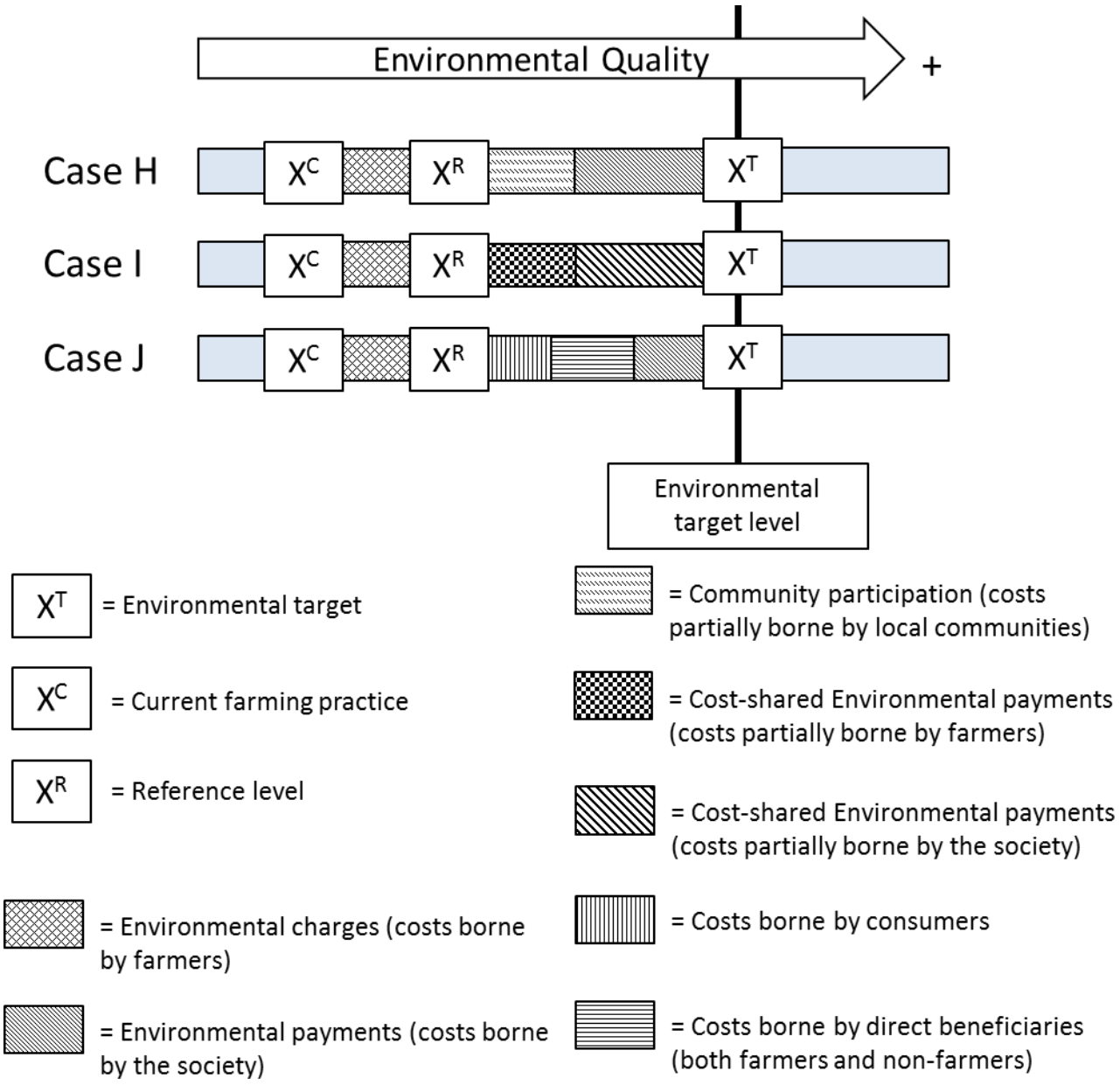
The level of reference levels and distribution of costs associated with agri-environmental public goods are not just decided by farmers and governments, but indirectly also by beneficiaries of agri-environmental public goods such as local communities. The provision of agri-environmental public goods benefits or imposes costs on particular individuals in many cases (OECD, 1992). Especially when they occur at a local scale, it is easy to identify beneficiaries. In this case, they should also bear some of the costs of the provision of agri-environmental public goods (the Beneficiary-Pays-Principle) (OECD, 1996). Some community-based approaches for managing and providing agri-environmental public goods (e.g. the Caring For Our Country in Australia, Measures to Conserve and Improve Land, Water, and the Environment in Japan) can be seen as an example of this case since not just farmers but also non-farmers participate in collective action and provide assistance for providing agri-environmental public goods, i.e. sharing some of the costs of the supply (OECD, 2013b). ***Case H*** of Figure 4 shows this case. Beyond the reference level (X^R), some costs are borne by communities.

Some agri-environmental public goods actually bring benefits to farmers as well. For instance, better soil quality brings both private benefits to farmers (e.g. higher productivity) and public benefits to society (e.g. prevention of soil erosion, carbon storage and biodiversity). In these cases, beyond the minimum level of environmental quality that farmers are obliged to provide at their own expense (X^R), farmers should bear some additional costs for the provision of agri-environmental public goods. Governments sometimes use cost-shared environmental payments to ask farmers to bear additional costs (***Case I*** of Figure 4). Examples include the Environmental Quality Incentives Program (EQIP) in the United States. To what extent farmers share costs depend on benefits enjoyed by farmers.

So far, this paper has not discussed costs borne by consumers. In many cases, consumers bear some of the costs for the provision of agri-environmental public goods through purchasing food. For instance, some labelling help consumers to understand how food is produced and some of them pay additional costs for purchasing food grown by environmentally friendly way (RISE, 2009). [3] Typically these agri-environmental public goods bring direct benefits to farmers and local communities. Thus, as shown in ***Case J*** of Figure 4, the actual amount of environmental payment that governments need to implement for achieving the environmental target level can be considerably smaller than those assumed in Case D of Figure 1. Depending on the distribution of benefits, the appropriate burden of costs varies so that identifying and measuring costs and benefits among different groups of people is significant (OECD, 1992).

3. Asking consumers to cover costs can be controversial in terms of equity. Higher price food can be regressive for socially disadvantaged groups such as the poor (RISE, 2009).

Figure 4. Reference levels, beneficiaries and cost burden sharing



5. Findings and Discussion

In order to understand who should bear costs to achieve environmental targets, it is necessary to decide reference levels and environmental targets. Reference levels define the benchmark between avoidance of negative effects and the provision of positive ones (OECD, 1997).

How reference levels are set?

In the studied countries, some reference levels are clearly defined, but others are tacit. For instance, there are both specified environmental targets and reference levels for water quality and soil quality in Japan. For these public goods, reference levels were set when pollution from various industries became problems

in 1960-70s. Not only farmers but also other business operators are obliged to meet requirements to prevent pollution. Minimum regulations are generally set by acts based on scientific evidence (e.g. water quality).

On the other hand, some agri-environmental public goods such as carbon storage have no clearly set reference levels. This does not mean that there are no reference levels. It means that current farming practices are generally the reference levels (Case C of Figure 1).

Reference levels may also be set in terms of the driving forces including farming practices that affect the environmental outcomes or the environmental outcome (i.e. agri-environmental public goods) (OECD, 2010b). Table 1 summarises how reference levels are set in terms of the driving forces and environmental outcomes in the case of the Netherlands. As shown in the table, most reference levels are set in terms of driving forces such as farm inputs management (e.g. pesticides and fertiliser management).Reference levels that are set in terms of environmental outcomes were not found for some agri-environmental public goods such as air quality and resilience to natural disasters. This may be because controlling environmental outcomes by farmers is difficult for these agri-environmental public goods and asking them to bear costs for something that they cannot fully control is generally difficult to reach social consensus.

Table 1. Reference levels in terms of driving forces and environmental outcomes: A case of the Netherlands

Agri-environmental public goods	Reference levels	
	Driving forces (farm inputs, farm practices)	**Environmental outcomes (agri-environmental public goods)**
Soil protection and quality	• Soil management practices, restriction on applying farm inputs, stubble management, green manure crops, under grazing control, sewage sludge control and regulation on nitrate vulnerable zones	-
Water quality	• Soil management practices, restriction on applying farm inputs, establishment of no spread zones and regulation on nitrate vulnerable zones	• Nitrogen runoff control
Water quantity/availability	• Water licencing	• Water table and abstraction control
Air quality	• Soil management practices, burning control, sewage sludge control and regulation on nitrate vulnerable zones • Pollution prevention and control for intensive industrial agricultural units (mainly pigs and poultry)	-
Climate change – greenhouse gas emissions[1]	-	-
Climate change – carbon storage[1]	-	-
Biodiversity	• Habitats/special area protection • Grazing and burning control • Environmental impact assessments	• Wild birds protection
Agricultural landscapes	• Conservation of hedges, rows of trees and other landscape features	-
Resilience to natural disasters	• Managing dykes and irrigations	-

Note: For climate change (greenhouse gas emissions and carbon storage), current farming practices are equal to reference levels.

Regarding the administrative procedure for deciding reference levels, for example, in the Netherlands and the United Kingdom, the environmental targets and reference levels are set by the government and/or relevant authorities, and informed by international and EC commitments and policies, based on scientific evidence, expert analysis and public consultation. For many agri-environment public goods, this process takes place in the context of the development of the Rural Development Programmes (RDPs) for the countries of the Common Agricultural Policies (CAP). In Japan, councils composed of experts are usually held and after sharing their draft targets to the public, their comments are taken into consideration and

reference levels are decided. Especially when setting minimum standards which farmers are obliged to meet, experts discuss based on scientific evidence. Although overall frameworks tend to be set by Japanese laws that have to pass the Diet, concrete targets are often set in administrative documents.

Reference level and property rights

Property rights play significant roles for deciding reference levels. When property rights in land have priority over societal claims for certain agri-environmental public goods (e.g. soil and water quality, biodiversity), the pursuit of environmental objectives may infringe on such rights and may require compensation (OECD, 2010b). On the other hand, if the property right is assigned to consumers or the society, farmers have to compensate them for losses associated with their agricultural activities (not only pollution, but also poor quality and scarce quantity of the provision of agri-environmental public goods).

Reference levels may be legally defined by property rights, which entail obligations such as maintenance of the banks of a river, or preserving an historic building. Reference levels may be agreed tacitly as well (OECD, 1999).

It is often difficult to determine who holds the property right regarding agri-environmental public goods. While the property rights to land are often clearly established, ownership does not always mean that owners take responsibilities to the agri-environmental public goods related to the land. For example, the owner of land along a river is not entitled to do whatever he/she wishes with the water, because the community may have rights over the water quality and quantity in watercourses. In this case, the ownership of the land and the property right to the water quality and quantity do not belong to same entities (OECD, 1999).

Property rights can change over time because of different social objectives and priorities regarding agri-environmental issues, and different degrees of economic development and population density (Colby, 1995; OECD, 1999, 2001). The conditions under which farmers are rewarded or charged for their environmental performance evolve accordingly. The setting of property rights and reference levels involves issues of cultural tradition, equity and efficiency. As a result, it tends to be complex (OECD, 2001, 2010a).

In any case, defining the ways of taking into account the environmental impacts of agriculture (both positive and negative) and cost burden sharing among stakeholders requires a case-by-case response in relation to the settings of the environmental targets and definition of environmental reference levels based on the identification of existing property rights defining who can ask for remuneration and who is liable for charges (OECD, 2001, 2010a).

For instance, Australia has made extensive use of markets for the allocation of water amongst agricultural producers. Water trading allows scarce water resources to be transferred to their most efficient and productive uses. The result has been the generation of significant opportunities to achieve sustainable and efficient water use. The Australian experience is underpinned by a suite of institutional and property right reforms that have made it easier to set up viable water markets. State governments set legislations to make it clear that water is controlled by the State for the public. Farmers are required to have water rights for using water. Since water rights are held by other farmers, if a farmer wants to use more water, he/she needs to purchase the water right from others by his/her own costs. In this case, the reference level is set in terms of driving forces, i.e. water licensing. For successful water markets, generally, several factors are required, including a secure statutory basis for water entitlements; trading rules that reflect hydrological realities; systems for limiting and managing adverse third-party impacts; and robust trading platforms and accounting systems. Although there are many challenges in terms of technical, political, social, cultural

and managerial aspects, water markets are well established and are broadly supported by stakeholders and governments in Australia.

In Japan, *satoyama* landscapes (human-influenced natural environments) are considered to be of national importance. However, property rights of farmland are held entirely by farmers. They do not have obligation to maintain *satoyama* landscapes. Some farmlands have been converted to urban use, or some have been abandoned. As a result, some landscapes are being difficult to be maintained. Since farmers have property rights, in this case, reference levels are set at current farming practices. To preserve *satoyama* landscapes, some regions have introduced *tanada* (terraced paddy fields) ownership system. Beneficiaries of landscapes (citizens who care about the maintenance of the landscape) become "owners" of small parcels of *tanada*. Although actual property rights remain in hands of farmers, citizens pay annual fee to farmers who maintain *tanada* and help farmers keep *tanada* and *satoyama* landscapes. Farmers are remunerated since they do their efforts to conserve landscapes beyond the level that they are obliged to achieve by their own cost.

In the United States, historically, no property rights were set for discharges to water with the result that water was an open access good for pollution. Polluters did not need to bear costs for discharging waste water. As a result, serious degradation of water resources occurred. In 1972, to address this problem, the Unites States enacted the Clean Water Act (CWA) for water quality management. By introducing this CWA, the United States essentially nationalized access to surface waters for point sources of pollution. Since property rights are set for the water, polluters of point sources such as animal feeding operations are required to acquire discharge permits in order to have access to water for discharging waste water. To meet reference levels defined by property rights on the water, polluters of point sources have to bear costs. However, agricultural nonpoint pollution is largely exempted from regulations and most farmers are paid to reduce pollution.

Where to set reference level

As discussed, this study provides some cases of reference levels and they are useful to discuss who should bear the costs of providing agri-environmental public goods. However, reference levels and environmental targets are not clearly defined in many cases. More discussion on reference levels and environmental targets are necessary.

Environmental reference levels are set based on distribution (equity) considerations, historical and cultural backgrounds, historical social preferences, levels of economic development (developing countries may have lower reference levels than developed countries because of population, poverty and hunger), levels of pollution, international treaties and property rights (OECD, 2010a, 2010b).

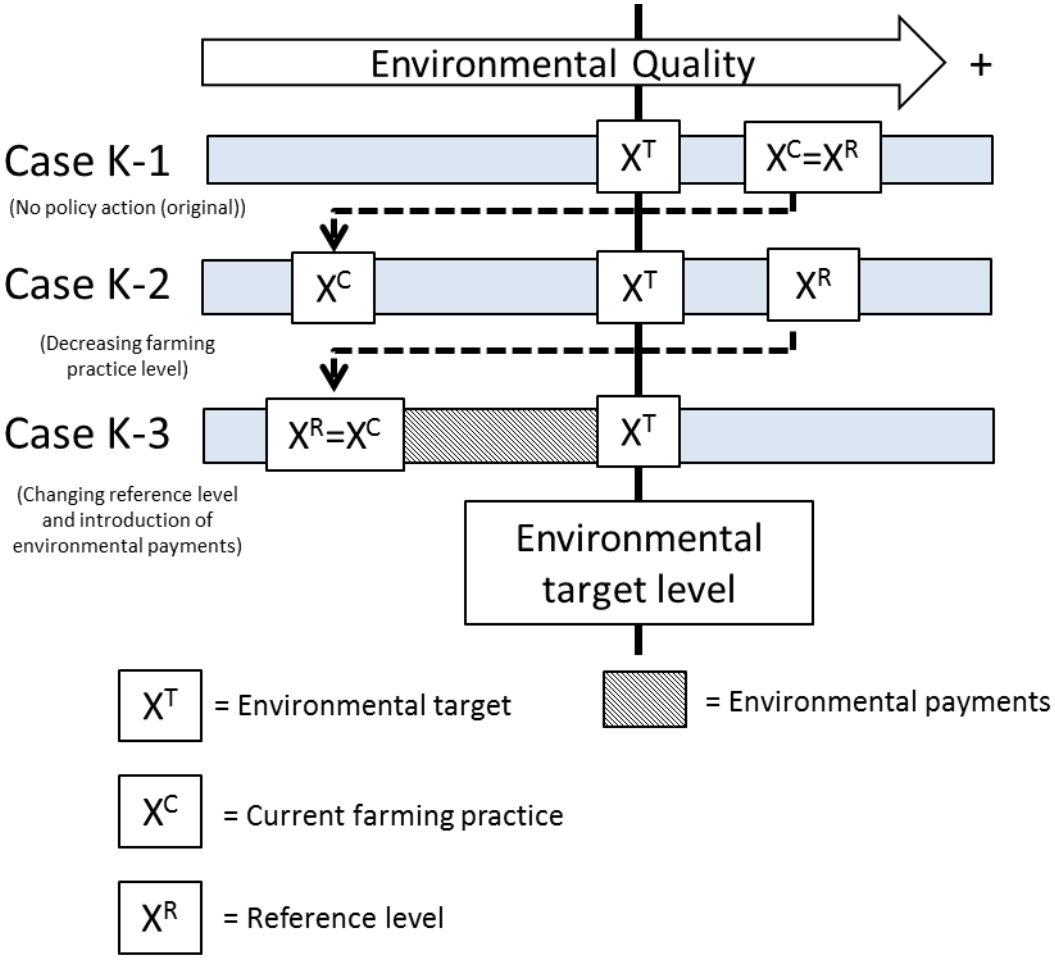
Depending on provided agri-environmental public goods, polluters, pollutes and beneficiaries differ. Identifying demanders and suppliers of agri-environmental public goods is a first step to discuss the distribution of burdens. Some principles such as the Polluter-Pays-Principles and the Beneficiary-Pays-Principles and other approaches such as cost-sharing and community participation can help to decide where to set reference levels and how to allocate burdends among different groups. Although economic and environmental aspects are important issues to be concerned, social aspects such as the equity of the distribution of economic costs and benefits between and among different groups (farmers, consumers and taxpayers) are significant points too (OECD, 2010a). Policy makers need to weigh up the trade-offs between equity, efficiency and other criteria in deciding reference levels.

Reference levels at various scales are another issue. In some cases, it could be better to define reference levels at regional or local scales, rather than at national scales. For instance, the Landscape Act in Japan promotes the development of landscape plans including the agricultural landscape by communities. Local

citizens and farmers decide their future plans for conserving landscape. They decide where to and how to conserve landscape through promoting environmentally friendly farming. Environmental targets and reference levels on agricultural landscape are set at local scales, not at national scales in Japan.

Reference levels can change over time as well. For instance, management of irrigation systems had been done at farmers by their own costs in Japan. At that time, the reference level and the level of current farming practices coincided and they were above the environmental target level ($X^R=X^C>X^T$) (***Case K-1*** of Figure 5). However, because of the decreased number of farmers and aging, the level of current farming practices decreased and it became difficult to manage the irrigation systems ($X^R>X^T>X^C$) (***Case K-2*** of Figure 5). Thus, to maintain irrigation systems and secure the provision of associated agri-environmental public goods such as water availability, flood prevention and biodiversity, Japan decided to provide payments to local communities composed of farmers and non-farmers that manage irrigation systems to achieve this environmental target. In this case, the reference level lowered ($X^T>X^R=X^C$) (***Case K-3*** of Figure 5). This could be explained from the demand side. Previously, the common perception of the irrigation systems was that they were mainly for farmers, and non-farmers or local communities did not appreciate their value, at least explicitly. However, as the importance of the environment associated with the irrigation systems started to be recognised more widely, society and local communities were asked to bear some of the costs for the maintenance as beneficiaries of the services. This example suggests that constantly reviewing reference levels is important to allocate appropriate burdens to stakeholders.

Figure 5. Changing reference levels: An example of Japanese irrigation system and associated agri-environmental public goods



Some countries try to enhance reference levels beyond the minimum standards or regulated constraints. For instance, Australia adopts the Duty of Care approach and Codes of Practices as voluntary approaches to ask farmers to take care of the environment and bear some of the costs for improving the environment. However, these approaches are totally voluntary without financial assistance, as a result, their current usage is limited, as is their effectiveness.

Environmental targets

Having clear environmental targets for each agri-environmental public good is also important, since they are goals which the society aims to achieve, and their levels are related with benefits and costs for the provision of agri-environmental public goods. Policy measures, if necessary, help farmers to provide agri-environmental public goods up to reaching these points. Each country set environmental targets for various agri-environmental goods and some of them are decided as a part of broader environmental issues. For instance, Japan set Environmental Standards based on Basic Environment Law, which decide the ideal goals of the policies. The Environmental Standards include all sectors, not only agricultural sectors. Currently, Environmental Standards that are related to agriculture are ones for air quality, water quality and soil quality. In EU countries, some strategies or directives (e.g. EU Biodiversity Strategy, EC Water Framework Directive) set overall environmental targets, not just for public goods associated with agriculture. Environmental targets, ideally, should try to improve the environment; however, keeping current situations could be also environmental targets since many agri-environmental situations keep worsening.

In principle, environmental targets should be output based or directly related to the status of agri-environmental public goods provided. However, environmental targets are not always clearly defined for many agri-environmental public goods. There are many cases where proxy indicators are used. For instance, Japanese National Biodiversity Strategy 2012-2020 (Japanese Government, 2012) set various targets about biodiversity including agricultural biodiversity in Japan. The strategy includes 50 quantitative indicators (both agri-environmental and non-agri-environmental indicators). Agri-environmental indicators include ones about farm inputs (e.g. the number of areas where Good Agricultural Practice is introduced, setting withhold standard for pesticide registration for all agricultural pesticides), farm systems and practices (e.g. the number of registered *eco-farmers*, the total number of participants in local collective action) and agricultural infrastructures (e.g. prevention of reducing farmland in hilly and mountainous areas, the percentage of people who have access to agricultural community effluent treatment systems). However, for some of these indicators, it is difficult to find the clear relationships with the outcome, i.e. the status of biodiversity. The Australian main agri-environmental programme, *Caring for Our Country*, set a number of specific targets, but some of them are targets for proxy indicators such as the number of farmers adopting management practices to improve soil quality and biodiversity, not directly targeting soil quality and biodiversity.

In addition, in some cases, there are no quantitative targets, and instead, qualitative targets are set. For example, maintaining agricultural landscape is an important agri-environmental public good in Japan, the Netherlands and the United Kingdom; however their targets are often quantitative targets such as keeping agricultural landscape in a certain area. This makes it difficult to evaluate policy measures.

Furthermore, targets of policy measures are often vague. Even if there are overall environmental targets (e.g. preserving biodiversity), it is not always clear to what extent a particular policy measure (e.g. payments for environmentally friendly farming practices) tries to address the targets, and to what extent other policy measures (e.g. technical assistance and extension) try to contribute to achieve the targets.

Moreover, in some cases, environmental targets are not set. For example, environmental targets on carbon storage are missing in Japan because of lack of appropriate data and knowledge. Environmental targets should be based on generally accepted criteria, such as SMART (Specific, Measurable, Attainable, Realistic and Timely) (OECD, 2010c) and the concept of SMART targets is adopted by some countries such as Australia. However, few environmental targets are SMART.

Environmental targets depend on society's preferences for environmental quality (OECD, 2010a). They are decided based on historical and cultural backgrounds, levels of economic development and international treaties, but compared to reference levels, political concerns and interests can be more directly reflected when targets are decided. The efficient setting of environmental targets has to balance the benefits of pursuing agri-environmental objectives against the resulting welfare losses due to lower production or consumption of other goods and services associated with agriculture (OECD, 2010a).

6. Conclusion and policy implications

This study has applied the reference level framework to some cases in the five OECD countries (Australia, Japan, the Netherlands, the United Kingdom and the United States), and illustrates how costs associated with the provision of agri-environmental public goods are distributed among different groups with some examples.

Environmental targets and reference levels are not clearly defined in many cases. Many voluntary measures set reference levels as current farming practices so that governments are required to pay farmers to adopt sustainable farming practices. However, more careful examination of appropriate setting of reference levels is necessary. For example, some farming practices can bring private benefits to farmers, in addition to off-farm benefits. In this case, it might be appropriate to ask farmers to bear costs of the supply beyond the reference levels.

In some cases, direct beneficiaries of agri-environmental public goods can be identified. In this case, asking these beneficiaries to bear some of the costs of provision can save the costs of government intervention as well as reduce farmers' burden. Community-based approaches or collective action help these people and organisations to be included in the discussion on distribution of burdens.

There must be more discussion on sharing the cost burdens that are associated with providing agri-environmental public goods. Before any government intervention, it is necessary to discuss the extent to which farmers should bear the costs and the extent to which taxpayers and consumers should bear the costs. Setting reference levels and environmental targets can stimulate the discussion and help policy makers to decide the distribution of the costs.

References

Colby, B. G. (1995), "Bargaining Over Agricultural Property Rights", *American Journal of Agricultural Economics*, Vol. 77, pp. 1186-1191.

Cooper, T., K. Hart and D. Baldock (2009), *The Provision of Public Goods through Agriculture in the European Union*, report prepared for DG Agriculture and Rural Development, Contract No 30-CE-023309/00-28, Institute for European Environmental Policy, London.

Japanese Government (2012), *National Biodiversity Strategy 2012-2020: Roadmap for Achieving Rich Nature-coexisting Society*, Japanese Government, Tokyo.

OECD (2013a), *OECD Compendium of Agri-environmental indicators*, OECD Publishing, Paris.

OECD (2013b), *Providing Agri-environmental Public Goods through Collective Action*, OECD Publishing, Paris.

OECD (2010a), *Guidelines for Cost-effective Agri-environmental Policy Measures*, OECD Publishing, Paris.

OECD (2010b), *Environmental Cross Compliance in Agriculture*, OECD Publishing, Paris.

OECD (2010c), *Evaluating Development Co-operation*, OECD Publishing, Paris.

OECD (2001), *Improving the Environmental Performance of Agriculture: Policy Options and Market Approaches*, OECD Publishing, Paris.

OECD (1999), *Cultivating Rural Amenities: An Economic Development Perspective*, OECD Publishing, Paris.

OECD (1997), *Environmental Benefits from Agriculture: Issues and Policies*, OECD Publishing, Paris.

OECD (1996), *Amenities for Rural Development: Policy Examples*, OECD Publishing, Paris.

OECD (1992), *Agricultural Policy Reform and Public Goods*, OECD Publishing, Paris.

Pannell, D. J. (2008), "Public Benefits, Private Benefits, and Policy Intervention for Land-use Change for Environmental Benefits", *Land Economics*, Vol. 84, No.2, pp. 225-240.

RISE (2009), *RISE Task Force on Public Goods from Private Land*, Directed by Buckwell, A., RISE (Rural Investment Support Europe).

Vojtech, V. (2010), *Policy Measures Addressing Agri-environmental Issues*, OECD Food, Agriculture and Fisheries Working Papers, No. 24, OECD Publishing, Paris.