

Farmland Conversion

The spatial dimension of agricultural
and land-use policies



Foreword

This report was prepared by Professor David Freshwater, of the Department of Agricultural Economics and the Martin School of Public Policy, University of Kentucky, for discussion in the Joint Working Party of the Committee for Agriculture and the Environment Committee.

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Executive Summary

Agricultural policies in OECD countries are in the process of evolution and there has been a shift away from production-linked support, towards various types of payments, which are frequently linked to land-use. In many OECD member countries, this shift in agricultural policies is intended – to an increasing extent – to be a vehicle for contributing to the economic and social revitalisation of rural areas – and not solely a means of maintaining farm incomes. Nevertheless, the sector-specificity of these policies – and their economic cost – have raised questions about their effectiveness in addressing non-agricultural objectives, including rural development.

Agricultural land has declined, on average, by 4% in the OECD area over the last two decades and this decline is projected to continue. But it still remains the main user of rural land across OECD countries, and accounted, on average, for more than 85% of rural land in the OECD area in 2005. Despite its predominance, the loss of farmland can adversely affect the rural economy of some regions in OECD countries.

Today, in particular, there is concern expressed in some countries that farmland loss could be associated with reduction in the potential supply of food. However, the most significant concern about farmland loss, to a varying extent across OECD countries, is driven by the potential effects on farmland-based rural amenities. This is reflected in the adoption of an array of farmland protection programmes designed to provide rural amenities in several OECD countries.

Land is an input to the production of a wide range of private goods, including – but not of course limited to – agricultural commodity production. Private decisions about the use of land, however, often give rise to external costs, such as restrictions on access to land and deterioration of wildlife habitat, and to external benefits, such as visual landscape, the provision of opportunities for recreation and countryside activities.

Changes in agricultural, agri-environmental, land-use and regional policies and many non-policy factors – such as climate change, demographic change and globalisation – increasingly affect land-use and management choices. The environmental implications of changes in agricultural land-use are complex, because they can impact on other agricultural land-uses; alter the mix of arable crops, permanent crops and pasture; or change property-rights related to land (and water).

From the rural development perspective, policy concerns with changes in the use of farmland are five-fold: i) adverse environmental impacts on landscape provision, wildlife habitat and the preservation of ecosystems, stemming from the abandonment of farmland in some rural areas of high nature-value; ii) knock-on economic effects of the abandonment or long-term retirement of farmland influencing the socio-economic viability of such rural areas; iii) risks to the provision of farmland-based rural amenities, particularly in those rural areas where such amenities are instrumental for their sustainable development; iv) concern with the alternative uses of farmland and water in the encouragement of environmentally sustainable rural development and alternative sources of income and employment in rural areas; and v) urban sprawl in cases where farmland is lost to urban uses. One role of policies is to narrow the divergence between privately and socially desirable outcomes.

The aim of this report is to analyse the effects of diverse policies on farmland conversion. The approach adopted is a combination of economic analysis and empirical case studies material. A central hypothesis of the report is that agriculture is essentially a spatially specific activity, as both the returns from agriculture and the opportunity costs of keeping land in agriculture vary across space.

In order to analyse these differences and to analyse how agricultural and land-use policies influence changes in farmland-use, a generic typology of three agricultural land categories is developed, with the extent of each varying between countries:

- The urban fringe, or peri-urban zone, found at the edge of a town or city, where urban activity has a strong influence on land-uses and on the nature of farming: farmland conversion to urban uses is largely irreversible in this zone.
- The agricultural core zone: this zone comprises the majority of agricultural land in most OECD countries. Returns from farming are high enough to keep the land in agriculture and there is little pressure for urbanisation. Land may be idled by farm operators, but typically it is not sold and can be returned to farming should economic conditions warrant this. The management of agricultural land may also be altered either by changing the allocation of land to the production of different crops or to be used more intensively for the production of a given commodity.
- The far, or extensive, margin zone: agriculture is a marginally profitable activity, due to a combination of remoteness and low productivity, and declines in the returns from farming cause production to cease. Whereas the urban fringe faces pressure to convert farmland to higher-value uses, the issue at the far margin is whether agriculture can be sustained. If this is not the case, then land will revert to a less intensively managed use, such as forests or native ground cover for hunting and recreational activities. But, in contrast to the case of the urban fringe, farmland can be brought back to farming, should returns from farming warrant this, except if permanent vegetation has begun to grow, as reconversion can become too expensive.

While the categorisation of three spatial zones in the paper is a gross simplification of the spatial distribution of agriculture across OECD countries, it is capable of showing how policy effects can vary with geography. The key observations emerging from the analysis can be summarised as follows:

- The production and value of many farmland-based environmental services is specific to particular farming practices in specific locations.
- The conversion of farmland is also spatially determined. It is largely an issue at the urban fringe and the extensive margin, where the economic returns from farming are inadequate to maintain land in agriculture. A potentially key aspect of the conversion of farmland to non-agricultural uses in these two margins is how the environmental amenities associated with farmland are valued.
- Given that the farmland in the agricultural core zone (which can represent the majority of farmland) is not at risk of conversion, across-the-board policies are inefficient against farmland conversion and specific policies need to be defined for the two margins. In the agricultural zone, agricultural policy influences the relative mix of products produced, the farming practices used and may alter the spatial location of specific products, but it does not really influence the amount of land in farms. However, these policies will be a critical factor in setting the spatial location of the boundary with the extensive margin.
- In the urban fringe, as the opportunity costs of farmland can be high, policy tools to prevent conversion to urban use, spatially non-targeted agricultural policy and those forms of land-use

policy that use payments, will be either inefficient or exceedingly expensive instruments. However, these policies can be used in a complementary way to ensure farming is profitable.

- In the extensive margin, while some forms of agricultural policy can be effective, traditional payments for commodity production may have limited effectiveness because the level of commodity production per farm is typically small. Land-use policy is largely impotent at the extensive margin because it acts mainly to impede changes to higher-value uses.
- At the extensive margin, the central issue is the value society places on maintaining a managed environment, which is location-specific. Habitat change can have important ecological consequences, but not all habitats are of equal importance. If farm policy continues to evolve in a way that includes increased support for farmland-based rural amenities, then there is an obvious mechanism for maintaining farmland. Whether similar ecological benefits could be maintained using another policy instrument at a lower cost, is, of course, a relevant question.

To summarise the analysis of how agricultural and land-use policies influence the conversion of farmland in the three spatial zones identified in the paper, Table 1 provides a stylised description summarising the relative effectiveness of various broad programme categories. As shown in the Table, certain categories of policy could be more or less effective in different spatial conditions. Starting with traditional commodity programmes, they have the largest influence on farms in the agricultural core zone, where farming is a dominant land-use and larger farms, especially those with high levels of output per unit of land, tend to benefit the most from commodity programmes.

Agri-environment programmes to address environmental problems (*e.g.* buffer strips, hedges, etc.), by contrast, tend to have the largest influence on farmland conversion in the urban fringe and the extensive margin. The rationale is that it is in these two zones where farmland faces significant opportunity costs. If agri-environment programmes increase the cost of production by forcing farmers to internalise externalities without compensation, a logical consequence is that farming becomes less viable. In the agricultural core zone, the lack of significant conversion pressure leads to the increase in costs not having a large effect on farmland conversion, although some marginal land may be shifted to an alternative use on the farm.

The spatial effect of rural development programmes (*e.g.* infrastructure, off-farm diversification), however, differs from the programmes described above. A major goal of rural development programmes is to expand economic opportunity in rural areas. In the peri-urban zone, the presence of an urban economy creates economic opportunity for rural residents. Indeed, a common concern in these regions is that growth and conversion of farmland are occurring at too rapid a pace. In contrast, in the agricultural core zone, the dominance of farming as a land-use implies a limited level of economic opportunity. While it is possible that rural development may provide diversification benefits in this area, these benefits are not linked to significant losses of farmland. In the far margin regions, if opportunities for rural development exist, these programmes can play a significant role in slowing farmland losses by augmenting farm family household income. A higher income stream may lead to more part-time farms, but it tends to preserve land in farms.

Programmes that target farmland-based environmental services can have various effects. In the urban fringe, the presence of high amenity benefits, if fully compensated, can slow farmland conversion. In the agricultural core zone, these programmes may be of limited importance due to the predominant role of commodity support programmes. In the extensive margin, high farmland-based environmental services may be associated with strong potential future demand for the consumption of environmental goods and services provided by agriculture (option value) if unique species habitat is involved. Moreover, in cases where high levels of tourism are possible, there may also be a strong direct demand for environmental services from agriculture.

Turning to various land-use policies, it is clear from country experience that the regulatory power of the state can obstruct farmland conversion. This is most evident in the urban fringe, where pressure for conversion is strongest. But it is important to recognise that regulations do not remove the pressure for conversion – they only impede it. Since there are strong economic incentives for farmland conversion, there are also strong pressures to find ways to bend the intent of restrictions on conversion. The presence of horse farms in the urban fringe is a common example of ex-urban residential development fitting in the technical definition of maintaining farming. In the other two zones, regulation is less effective, because there is either less pressure for conversion, or because the low levels of return from farming make it unviable.

Table 1. Summary of the potential ability of policy to influence farmland conversion

| | Urban fringe | Agricultural zone | Far, or extensive, margin |
|---|---|--|---|
| <i>Dimensions of agricultural policy and their spatial effects</i> | | | |
| Traditional commodity programmes | weak influence due to high land values and presence of other policies that are more powerful | dominant influence on land use and farmers' decisions | critical factor in setting the spatial location of the boundary, but high cost of production weakens benefits |
| Agri-environmental programmes to address environmental problems | strongest effect because externalities are most visible | weak effect in general, but can be important in some locations | can be important in either maintaining or discouraging agriculture, depending on programme specifics |
| Programmes for the provision of farmland-based environmental services | Environmental services from agriculture may be more important than commodities, with direct experience more important than option value | limited importance due to stronger role of commodity programmes | Environmental services from agriculture may be more important than commodities, with option value more important than direct experience |
| Rural development programmes | generally not applicable because development is driven by urban proximity | may be important in areas where full-time farming is not common | potentially important but difficult to implement, due to remote nature of these regions |
| <i>Dimensions of land-use policy and their spatial effects</i> | | | |
| Restrictions on land conversion | strong effects if enforced because land uses can be effectively frozen | no real impact because there is no pressure for major changes in use | ineffective because land cannot be held in a loss-making activity |
| Financial incentives | in general limited impacts because the compensation cost for holding land in its current use is high | little value in using this type of programme because land uses do not change | can be effective on a local basis for specific high-value parcels |

By contrast, financial incentives to maintain current land-use can be most effective at the far margin, where a modest payment may be sufficient to maintain a farm in operation. In the agricultural core zone, these payments are not needed. In the urban fringe, payments would have to be so high in order to be effective that they are likely to be used only in very particular cases where it is difficult to block conversion by regulation, but where a strong interest exists to maintain a particular parcel of land in farming.

Concerning coherence of agricultural policies with other policies, at the urban fringe, the interaction between urban policy and rural policy is crucial. The motivation for restricting farmland conversion mainly stems from urban development rather than from factors related to farming. This means that better co-ordination between urban policy and agricultural policy is important. In terms of policy, it would seem that the current application of land-use regulations will continue to be the dominant way for society in OECD countries to manage urban fringe farmland conversion.

The generic analysis of this report is complemented with information on a range of programmes in five OECD member countries that have been designed to influence farmland preservation. These examples show that different countries influence farmland preservation in different ways. Another important observation is that in all of the cases examined, a significant reason for maintaining farmland is its importance as a habitat for desirable species of plants and animals. They also suggest that it is much easier to maintain land as open space than to maintain the viability of farming, even though maintaining viable farms is a stated goal of most programmes. In the peri-urban area, where agricultural land faces urban development pressures, unless there are some land-use controls in place, raising farm incomes through agricultural support policies is unlikely to succeed in preserving agricultural land.

Although lack of spatially disaggregated information may be a serious impediment for undertaking an analysis of the relative cost-effectiveness of various policies in influencing farmland conversion in different locations, rural land-based amenities can also be provided by non-farm uses of rural land, although the nature of these amenities would be different (such as biodiversity and landscape). A clear definition of the quantity and quality of the public goods provided through agricultural land management that should be supported through agri-environmental policy – including programmes to protect farmland from conversion to non-agricultural uses – is necessary for evaluating whether such public goods are not provided more efficiently by other non-farm uses of land. Overall, the contribution – particularly in quantitative terms – of farmland-based environmental services to the development of rural areas, including the development of sectors such as rural tourism warrants further empirical analysis.

Chapter 1. Introduction

In the paper a variety of factors that influence the conversion, or preservation, of farmland in OECD countries is considered. The stock of farmland shows slow declines in all countries, but this decline is considerably slower than might be expected given pressures for conversion of farmland to urban uses near cities, and persistent low levels of return available to farmers operating in more remote areas that are less favorable for agriculture. This suggests that while market forces are important in defining land-use, there are other forces at work as well. Notably these are: agricultural policy that alters the returns from agricultural activity, environmental policy that imposes restrictions on the way farmland is used to ensure that the natural environment is protected, and land-use policy that determines which types of land-use will be allowed by society on specific parcels.

The combination of market forces and policies shape the use of farmland in all countries. The particular patterns of land-use depend on the specific mix of economic factors and policy in place in each country. In the case of economic forces the most important pressures are population growth, levels of income and wealth, and the cost of transport. From a policy perspective the important issues are social demands for support for farmers, protection of the environment and the desirability of maintaining a compact urban form.

The central idea of the paper is that agriculture is fundamentally a spatially specific activity. Both the returns from agriculture and the opportunity costs of keeping land in agriculture vary across space. To examine these differences a typology of three agricultural land categories is developed. The first is the urban fringe or peri-urban zone found at the edge of a city. In this zone urban activity has a strong influence on land-uses and on the nature of farming, even in those countries where there are strong restrictions on converting farmland to other uses. The second, or agricultural core zone, comprises the majority of agricultural land in most countries. In this zone farmland has very low opportunity costs and the chance of market forces causing significant changes in land-use are low. Returns from farming are high enough to keep the land in agriculture and there is little urbanisation pressure. The third zone is the far, or extensive, margin. In this zone agriculture is a marginally profitable activity and declines in the return from farming cause production to end. If the urban fringe faces pressure to convert farmland to a higher value use, the issue at the far margin is whether agriculture can be sustained. If it cannot, then land will revert to a less intensively managed use, such as forests or native ground cover.

Given the typology, conversion of farmland is fundamentally a problem only at the urban fringe and the far margin. By definition in the agricultural zone, while the particular use of land in terms of the agricultural commodity produced may change or the operator of the farm may change, the land itself will remain in farming. However while the majority of farmland may, in most countries, be in this agricultural zone, there is great interest in what happens to farmland at both the urban fringe and at the far margin. Depending on the specific country these two zones can account for a large number of farms and a considerable share of farmland. Moreover these two zones produce a disproportionately large share of the non-commodity outputs of agriculture.

1.2. Structure of the report

The OECD has a long-standing interest in changes in farmland-use and several studies have been produced on specific aspects of its development. The most recent study of the subject (OECD, 2008a), assesses the consequences of inflated asset values and suggests lessons for future policy making. An earlier report, (OECD, 1998b), examines the issues associated with land mobility and the capitalisation of support. The environmental effects of reforming agricultural policies – including the changes in land-use, farming practices and inputs are analysed in a report which examines concrete policy experiences from OECD countries (OECD, 1998c). The environmental effects of land diversion schemes are examined in relation to the experiences in these schemes of **Canada**, the **European Union**, **Japan**, **Switzerland** and the **United States** (OECD, 1997).

OECD work on multifunctionality (OECD, 2003a; 2003b), including the 2006 Workshop on Evaluating the Degree of Jointness (OECD, 2008b), as well the numerous studies undertaken by the Directorate for Public Governance and Territorial Development on the subject of rural amenities (OECD, 1998d; 1999; 2000; 2008b) have examined issues related to the provision of the land-based rural amenities associated with agriculture. In addition, the likely impacts of agricultural policies and policy reform – including multilateral trade liberalisation environmental issues – associated with changes in land-use in the case of arable crops, were analysed in the *Arable Crop Study* (OECD, 2005).

Land-use is an extremely broad topic. This study analyses the effects of diverse policies on farmland conversion. Within this broad remit there are four main objectives to:

- Examine issues related to the conversion of agricultural land in three spatial zones – the urban fringe; the far, or extensive, margin; and the core agricultural zone;
- Assess how various agricultural and land-use management policies influence farmland conversion in the three zones;
- Look at country/regional experiences and provide up-to-date information on a range of policy measures in diverse rural areas, across OECD countries, that have a bearing on farmland conversion and the provision of countryside environmental amenities;
- Draw implications for policy design and policy coherence.

The motivation for this study stems from the OECD Workshop, held in October 2005 in Bratislava, on the *Coherence of Agricultural and Rural Development Policies*, during which monitoring and evaluation of the impact of agricultural policies and policy reform on rural development was identified as one of the key issues meriting more analysis (OECD, 2006).

The paper is structured as follows:

- Chapter 2 discusses the economic theory of the spatial allocation of agricultural land-use in three spatial zones – the urban fringe, the far (or extensive) margin and the core agricultural zone.
- Chapter 3 examines the extent to which conversion of agricultural land-use in the three zones has been influenced by different types of agricultural policies.
- Chapter 4 examines how various rural land management policies (e.g. land-use and rural development policies) influence farmland conversion in the three zones. The distinction between this and Chapter 3 is that these policies are typically not part of the core set of agricultural policies. There is, however, a growing convergence between the two sets of policies, as farm policy is steadily broadened to take into consideration agri-environmental impacts.

- Chapter 5 provides a variety of country/regional examples from both traditional agricultural and non-agricultural land management policies (*e.g.* zoning, purchase of development rights, private contracts, integrated approaches, etc.), which serve as specific, country examples of ways to mitigate farmland conversion. These include the experiences of Australia, Belgium, Canada, Finland and the Netherlands.
- Chapter 6 draws together the main findings of the analysis.
- Annex 1 describes the traditional von Thünen model provides an examination of how fuzzy boundaries develop and examines their implications, including the role of part-time farming.
- In Annex 2, a review of basic ideas in spatial economics as they apply to rural areas is undertaken, to establish the larger context for the discussion is provided.

Chapter 2. The Spatial Dimension of Agricultural Land

2.1 The spatial nature of agricultural production

Agriculture is the largest single form of land-use in most OECD countries and most land currently used for crop and livestock production is unlikely to change uses substantially in the foreseeable future. But there are parcels of farmland that are susceptible to a change in use. The majority of this land is either adjacent to urban areas, or at the fringe of an inhabited areas where agricultural productivity is limited (Annex Table 1). This leads to a typology of three farmland categories: agricultural zone, urban fringe and far margin (Figure 1). Understanding the nature of land-use in each region is a necessary step before assessing the ability of various types of policy to control farmland conversion.

2.1.1 *Urban fringe agriculture*

The conventional perspective on agriculture near urban zones is that it will tend to specialise in high-value activities that have relatively high transport costs, with more remote farmland specialising in the production of lower unit value products that have low unit transport costs.¹ This model is predicated on the classic work of von Thünen (see Annex 1). But is the von Thünen analysis still appropriate?

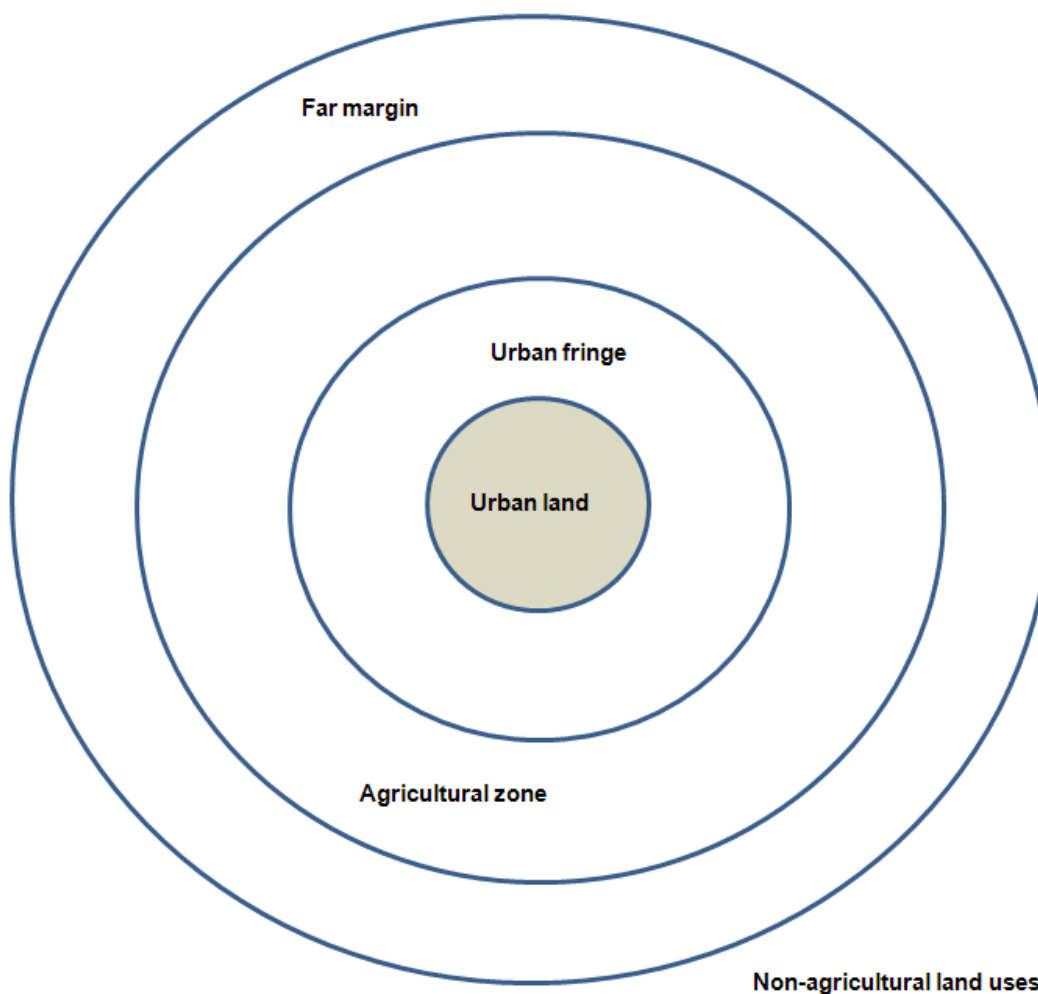
Von Thünen postulated an isolated state with a single market town and a featureless and uniform agricultural hinterland. In this context, the logic of his model dictates concentric rings or circles around a city with higher-value or perishable commodities produced close to the market point. However, today agricultural production takes place in a more complex world. The most obvious differences are that there is not a single demand point and that farming does not take place in a homogeneous and featureless plain.

The implications of this are important. A farm may serve multiple markets and, where this is the case, standard industrial location methods will lead it to locate at a point that minimises total costs (not the costs of serving any particular market). Further, differences in topography, soil quality and access to a transport network will result in farms having a different spatial pattern from the simple suggested by von Thünen. These, however, are obvious complexities that qualify the underlying model.

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1. In the urban fringe, the typical rural development problem is an excess of investment and population to the point that the rural nature of the region is transformed. Because the focus of rural development theory is on stimulating growth, very little attention is paid to problems of the urban fringe. Instead, concern with the decline of these rural areas is most commonly found in the urban development literature. The literature on sustainable urban development often includes some reference to the desirability of maintaining an intact rural zone in its discussion of revitalising the urban core. Thus, the literature on farmland preservation is more strongly connected to ideas of urban development than it is to rural development.

However, there are other factors that affect the spatial distribution of production that are also important, although less obvious. Rather than simply qualifying the von Thünen model, they fundamentally alter its basic assumptions to a point that it is less germane. These are most important in the urban fringe, where farmland has a significant opportunity cost.

Figure 1. Farmland typology



In particular, the anticipated time-scale for land conversion is a crucial factor. If the planning horizon is short, then farm operators are likely to avoid using land to produce commodities that involve large fixed capital investments that are immobile. For example, construction of a dairy barn or milking parlour involves a large capital investment cost that can only be recovered over an extended time interval. Even though dairy may generate a high rate of return per unit of output and involve high transport costs, it may not be competitive with field crops on land that has only a brief time-interval before conversion. In addition, while field crops may also involve large capital costs for equipment, these investments are mobile and can be easily relocated to a different site.

If developers purchase farmland well before there is any discernable pressure for conversion, similar effects on farmland-use can occur. Once the land is purchased it is typically leased to farmers until it can be developed. But in this circumstance neither the farmer nor the developer has any incentive to invest in long-term improvements – the developer, because he/she plans to use the land for another purpose; the farmer, because he/she has only a short-term right to use the land. Indeed, this process may lead to the rational decision to adopt farming practices that maximise short-term profit, but are not sustainable over an extended period of time.

Similarly, in the situation where agriculture has become only one of several types of land-use, the interspersed other forms of land-use may lead to restrictions on farm management practices. Following von Thünen's analysis, more intensive land-uses would be expected the closer the proximity to urban areas, because of the high cost of land. However, if higher-value intensive production requires farm practices that impose burdens on other neighbouring parcels of non-agricultural land, then it may not be possible to adopt that form of production.

To take an example: a producer of tree fruit on a small land base has a high-value perishable crop and, in a von Thünen world, might be expected to be located near urban areas. However, if the farmer uses pesticide sprays and noise-makers to prevent damage from birds, adverse responses from neighbouring private residents may result. Should these management practices consequently be prohibited, then returns from tree fruit production could be lowered to such a point that it ceases to be a viable activity. In this case, a lower-value activity, such as row crops, which involves fewer management practices that are incompatible with adjoining land-uses, may be adopted.

A third complicating factor outside the von Thünen model is the potential for part-time farm enterprises. A consequence of having higher-value farmland in close proximity to urban areas is the much larger investment necessary to assemble sufficient land to support full-time farming. Moreover, opportunities for off-farm employment are typically greater the closer a farm is to an urban area. These two factors would suggest the existence of more small farms capable of providing only a portion of household income. In this context, the choice of farm enterprises is conditioned by other opportunities for labour and capital. Consequently, one can imagine that such a farm would be used to produce commodities (*e.g.* beef cattle), which would not be those predicted by the standard von Thünen model.

Finally, von Thünen did not include environmental services in his analysis. Farms can produce positive amenity benefits, both to neighbours and to wider society. If farmers are able to capture some of this value, either through direct payments or through tax expenditures, then the returns from farming will be increased. However, some farming management practices generate higher amenity benefits than others and it would be rational for governments to provide additional financial incentives for promoting the adoption of amenity-enhancing farming practices. As a result, if a farmer considers the total return from commodity and non-commodity production, one might observe a different spatial pattern of land-uses than is the case if only the returns from standard commodity production are considered.

2.1.2 The agricultural core zone

The von Thünen model suggests that in the agricultural core zone there will be concentric rings of specialised production around the urban centre, which serves as the market point. A combination of differential transport costs and different demand levels for the various outputs will determine the order of products to be produced and the relative size of each ring.

In the modern agricultural core zone, most of the von Thünen analysis still holds in a general sense but with some significant variations, stemming from the following influences: first, farms may tend not to specialise in producing a single commodity as a part of a risk-mitigation strategy. Thus, mixed farms combining multiple crop and livestock enterprises are frequently found, even though this practice may

lower the aggregate net return. If farms have access to government programmes that reduce enterprise risk it may be more likely to find a spatial distribution that involves a higher share of specialised farms.

Second, von Thünen assumed a uniform homogeneous plain. In reality, soil quality can vary considerably over a relatively small area and this can make certain crops more or less viable, irrespective of their distance from a market. Further, topography can also vary and this, too, will alter the spatial distribution of farm products. The existence of spatial variability in the productive capacity of farmland is the basis of Ricardian rents and provides a different perspective on the extensive margin (see Box 1). Ricardo recognised that within the agricultural core zone the quality of land will vary and will command different prices. If commodity prices fall then it is possible that inferior land leaves production because it can no longer generate enough output to cover costs. This means that even within the agricultural core zone there may be pockets of land that are too unproductive to be farmed. It also means that in many regions the mix of commodities produced varies considerably from the regular rings described by von Thünen.

Within the agricultural core zone, land that is at the extensive margin in the Ricardian sense can be divided into two categories. Some of this land does not form part of a farm and is generally not bought and sold by farmers as commodity prices change. For the most part, this land is not farmland in any sense. The second category of land consists of those parts of a farm that are marginally arable or marginally useful for permanent pasture. Whether this land is used for commodity production depends on prevailing prices and on prevailing policy.

In some cases, policy and prices reinforce each other in moving the land in or out of production, while in other cases they act at cross purposes. For example, the Conservation Reserve Program (CRP) in the **United States** has taken a considerable quantity of farmland out of production. When commodity prices were low, the policy and market signals were reinforcing. Nevertheless, when commodity prices were high in 2007-08, although a large amount of this land would have been expected to be brought back into production, the CRP contracts prevented this from happening.

Third, there is the influence of multiple markets. In most regions the majority of production is not sold for consumption in the local urban centre. Consequently, the relevant transport costs are far more complex, and points more remote from the nearest urban centre may actually have lower transport costs to external markets than do points closer to the city. More importantly, the existence of multiple markets can lead to specialisation of production. A region may produce far more of some commodities than can be consumed locally and no other commodities. In this case the mix of production is not determined by the process described by von Thünen –here, production is determined by larger market forces, not local markets.

2.1.3 The far, or extensive, margin

The typical problem of rural development involves a region with declining income and employment and a falling population. In these areas, the main concern is how to stimulate growth in the rural economy and attract new sources of income and population to prevent stagnation and possibly decline to the point that abandonment results.

Land at the far margin is marginally profitable and continually faces the possibility of being withdrawn from production. From a spatial perspective, a major impediment for the viability of farms in this zone is the high transport costs. However, it is also typical that land at the far margin is also of inferior quality. LFAs typically are found in remote rural regions, so they are far from markets, but also commonly experience some combination of infertile soils, steep topography and poor climatic conditions.

Box 1. Concepts of the extensive margin

The concept of the extensive margin is important in agricultural economics, including analysis of the environmental effects of agricultural land-use change (Lubowski *et al.*, 2006). It describes land where profitability in agricultural use ceases. But there are two concepts of the extensive margin, and each approaches the idea from a different perspective. The original concept comes from Ricardo's analysis of land rent. Ricardo recognised that land of different quality, when applied to the production of the same commodity, will generate different yields. These yield differences may be accompanied by differences in cost of production with the result that the unit cost of production varies from one parcel of land to another. However, all units of output have the same price. This results in competition and higher rents for the better land. For Ricardo, the extensive margin is defined as land of sufficiently low quality that its output just covers the opportunity cost of undertaking production. If we assume farmland has no opportunity cost, then the rent for this land will be zero since all revenue will be consumed by inputs that do have an opportunity cost.

The second approach to the extensive margin comes from von Thünen. While the definition of the margin is the same – farmland that only covers the opportunity cost of other factors and earns no return for itself, the cause of differential land rents is different. Land rent for von Thünen is determined by differences in transport cost. Farms further from the central market incur higher transport costs to ship their goods, but all have the same price. The extensive margin here is defined by the furthest distance a good can be shipped and still cover its opportunity cost of production.

Ricardo assumes farmland has different quality, but ignores transport cost. Conversely, von Thünen assumes transport cost, but assumes land of homogeneous quality. In reality farmers face both factors. This means that both quality and distance will alter returns and land rents. While every farm has a mixture of higher and lower quality, the main policy interest in the extensive margin comes from the existence of large blocks of land that are vulnerable to leaving production collectively. Two reasons underlie this focus. The first is that a local economy is more affected if the majority of the farms in its territory are at risk of ceasing production than if marginal land is uniformly distributed across all farms, nationwide. The second reason is the importance of marginal land for environmental purposes. Because marginal land is less intensively managed it offers greater habitat value, but because it is more susceptible to erosion and other harmful management practices it is more likely to be associated with adverse environmental effects. Once again, the concentration of environmental impacts in a small area can imply a larger concern than would occur if the effects were uniformly distributed.

The two ideas lead to different sets of policy concerns. In some countries, the extensive margin mainly reflects a concern with Less-favoured Areas (LFAs) that are remote from population centres. These are often on hilly land, where the combination of low productivity and distance makes farming marginal, but also has the effect of limiting alternative economic activity. However, the habitat value of this land is often high if it remains in farming. In other countries, most truly remote land has been permanently withdrawn from farming, so the term “extensive margin” mainly refers to blocks of land within the core agricultural zone that are of limited productivity. On this land there may be better opportunities for other activities and its habitat value is often not as significant as land in LFAs because it is embedded in a larger agricultural zone.

While von Thünen postulated a sharp edge between farmland and land too inferior for farming, in reality there is a transition zone similar to the urban fringe. Within this zone, there will be a mix of farmland and land used for less profitable purposes. The key distinction between the near and far margins is that farming is a low-value activity in the former and a high-value activity in the latter case. The common aspect is that opportunity costs are the determining factor in establishing land-use.

At the far margin both market forces and policy influence land-use. Higher or lower output prices lead to land being brought into, or taken out, production. Unlike marginal land in the agricultural zone, price changes at the far margin may lead to changes in ownership and use of marginal land. Low prices can lead to farms being sold as holiday homes, or even abandoned if no buyer comes forward. In many countries policy for LFAs provides supplemental revenue to farms that would otherwise be unprofitable and cease production.

A central argument for this support is that farms in LFAs may provide significant environmental services from agriculture, especially when the land has been in production for an extended period of time and the ecosystem has been converted from one based on natural processes to one that reflects significant human management. In this situation, species have long adapted to the managed environment and may no longer be suited to an environment that does not include agriculture. Thus, a major justification for LFA programmes is social pressure to preserve particular kinds of species habitat and landscapes.

2.2 The amenity value of agricultural land

2.2.1 What are the farmland amenities?

Provision of amenities in rural areas primarily entails control over the use of rural land, at either the extensive margin of production (*e.g.* what land is used for farming) or at the intensive margin (*e.g.* how is the land used?) (Heimlich, 2000). Agricultural land is one of several types of rural land that produces amenities. As agricultural activities cover a high proportion of the land in rural areas, the relationship between agricultural land-use and the environment is often central to the provision of rural amenities. Nonetheless, the relationship between the use of agricultural land and the amenities provided is not straightforward.

Rural amenities associated with the use of land include the provision of services, such as landscapes, biodiversity, ecosystem functions and community support (Hodge, 2000). Farmland-specific amenities are attributes of farmland that are uniquely provided by farmed land. Examples include the scenic beauty of rolling pasture and the cultural value of farming as a way of life. Farmland also produces rural non-farm amenities, such as open space, wildlife habitats, groundwater recharge and preventing urban sprawl. These rural amenities may be provided by other types of rural lands.

Amenities associated with the use of farmland tend to arise from both negative and positive externalities associated with primary use of farmland as an input to agricultural production (Johnston and Swallow, 2006; Hellerstein, *et al.*, 2002; Heimlich, 2000; Hodge, 2000). The treatment of these externalities depends heavily of the prevailing property rights and their enforcement as well as of policies affecting all land-use sectors (Hodge, 2000).

Some farmland amenities, such as recreation activities, may be marketed as private goods.² However, as farmland amenities have, in general, public-good characteristics – they are non-rival (because at least some of the benefits they provide are available to all) and non-excludable (one person's consumption does not reduce another person's consumption) – there is a potential for under-production of amenity benefits (OECD, 2000). Research has shown that individuals from many societies tend to prefer the same sort of scenery, involving a combination of small fields, fences or hedgerows, a mix of vegetative cover and the presence of grazing farm animals (Hodge, 2008; McGranahan and Thomson, 2008). As a result, various farmland preservation programmes have been implemented by national and local governments, trusts, and non-profit organisations across the OECD countries. The study undertaken by the Economic Research Service in the **United States** found that provision of rural amenities in the country is a key reason for the increasing importance of farmland preservation programmes, both at the Federal and State level (Hellerstein, *et al.*, 2002).³

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2. For example, a farmer can control hunting access to his/her land by demanding payment for the right to hunt and withholding that service from non-payers.
 3. For example, at the Federal level, the 2002 Farm Bill authorised a more than ten-fold increase in the funding for the Federal Farm and Ranch Lands Protection Program, from about USD 53 million

The amenity value of agriculture also provides a partial explanation for why ex-urban development takes place. Those individuals who place a high value on living in open spaces will be prepared to absorb the high commuting costs associated with a home in the country. Even if prospects for future capital gains from urban expansion are not great, there will still be individuals who prefer an ex-urban life style. Moreover, these individuals may be strong opponents of additional development once they have moved to the countryside because any additional farmland conversion would reduce their amenity benefits.

2.2.2 Valuing farmland amenities

The amenity value of agriculture is widely recognised (OECD, 2000; 2008b). This shift in relative importance of private commodities versus public environmental services has important implications for valuing farmland. The standard way of valuing agricultural land is to estimate the discounted present value of the future stream of net revenues generated by the sale of agricultural commodities (OECD, 2008a), except when land market prices are regulated. Rivalrous and excludable goods that were sold in private markets generated an income stream that was used to purchase another good farmland that was also rivalrous and excludable. If one person owns a parcel of farmland that means no one else can own it and legal and social conventions in all OECD countries preclude others from using that person's land without their permission.

Historically, this has provided a measure of the relative productivity of land and any benefits accruing from agricultural support. For example, for land in the agricultural zone, where opportunity costs are low and non-commodity benefits are less important, this approach remains satisfactory. However, for land at either margin other influences play a role in determining the full value of farmland.

When the social value of farmland stems from the production of both private and public goods, the underlying calculus of value and return to land ownership becomes more complex. In principle, the value of farmland becomes the discounted value of the stream of future returns from both the commodity and environmental services from agricultures. But if the environmental services have no price, how is their value computed and how does the landowner receive benefits?

Moreover, any particular price that is established by the landowner is likely to lead to underproduction of the public good outputs because they are non-rivalrous in consumption. Private ownership of land leads to owners making decisions on land-use that are driven by comparing alternative income streams from various land-uses. In particular, for farmers, the future stream of agricultural income is compared to the lump sum that becomes available on selling to a property developer. The farmer has no reason to consider the value of environmental services associated with farming in this decision if the farmer receives no payment for producing these outputs.

Where environmental services have low value, because either demand is low or there are numerous alternative sources of equivalent output, decisions based solely on income streams are relatively efficient. But in cases where environmental services generate a large share of value, ignoring their existence will lead to farmland losses that are socially undesirable. Obviously, if farmers are paid the social value of non-commodity outputs the externality is internalised, and land is more likely to remain in farming. Alternatively, farmers can be prohibited from selling their land for alternative uses. Either option has the same outcome, but the distribution of costs and benefits is different.

during 1996-2001, to USD 499 million for FY2002-07. Furthermore, the 2008 Farm Bill mandates USD 743 million in funding for FY 2008-12. However, with the new Farm Bill, the purpose of the programme changed and eligible land now includes forest land and other land that contributes to the economic viability of an agricultural operation, or that serves as buffer from development.

In the first case, individuals implicitly pay the farmer for environmental services through a tax that is imposed on them and used as a recompense for the provision of these amenities. Alternatively, a tax expenditure, such as use value assessment, can be employed. This approach is consistent with a philosophy that prices generally provide appropriate signals for allocating resources, and with property owners being able to hold all rights associated with land.

In the second case, it is assumed that the right to alter land-uses is severed from the property owner and reserved to the state. Property owners only have those specific rights explicitly granted to them and any residual value rests with the state. The argument for this approach is that the property owner usually does not bring about the increase in value associated with a change in land-use. Therefore any increase in property value is a windfall to the farmer that may appropriately be kept by society, since it was society that generated the increase in value. Further, if the farmer incurs no, direct costs in generating environmental services there is no obvious reason to pay for them.

There are divergent views on whether the presence of at least some agricultural production is necessary for the provision of certain farmland-based environmental services in rural areas, such as landscape or flood control (OECD, 2003a; 2003b; 2008b). The OECD work on multifunctionality has shown that non-commodity outputs (NCOs) provided directly by the use of fixed factors in agriculture (land) are more typically related to commodity outputs by a relationship of technical interdependency than because they use the same allocable fixed factor. The typical case is of a fixed input that generates a NCO simultaneously with a commodity output, and not of commodity and non-commodity outputs competing for the rival use of a fixed input. However, it depends on the particular case as to whether this technical interdependency operates at the margin (*i.e.* the more commodity output is generated by the fixed factor, the higher (lower) the level of the non-commodity output) or whether the provision of the non-commodity output requires simply that the fixed factor should be used to produce a particular agricultural commodity, regardless of the intensity of use. Thus, if commodity price changes alter the *intensity* of use of the fixed factor it is not always clear what the impact on non-commodity output would be (Burrell, 2001).

In some cases, commodity outputs are complementary with farmland-based environmental services, but competing in others. For example, grassland biodiversity can depend on farming intensity (Havlik, 2008). That is, at low levels of intensity, agricultural production can be complementary to grassland biodiversity by preventing land from reverting to forest. At high levels of intensity, excess nutrients from livestock or crop production can jeopardise nearby grasslands. Moreover, there may be regions of complementarity and regions of competition between commodity, environmental services from agriculture and non-agricultural rural activities (*e.g.* rural tourism), again depending on production intensity (Hodge, 2000; 2008; OECD, 2008b).

Some farmland-based environmental services are complementary with each other, but there are competing relationships in other cases, depending primarily on: i) farm characteristics that facilitate provision of one environmental service may facilitate provision of the others (such as more land area per farmer and more woods and hedges on a farm); and ii) a farm's previous experience in seeking out information about agri-environmental programmes may lower its transaction costs with respect to committing to supply environmental services (Dulpaz, 2008; Ollikainen and Lankoski, 2008). Moreover, biodiversity protection requires particular types of land-use, not just a certain amount of land in agriculture irrespective of what is being produced on it. Thus, unless the amenity values that matter the most are evaluated, how to provide farmland amenities most efficiently remains an open question.

The relative value of farmland amenities varies from region to region and depends on several factors, including the total amount of farmland available in the region, availability of other rural land offering similar amenities (*e.g.* forest, parks) and the socio-economic characteristics of people living in the region. For example, as a region's population, incomes and education levels increases, demand for a broader array of farmland amenities will also increase, especially in sub-urban and urban-rural fringe

settings versus rural settings (Nickerson and Hellerstein, 2003; Wu, *et al.*, 2004). The geographic distribution of population also matters. On one hand, too many houses in a farm landscape could diminish its visual benefits, but on the other, the more people living within close proximity to the farmland, the more valued the scenic amenities may be.

2.2.3 Implications for farmland preservation policies

Reflecting heightened policy concerns over the environmental performance of agriculture, programmes for the environmentally sustainable use of farmland are now receiving greater prominence among policy makers in several OECD countries. Countries across the OECD area have, to an increasing extent, made support payments to farmers subject to environmental conditions (cross compliance) (OECD, 2005). In the **EU** and **Switzerland** farmers are obliged, *inter alia*, to comply with specific environmental standards and land-management practice requirements in order to receive most forms of farm-support payments. **Japan** and **Korea** have also attached environmental conditions to their newly implemented system of direct payments.

In several OECD countries, especially the **United States**, measures to achieve the environmentally sustainable use of farmland include specific voluntary incentive programmes, such as cost-share programmes; payments for land retirement; purchase/transfer of development rights; zoning; and tax programmes (Hellerstein, *et al.*, 2002; Heimlich, 2000).

In the **EU**, one of the three core policy objectives of the Rural Development Policy 2007-13 (RDP) is to improve the environment and support land management. Farmers receive compensation when they voluntarily cultivate farmland according to management and maintenance agreements that recognize clearly defined nature and landscape values. More specifically, two types of support exist under *Axis 2 - Environment and land management* of the 2007-13 RDP:

- Measures targeting the sustainable use of agricultural land through payments to farmers in areas with natural handicaps; NATURA 2000 payments; agri-environment and animal welfare payments; and support for non-productive investments;
- Measures targeting the sustainable use of forested areas through afforestation of agricultural and non-agricultural land; NATURA 2000; forest environment payments; and support for non-productive investments.

Environmental and land management measures comprising programmes designed to enable the continuation of farming in disadvantaged areas, despite permanent natural handicaps, are also implemented in other OECD countries, particularly in **Japan**, **Norway** and **Switzerland**. Such schemes for farming in mountainous and less-favoured areas are implemented – not to facilitate adjustment or modernisation of the agricultural sector - but rather to enable farmers to cope with these conditions and thus avert land abandonment.

In **Australia**, **Canada** and **New Zealand**, the emphasis is on community-based approaches (*i.e. Landcare groups*) for resource management in rural regions, with the purpose of mobilising and motivating citizens to take on greater responsibility for addressing environmental issues. The use of regulations is also widespread across the OECD area. Further, several countries, at the national and sub-national level, protect farmland by purchasing development rights or by providing tax breaks that encourage farmers to continue farming the land in a specific geographical area. Zoning rules and taxation are particularly important in urban fringe areas where rural land is being developed for residential or commercial purposes (OECD, 2008a).

In general, the land-preservation policy approach is most common when there are perceptions of a high value from the environmental services from agriculture and there is a considerable likelihood that a significant portion of farmland will be converted to some other use that will eliminate the provision of

these services. Thus, in cases where farmland has low opportunity costs there is little pressure for land-use controls even if levels of environmental services from agriculture are high. There may, however, be pressures for the adoption of specific farm management practices in order to ensure continued non-commodity production. For example, in Scotland extensive cattle production is encouraged in remote areas to provide nesting and feeding habitat for birds. Similarly, in the migratory fly-paths of North America, farmers are encouraged to maintain wet areas or potholes in fields in order to provide habitat for ducks and geese.

The specific approach adopted by a country reflects many factors, including the underlying structure of its legal system, land tenure rules, relative importance of individual and collective property rights, the relative scarcity of open land near cities, and the degree of urbanization. Clearly, schemes where farmers are paid for the production of environmental services are preferred by farmers, while schemes that preclude farmland conversion without public compensation are preferred by urban dwellers.

Overall, identifying the optimal amount, mix, and geographic arrangement of farmland amenities is a complex task for several reasons. First, farmland amenity values are likely to vary over time—thus studies at one point in time reveal little about changes in these values. Second, amenities provided by changes in other rural lands may substitute for farmland amenities, making the optimal amount and pattern of farmland amenities dependent on changes in the pattern of other rural land-uses. Finally, competing effects make identifying the optimal spatial pattern of farmland difficult. Working farmland may exhibit economies, making preservation most efficient when done in large, contiguous blocks. Preserving large blocks of farmland also enhances certain rural amenities, such as wildlife habitat. However, this geographic concentration could reduce the accessibility of farmland amenities to more people. Visual farmland amenities might be enhanced by preserving smaller tracts of more widely distributed farmland or by concentrating preserved farmland in more densely populated areas.

Chapter 3. The Spatial Dimension of Agricultural Policies

3.1 Analytical assumptions

In order to facilitate the analysis of the impacts of agricultural and land-use policies on farmland-use management, a generic typology of three agricultural categories is developed: the urban fringe or peri-urban zone; the agricultural core zone; and the far, or extensive, margin zone.

In the *urban fringe or peri-urban zone*, which is found at the edge of a city, urban activity has a strong influence on land-uses and on the nature of farming, even in those countries where there are strong restrictions on converting farmland to other uses.

The *agricultural core zone* comprises the majority of agricultural land in most countries. In this zone, farmland has very low opportunity costs and the chance of market forces causing significant changes in land-use are low. Returns from farming are high enough to keep the land in agriculture and there is little pressure for urbanisation.

In the *far, or extensive, margin zone*, agriculture is a marginally profitable activity and declines in the return from farming cause production to cease. If the urban fringe faces pressure to convert farmland to a higher-value use, the issue at the far margin is whether agriculture can be sustained. If this is not the case, then land will revert to a less intensively managed use, such as forests or native round cover.

Given the typology, conversion of farmland is fundamentally a problem only at the urban fringe and the far margin. By definition, in the agricultural zone, while the particular use of land in terms of the agricultural commodity produced may change or the operator of the farm may change, the land itself will remain in farming. However, while the majority of farmland may, in most countries, fall into this category, there is great interest in what happens to farmland at both the urban fringe and at the far margin. Depending on the specific country, these two zones can account for a large number of farms and a considerable share of farmland; moreover, they produce a disproportionately large share of agriculture's environmental services.

In developing the analysis a number of assumptions are made to provide a stylised framework of farmland conversion that is generally applicable to the OECD member countries. An inevitable consequence of this process is that the framework does not describe any given country with sufficient precision for it to be used directly for policy purposes. Instead, the framework describes the broad forces acting upon different types of farmland that influence the conversion process. In particular, the framework is presented as a set of three concentric rings of farmland surrounding an urban centre. Obviously, in any country there are multiple urban centres and not all of them will have a corresponding pattern of farmland. Moreover, the quality of farmland varies considerably in most countries and this, too, will alter the specific geography of farmland types. However, the point of the framework is to provide a way of identifying the specific types of farmland most at risk of conversion, and it does fulfil that function.

A second simplified assumption used to facilitate the analysis is that farmland situated at some distance from the urban fringe, in the core agricultural zone, has an arbitrarily small opportunity cost. Since all parcels of land are immobile, it is common in land value analysis to conclude that any payment to land is a pure economic rent or should serve other objectives than keeping land in farming. If there are no alternatives to the current use and if farming is a profitable activity, land will remain in that use, even at a payment that is close to zero - for, by definition, it has little or no opportunity cost. This is a rough approximation of the condition facing large amounts of farmland, especially in countries with low population densities and high rates of urbanisation. In reality, there are small amounts of farmland outside the urban fringe that may be used for ex-urban residences, rural manufacturing locations, etc., but these uses are small compared to the total mass of farmland. Indeed, this assumption fundamentally underlies the common practice in agricultural policy analysis of assuming the stock of farmland is fixed (OECD, 2008*b*).

The analysis also largely overlooks the issue of shifts in land-uses that are internal to any given farm. Because land has different qualities there will typically be price regimes that lead to some land on a farm being idled in the short to medium run. However, in the long run there is a good chance that these parcels will return to production as prices improve. The rationale for not focusing on these land-use adjustments, which can have significant consequences, is that there is no change in ownership. Just as a farmer chooses to plant some land with one crop and another parcel with another crop and use a third as pasture, so too is the decision to withhold land from production part of the internal farm management process. For the purposes of this study, farmland conversion will involve land leaving the sector and becoming unavailable for short-term re-use.

A significant part of the analysis concentrates on the role of environmental services from agriculture. For the purpose of simplicity, the analysis treats these non-commodities as local public goods. This means that their value is largely determined by the direct experience of those living in close proximity to the point of production.

The analysis is static, in so far as only the effects of the agricultural policy measure considered are taken into account, while other factors that could influence conversion of farmland are assumed to be constant. In addition, it is assumed that producers are risk-averse.

Finally, the last major assumption is that the farm household assesses the available returns from both farm and non-farm allocations of labour and capital. If agriculture pays a lower return than from off-farm work, then individual household members will shift more resources to off-farm activity, where it is available. Certainly, in some countries the returns to full-time farming are sufficiently high to prevent this becoming a common phenomenon. However, if returns from farming are low, some other mechanism is needed to allow farming to persist in urban fringe areas, where farmers face a combination of: small farm size – leading to low levels of farm income, high production costs leading to low unit returns, and competition for land for other uses – leading to pressure for conversion.

3.2 The spatial implications of agricultural policy

Agricultural support policies have evolved over time. These changes, which range from limited re-instrumentation, to comprehensive reform, have had particular consequences for the spatial impacts of agricultural land-use. In a number of OECD countries both the number and complexity of policy measures are increasing, as the centre of gravity of policy measures shifts gradually from traditional market price support and output-related measures towards sector-wide and non-commodity-specific policies, particularly those encompassing environmental and rural development concerns.

Reductions in the most distorting forms of support have been associated with increases in more decoupled payments, including the provision of payments with no requirement for the farmer to produce

in order to be eligible for the support (Table 2). For the OECD as a whole, the use of payments based on area (current or non-current), although very diverse, has increased by more than 400% between 1986-88 and 2005-07. Moreover, cross-compliance conditions, especially environmental, are increasingly being attached to payments.

Despite the steady evolution of agricultural policy in the OECD countries to include increasing support for environmental and rural development programmes, the majority of support for farmers is still delivered through programmes that influence the quantity or price of commodities. While rural policy and environmental policy both have a spatial dimension, in the sense that only specific areas qualify for this type of support, traditional commodity programmes are essentially spatial in nature.

Table 2. Composition of producer support in the OECD area

| | Amount (USD million) | | Shares (%) | |
|---|----------------------|---------------|------------|------------|
| | 1986-88 | 2005-07 | 1986-88 | 2005-07 |
| A. Commodity production required | 236044 | 207406 | 99 | 79 |
| Support based on commodity output | 196715 | 144902 | 82 | 55 |
| Payments based on input use | 20129 | 29813 | 8 | 11 |
| Payments based on current A/An/R/I ¹ | 18666 | 31670 | 8 | 12 |
| Payments based on non-current A/An/R/I | 533 | 1021 | 0 | 0 |
| B. Commodity production not required | 3015 | 55225 | 1 | 21 |
| Payments based on non-current A/An/R/I | 2080 | 51031 | 1 | 19 |
| Payments based on non-commodity criteria | 935 | 4194 | 0 | 2 |
| C. Miscellaneous payments | 210 | -99 | 0 | 0 |
| Producer Support Estimate (PSE) (A+B+C) | 239269 | 262533 | 100 | 100 |

1. A (area planted) / An (animal numbers) / R (receipts) / I (income).

Source: OECD, PSE/CSE database 2008.

More significantly, traditional agricultural policy rarely focuses on the spatial distribution of agricultural commodities that will be produced in a country (Freshwater, 2008). Instead, it is assumed that farmers in each location will make appropriate production decisions based upon their price and output expectations and their cost of production. Thus, policy relies upon market forces to determine the specific locations where production occurs.

Agricultural policy has spatial implications, even though they may not be explicitly identified. Policies that alter the relative prices of commodities will alter the rates of return to farms in different locations and, hence, the spatial distribution of agriculture. Although traditional agricultural policies, do not, in general, focus on where these farmers are located, they may, in practice, provide higher or lower returns to farms of different size. But, if farm size is a function of location, then there are clear implicit spatial effects.

In the core agricultural zone, agricultural policy affects the particular type of farming carried out, but the land, by definition remains in farming irrespective of how policy changes. In this case, the opportunity cost of farmland is at such a low level that no other land-use can be considered, even in the countries where the majority of agricultural land falls into this category. However, this does not mean that farmland is a single contiguous block of land. There may well be pockets of settlement or abandoned land interspersed with farming, but the general use of land is agriculture. From a national policy perspective this land is always part of the “single large national farm.”

This category encompasses the bulk of agricultural land and in this situation it is the land that leads to the common policy assumption that the stock of farmland is essentially fixed in the short to medium run. If a parcel of farmland has no opportunity cost, it will remain in its current use irrespective of the level of return. Thus, any payment to land can be thought of as a pure economic rent. A consequence of no opportunity cost is the limited influence of changes in agricultural policy or changes in agricultural prices on land-use. To be sure, changes in agricultural prices or policy can alter ownership of this farmland. Individuals may be forced out of business and lose their farms, but, given the lack of opportunity cost, the land will be operated as a farm by someone else.

At the far margin, where farming becomes unprofitable, agricultural policy has its largest effect on land-use. The location of this margin is determined by the returns from production, net of transport costs. The policies in place are also crucial to define the location of the boundary. These returns have to cover the opportunity costs of the labour and capital employed on the farm and generate enough of a return for the land to just cover its value in its next-best use. Often this is a low-value per hectare use, such as forestry, but it may be a nature reserve or some other socially valued use, in which case the opportunity cost is higher. The central point about the extensive margin is that changes in agricultural policy can induce a relatively large shift in the location of this margin, with farmland going out of production if prices and returns fall, or new land being brought into agriculture if prices and returns rise. This reflects the relative ease of moving land from one use to another at the extensive margin.

The final situation is the urban fringe, where the transition between agriculture and urban settlement takes place. In general there is no precise boundary between urban and agriculture. Instead, there is a relatively broad transition zone where closer, to the urban core, there are fewer farms and more urban land-uses, with the relative proportions switching, as distance from the city increases. A distinguishing feature of this transition zone is that it is influenced by both agricultural and urban policy.⁴ In general, agricultural policy is the weaker of the two and its greatest influence is at the far edge of the urban fringe.

Urban land-uses almost always generate higher returns for landowners than does agriculture. However, the interest in converting farmland to an alternative use typically declines with distance from the edge of a city. In an ex-urban setting we would expect to find a relatively low premium for urban land over agricultural land near the far edge of the urban fringe. Thus, changes in agricultural policy can influence the far edge of the fringe by making farming more or less competitive with alternative land-uses. Closer to the edge of the city – while there may be land remaining in agriculture – it mainly reflects a holding strategy, where the landowner waits for a more attractive purchase price. In this situation traditional agricultural policy can have little influence on land-use.

This follows from the fact that traditional policy affects commodity prices everywhere, so to raise prices for farms in the fringe, and increase their returns to a point where farming becomes attractive, would require raising prices for all farms. This would include the majority of farms that are found in the infra-marginal area, as well as resulting in a pushing out of the extensive margin, because new land would now be profitable in agriculture. The effect of these changes would be a major increase in output that would tend to depress prices unless some additional policy measure was introduced to remove it from the market. This suggests that agricultural policy cannot be used to influence either the size of the urban fringe or the relative mix of farm and non-farm land-uses.

4. Cavaillès and Wavresky (2003) show, *via* a theoretical model which was applied in 319 *communes* (lowest-tier administrative area in France) around Dijon, that farmland prices in peri-urban areas are determined not only by agricultural factors, but also by both the potential future residential rent and the expected date of conversion of the land from agricultural to residential use.

Urban policy can, however, have a major influence on the size and nature of the urban fringe. If we start from a situation where urban policy does not exist, then the size of the fringe will be largely determined by a combination of the following factors:

- Preferences for rural residential living;
- Ease and cost of commuting from rural residence to urban employment; and
- Size of the price differential between urban and agricultural land.

If these factors are at levels that make it attractive to live in a rural setting, then the fringe will have a relatively large number of non-farm land-uses and will extend a considerable distance from main urban centres. Conversely, strong preferences for urban living, high transport costs and high farmland prices would all tend to reduce the size of the urban fringe.

Now, if urban policy is introduced it will generally reduce the size and density of the fringe. For example, zoning can be used to limit land-use changes, development rights can be withdrawn from farmland to block its conversion, public services such as water, sewer and emergency services can be restricted to specific areas, development impact fees can be set at a high level to reduce the return from land conversion, and taxes can be used to increase the cost of commuting by car. All of these factors will tend to limit the extent of the fringe by making it less attractive for urban land-uses to leave the primary urban settlement zones.

3.2.1 *Agricultural policy effects on farmland types*

The OECD has developed a typology of agricultural policies that is used to assess the relative ability of policy to alter the decisions of farmers. In its work on monitoring and evaluating agricultural policy developments, each year since the mid-1980s, the OECD measures the level and composition of monetary transfers (support) associated with agricultural policies in OECD countries (and increasingly for non-OECD countries), using a standard methodology. The classification of support into different categories is based on how policies are actually implemented and not on the objectives or impacts of those policies.⁵ Table 3 displays some selected examples of classification of policies into different categories for the **EU** and the **United States**.

The main focus of the OECD analysis used in monitoring and evaluating agricultural policies in OECD countries is the aggregate effect of these policies on prices and outputs at the national level. However, it is useful to consider how the various types of policy might affect farmers' decisions depending upon their spatial location. Table 4 provides a summary of the spatial influence of different forms of agricultural policy on three types of location – the urban fringe, the agricultural core zone and the extensive margin.

In general, the conclusion is that agricultural policy has the greatest impact on farm income and the level of output of farms in the infra-margin or agricultural core zone. As this is where the largest number of farms are to be found, it would be surprising if farms in this location were not strongly influenced by agricultural policy. However, agricultural policy has little effect on land-use in this zone, because farmland in the infra-margin has virtually no opportunity cost (*i.e.* there is no alternative use that can generate as high a positive return to land as agriculture).

5. It should be noted that, in addition to classification into categories, each policy measure is assigned several “labels” that provide additional details on policy implementation. For more details on the methodology, see *The PSE Manual*, OECD (2008f).

Table 3. Selected examples of classification of policies in the EU and the United States

| | EU | United States |
|---|---|---|
| Support based on commodity output | | |
| <i>Market price support</i> | Policies which create a gap between a country's domestic and border prices (e.g. tariffs, tariff quotas, etc.). Important for several commodities | Policies which create a gap between a country's domestic and border prices (e.g. tariffs, tariff quotas, etc.). Important for sugar and dairy |
| <i>Payments based on output</i> | Tobacco premium | Storage payments; commodity loan interest subsidy |
| Payments based on input use | | |
| <i>Based on variable input use</i> | Insurance subsidies; fuel tax rebates | Energy subsidies |
| <i>Based on fixed capital formation</i> | Investment in agricultural holdings | Environmental Quality Incentives Program (EQIP); Farm ownership loans; Grassland Reserve Program (GRP) |
| <i>Based on on-farm services</i> | Pest and disease control; extension; technical assistance | Pest and disease control; extension; technical assistance |
| Payments based on current A/An/R/I ¹ , production required | Per hectare payments to crops; suckler cow premium; compensatory allowances/LFAs (after 2000) | Crop insurance; Income tax concessions |
| Payments based on non-current A/An/R/I, production required | not important | none |
| Payments based on non-current A/An/R/I, production not required | Single Farm Payments Scheme | Counter-cyclical payments; direct payments; production flexibility payments (1996 Farm Bill) |
| Payments based on non-commodity criteria | | |
| <i>Based on long-term resource retirement</i> | Long-term set-aside; afforestation | Conservation Reserve Program; Wetland Reserve Program |
| <i>Based on a specific non-commodity output</i> | National payments for landscapes, preservation of biodiversity and amenities (terraces, stone walls, hedges, shelter belts, buffer strips, etc.) | none |
| <i>Based on other non-commodity criteria</i> | Some payments in LFAs (after 2000) | Wildlife Habitat Incentives Program |

1. A (area planted) / An (animal numbers) / R (receipts) / I (income).

Source: OECD, PSE/CSE database 2008.

By contrast, agricultural policy at the two margins has markedly different effects on farmland conversion. In the urban fringe, the returns from agriculture are low relative to the returns from conversion, even with high levels of support. At the extensive margin, the incremental income from agricultural support can: maintain land in farming; cause land to enter agriculture if support is increased; or cause land to enter an alternative use if support is reduced.

Table 4. Ability of agricultural policy to influence farmland conversion

| | Urban fringe | Agricultural zone | Far, or extensive, margin |
|--|---|---|---|
| support based on commodity output | generally minor, but in those places where farms produce large output, benefits are large | small effects on the total stock of farmland, but a large influence on types of output and farm welfare | generally small because farms are small and intensity is low |
| payments based on input use | generally minor, but in those places where farms are large, benefits are large | small effects on the total stock of farmland, but a large influence on types of output and farm welfare | generally small because farms are small and intensity is low, so input use is low |
| payments based on current A/AN/R/I commodity, production required | generally minor, but in those places where farms produce large output, benefits may be large | small effects on the total stock of farmland, but a large influence on types of output and farm welfare | generally small because farms are small and intensity is low, but if payments are designed to promote low intensity farming then the effects can be large |
| payments based on non-current A/AN/R/I commodity production required | for the majority of farms that historically had low A/AN/R/I benefits are small, but can be large in the case of large farms | small effects on the total stock of farmland, but a large influence on types of output and farm welfare | generally small because farms are small and intensity is low |
| payments based on non-current A/AN/R/I commodity production not required | generally small, but if the landowner expects continued increases in land values, the payments provide an incentive to delay conversion | small effects on the total stock of farmland, but a large influence on types of output and farm welfare | generally small because farms are small and intensity is low |
| payments based on non-commodity criteria | can be large if criteria tend to reward farms with large amenity value | generally small, because main focus of farm is to produce commodities | can be large if criteria tend to reward farms with large amenity value |

Note : For detailed definition of categories see *OECD (2007a and 2008f)*.

A/AN/R/I refers to Area, Animal numbers, Receipts and Income

Support based on commodity output

This form of support has historically been one of the main forms of agricultural policy in OECD countries (*e.g.* market price support and payments based on output). It provides payments to farmers based on the level of output. As a result, those farms with higher levels of output receive higher total payments. There is a general recognition that these payments provide an incentive for farms to increase efficiency by specialising in a smaller number of commodities. They are able to do this because support reduces the risk associated with production and there is less need for diversification (OECD, 1998). A parallel effect of the support is an increase in farm size. Specialisation provides an opportunity to increase output and this is most easily accomplished by increasing the amount and intensity of land operated. Available evidence suggests that, while such policies may economise on administration and transaction costs, they fail to promote improvements in land management practices, such as hedge management or buffer strips (Hodge, 2008)

When these effects are put into a spatial context, the following conclusions can be drawn. The largest effect of output-based support is found in the agricultural core zone. Here, farmland quality is generally good and land is still relatively cheap (because it can command only a quality differential, or Ricardian rent). Higher levels of support have the effect of increasing the relative share of the supported commodities produced on this type of farmland. Smaller farms in the agricultural core zone benefit less from these payments than large farms because, by definition, they have a lower output and less ability to capture the scale economies that reduce unit costs of production. While farms in the agricultural core zone will receive the bulk of the benefit from this support it does not alter the stock of farmland because it does not alter opportunity costs.

One possible effect of this type of support is to encourage the intensity of production. If farmers are able to increase output per unit of land and if this increase is larger on larger farms (*i.e.* returns to scale), then a greater share of production may occur in the agricultural core zone. That is, support may lead to smaller amounts of farmland in both the urban fringe and the far margin.

At the far margin, the effect of high levels of this type of support is to preserve production on land that is close to being unprofitable in agriculture. Land at the far margin typically suffers from two disadvantages. The first is higher transportation costs and the second is lower production capacity. The first deficiency results in lower realised prices for output, once shipping has been paid for. The second deficiency leads to lower yields and/or higher unit costs of production. The cumulative effect is lower margins per hectare, and hence low returns for land and labour. If support is increased, there may be some expansion of land in production in the medium term, as land that was previously unprofitable in agriculture is converted to farmland, and vice versa.

The magnitude of the conversion process will vary by farm size at the far margin. Where farms are small the effect is likely to be small, given the relatively modest amount of money that flows to any particular farm. Each farm receives limited support because the farms in these areas are typically smaller and less productive than in the agricultural core zone. However, in some OECD countries farms at the far margin are large, and in these cases the effect of policy will also be large, with significant conversion implications.

In the urban fringe, output-based farm payments typically provide only a modest incentive to alter land-use decisions. Farms in this zone tend to be relatively small and the households operating them are likely to generate most of their income from non-farm employment. Further, farmland in this zone has high opportunity costs, associated with conversion to urban use. The combination of a low level of commodity output, a small share of household income coming from farming and high opportunity costs for farmland, suggests that output-based payments provide a limited incentive to maintain land in farming. The main exception to this would be those commodities that are highly valuable and can be produced on a small land base. In this instance it may be possible to maintain land in farming, but, by definition, only a small amount of land will be preserved.

Environmental effects of land-use change associated with reduction in output-related support

There is general consensus that producers would respond to reductions in output-related support by reducing their supply of commodity outputs. This can be achieved through: lowering the demand for variable inputs, such as mechanical and chemical-inputs; taking land out of agricultural production; or through using land less intensively.

Reduction in output-related support could strengthen the incentive for farmers to reduce the intensity of production and to facilitate reallocation of land to non-agricultural purposes such as forestry, leisure or nature preservation. The choice of whether to continue farming or to use land for which farming under market conditions has become unattractive for non-agricultural uses will depend on local circumstances. Moreover, farmland adjustment may be hindered by various structural and institutional impediments, such as the inability of the farm operator to exit farming – or by laws and regulations regarding the use, zoning, transfer, or inheritance.

Although it is difficult to postulate what the precise outcome would be, the expectation of the farmland-use impacts of agricultural policy reform is for an accelerated restructuring of agriculture. There is a likelihood – except where land has alternative more profitable uses – that agricultural land will remain in production, becoming amalgamated into larger farms. However, marginal land, often found in remote rural areas, would be under strong pressure to become derelict, particularly where the land had been used to produce highly subsidised products and was of no, or only limited, alternative use. In some remote rural regions, traditional systems of farming which have created particular landscapes,

could be threatened. In the more economically integrated rural areas, agricultural production on marginal land could be discontinued and more land would thus become available for non-agricultural purposes, including outdoor recreation.

Removal of output-related support is expected to lead to a decline in the value of the assets of in the sector in countries and regions with relatively high assistance, at least in the short run. A fall in the relative price of land implies that relatively more land could be used in the production process, but substitution possibilities among factors of production could differ across regions and countries. In some cases, agricultural policy reform may result in the substitution of land for other inputs, and farmers may regard expansion of area as a desirable adjustment. Land could remain in agricultural production, but labour and human capital might leave the sector, triggering structural change involving farm amalgamations (the technology effect). Larger structures would permit new technological and farming-practice options for exploiting the land that were not previously feasible.

In other cases, reforms may result in the removal of land, as well as labour, from production (resource effect) and lead to downward pressure on land prices. Price effects will also differ according to the possibility of alternative uses for farmland, and the likelihood of a different mix of farm enterprises (which is limited in some rural areas and significant in others).

Table 5 summarises the different scenarios involving the withdrawal of agricultural land and/or labour from agriculture following the removal of output-related agricultural support. For countries/regions whose agricultural sectors are already characterised by large-scale structures and low labour-land ratios, and where unused land can revert easily to an ecologically sound, pre-agricultural state, both scenarios in the bottom line may seem inevitable and desirable (Burrell, 2001). However, in countries/regions whose current provision of agricultural land-based environmental amenities is based on smaller-scale, more labour-intensive agriculture, and where high population density creates heavy demand for them from agriculture, these developments would be viewed with more concern.

Table 5. Summary of impacts on environmental services of changes in agricultural land-use following a fall in output-related support

| Labour | Land | |
|-----------|--|---|
| | Remains | Withdrawn |
| Remains | Farm incomes fall, rural poverty increases. Deterioration in farming practices possible. Consequences for environmental services from agriculture difficult to predict | Not realistic |
| Withdrawn | Farm amalgamation, restructuring → new technology Greatest threat to landscape preservation, biodiversity and rural employment. | Land abandonment or conversion, out-migration. Reduction in the total provision of landscape, biodiversity; loss of flood and disaster prevention, food security and rural employment (where relevant). |

Source: Adapted from Burrell (2001).

Payments based on input use

These payments reduce the cost of production for the commodities that use these inputs. Lower unit costs lead to higher levels of output and higher profits for farms receiving this benefit. The larger the support provided and the more important the input is in the total cost of production, the larger the effect on output. To the extent that the input is either a substitute for or a complement to farmland there may be either an increase in the amount of farmland used per unit of production, or a decrease. Thus, there is a degree of ambiguity in the impact of input subsidies on farmland. However, if the support triggers a large increase in production, a greater amount of farmland may be allocated to commodities that use the input, even if farmland is a substitute for other inputs.

In the agricultural core zone, the influence of input support will be significant, supposing the input is commonly used in various types of agriculture. To the extent that larger farms use more of the input, they will gain more of the benefit. If this increases the competitive position of large farms, an increase in average farm size could result. Once again, while the economic conditions of some farmers may decline and others improve as a result of the subsidy, and while a change in the mix of commodities produced could take place, there should be no material change in the amount of farmland in the agricultural zone.

Similar to the output-based support case, the effects of an input-based support on individual farm welfare should be modest at both margins, for small farms, when compared to the effect in the agricultural core zone. Similar results should also prevail for farmland conversion effects. At the urban fringe, input subsidies are likely to have a very limited effect on the decision to convert farmland to alternative uses. At the far margin, changes in the level of input subsidy may alter the location of the boundary between agriculture and lower-value uses, if the change in input subsidies is significant. This is most likely to be the case for those countries where farms at the far margin are large in size.

It should be pointed out that the payments based on the inputs-use category of support to producers also includes programmes which provide payments on condition that farmers respect certain production practices considered environmentally or animal-welfare friendly, or which address food safety or other societal concerns.⁶ Agri-environmental programmes designed to prevent or decelerate the conversion of farmland to other uses, such as urban development, are classified under this category. The *Farm and Ranchland Protection Programme* (FRPP) in the **United States** is one such example. The FRPP provides funds to state and local governments or non-profit groups to help purchase development rights that keep productive farmland in agricultural use. Funds can be used to purchase conservation easements or to purchase easements to protect historical resources.

Payments based on current area, animal units, revenue or income with commodity production required

These payments provide revenue to farms on the basis of some current measure of farm size. There are two types of such schemes. The first provides a flat rate per unit of measure (*e.g.* a farm may receive a fixed payment per hectare planted to a given crop). In the case of revenue and income payments, there may be a cap on payments or a trigger value for a decline in income or revenue. In each case, though, it is the current level of the measure that triggers the level of payment. The other type of scheme provides higher values for initial levels of the measure, and reduced support as hectares, animal units, revenue or income rise. This type of scheme aims to protect small farms. The second version is most commonly used in LFAs as a strategy to slow the rate of farm abandonment at the extensive margin.

6. For example, most of the agri-environmental programmes in the United States are included in this category.

In the agricultural core zone, the effects of this payment stream are the same as in the previous cases. If payments are constant per unit of measure, then larger farms receive larger benefits, and these benefits may be used to enhance their competitive position within the zone. The same conclusion also applies to the impact of these policies on the stock of farmland, with some effect on the mix of commodities produced, but little effect on the total quantity of farmland. In the urban fringe, these payments would typically have little effect because they offer most farms small benefits relative to the returns from conversion. In a limited number of cases, if payment levels are high and can be generated on a small land base, farms may have an incentive to remain in production for a longer period of time than would otherwise be the case.

It is at the far margin that the version of the payment scheme in place has a major bearing on the degree of impact, particularly for small farms. If flat-rate payments are in place, then there will not be a significant effect because the amount of money transferred is likely to be too low to alter the economic condition of farms facing low revenue and high costs.

However, if the payment scheme is structured so that farms with low values of the performance measure receive a high level of support and its level is reduced for higher values, the effect on farms in the far margin can be substantial. Where farms in this spatial zone tend to be small and have limited opportunity to increase output, a scheme that front-loads support on initial quantities of hectares, animal units, revenue or income, adds a large increment to income.

For farms with no potential to achieve higher levels of the specific performance measure, this approach maximises benefits. Consequently, a higher rate of farm survival and even an expansion of agriculture onto marginal land with high levels of support could be expected.

Payments based on non-current area, animal units, revenue or income with commodity production required

This form of support provides lump-sum payments based on some historical condition, with current production of any commodity required. This type of support is used by only a few OECD countries (e.g. **Norway**, **Canada** and **Mexico**) and, on average, accounted for less than 1% of total support to farmers in the OECD area in 2005-07. Its impacts are similar to those described in the previous case.

Payments based on non-current area, animal units, revenue or income with no commodity production required

These payments provide the same sort of benefits as described in the two previous cases, but do not require current production. Essentially, this form of support provides lump-sum benefits based on some historical condition, which effectively decouples support from production decisions. This type of support is particularly important in the **EU** and the **United States**, where it makes up around 25% of support to producers. It is now also important in **Switzerland**, **Mexico**, **Canada** and **Turkey**.

Typically, these programmes require the farmer to maintain land in a condition suitable for agriculture, even if no production takes place. Thus, it is unlikely that a farmer would be able to convert land to an alternative use and also maintain programme support. Unlike the previous case, there is generally only one version of these programmes, as there is little interest in providing high rates of support on the initial levels of the measure used to determine payments. This means that payments tend to be a constant amount per unit of hectares, animal unit, revenue or income up to a specified maximum. However, payments can be provided at fixed rates (*i.e.* the SFP in the **EU**) or at variable rates, where the level of payment is triggered by a change in price, yield, net revenue or income, or change in production cost (*e.g.* the Countercyclical payments of the 2002 Farm Bill in the **United States**).

In the agricultural core zone, the effect of this type of support will mainly be seen in a shift in the mix of outputs as farmers adapt to market signals given by changes in relative prices. Lump-sum payments clearly provide more resources to the enterprise, and farmers receiving large payments may choose to use them to support expansion of the farm through land acquisition or capital improvements. This may affect the distribution of land holdings, but it should not alter the total stock of farmland.

In the urban fringe, the main effect of these payments may be an incentive to delay development. Owners of farmland would no longer incur the expense of production, and the combination of current income from subsidies and potentially higher land values in the future may lead to a slower pace of land conversion in the short to medium term. However, if the farmland owner has a short planning horizon, it is unlikely that payments will block conversion when the opportunity to realise large capital gains from conversion is available.

At the far margin, the effects of lump-sum payments are more nuanced. Payments may be sufficient to keep land in farming, in the sense that it could eventually be brought back into production. However, this level of maintenance may not be enough to provide the full amount of environmental services that are associated with agriculture. For the farm owner, the net return from payments leaving land idle may be roughly the same as exceed the net return from production with lump-sum payments. In this case, land will be maintained in almost an intermediate status between out-of – and in-production. Alternatively, the payments may be adequate to keep land in production.

The study on the effects of the 2003 CAP reform in England (discussed in the next section) suggests that, due to limited opportunities for diversification, policy reform will tend to shift the relative spatial intensity of farming by concentrating production on the best and most accessible land, as defined at local level, and/or induce agricultural land to leave agricultural management.

Payments based on non-commodity criteria

These payments to farmers refer to transfers provided for agri-environmental reasons or for the production of visual and open space amenities of value to society. Although these payments are becoming more common as the broader functions of agriculture are explicitly recognised in the policy process across OECD countries, they still account for only 2% of total support to producers. They are most important in the **United States**, followed by **Switzerland** (7% and 3% of the total support to producers in 2005-07, respectively). In terms of the level of payments, the Conservation Reserve Program (CRP) in the **United States** is the largest single measure in this category.

Two main types can be distinguished: those payments which entail transfers for the long-term retirement of factors of productions from commodity production (*e.g.* the CRP States and in the EU the long-term set-aside); and those which provide transfers for the use of farm resources to produce environmental services, which are not required by regulations (*e.g.* payments for hedges and payments for floral fallow in **Switzerland**).

Long-term diversion programmes, although achieving rural development objectives is not their specific aim, can affect rural communities in a variety of ways. For example, by improving the rural landscape and fostering a cleaner environment, they can contribute to the quality of rural life; be of benefit to outdoor activities and recreation in many communities; and act as a significant stimulus to rural economies. Moreover, by increasing the revenue of farm households, they can boost consumer demand, including recreational spending.

On the other hand, retiring productive farmland can have the effect of reducing the demand for farm inputs and agricultural marketing services. Thus, if alternative economic activities (such as hunting, fishing and other forms of outdoor recreation) do not develop in tandem with the withdrawal of farmland from agricultural production, rural communities with high proportions of farmland enrolled in

such programmes can be adversely affected. Decreased farming activity could also result in decreased demand for non-farm goods – and the consequential job losses could contribute to out-migration from such areas. Pronounced shifts in a community's economy can also affect its desirability as a place to live and work, and, ultimately, its population level.⁷

The intent of the payments to provide environmental services is often to preserve farmland. These payments are of particular importance in urban regions where open space is scarce. Thus, if society wishes to maintain the production of amenity outputs, it may be prepared to provide additional income to farmers to reduce the incentive to sell off farmland for other uses. Of course, there is the possibility that some other use will also provide similar amenities (*e.g.* a golf course). However, most other uses are not likely to provide the same level of visual amenities.

By increasing farm income, the opportunity cost of keeping land in farming decreases. Whether non-commodity payments are effective in maintaining farmland depends upon the size of the increase in income and the capital gain from selling the land. There is likely to be a positive relationship between the value of open space and the alternative use-value of land, as congestion should increase both, albeit not at the same rate.

Payments for environmental services can have very different impacts depending on the type of farm and its location in space. In some instances non-commodity payments may reinforce production decisions – for example, a visual amenity payment associated with an extensive grass-fed cattle enterprise. In other cases they may be ineffective. For example, payments to maintain hedgerows are generally ineffective in cereal crop areas, where the benefits from field consolidation that allows the use of larger machinery are high.

In the agricultural core zone, non-commodity payments may influence farmers to alter production decisions for some portion of their land. This could include putting low-productivity fields into conservation uses or not cultivating wet areas. However, in times of low commodity prices, with or without support, these lands are likely not to be used, and, in times of high commodity prices, farmers seek to remove this land from conservation uses and bring it into production. This could suggest that in the agricultural core zone, non-commodity payments act as lump sum transfers in periods when commodity prices are low, but may, to a limited extent, influence the supply of farmland when commodity prices are high, if the policy effectively prevents the farmer from using the land.

Many of the environmental services of agriculture are local public goods. This means their value is determined within a relatively small geographic area by local supply and local demand. In the agricultural core zone, the supply of local non-commodities is typically high relative to demand, which results in a relatively low implicit or shadow price. This mainly reflects a large stock of farmland and a relatively small local population. By contrast, the demand for commodities is established at the international level, which leads to commodity production generating a higher value than non-commodity production. As a result, the use of farmland in the agricultural core zone is largely driven by commodity policy. If non-commodity payments are to be used for farmland preservation they will have to be targeted to those farms most subject to an alternative use.

In the urban fringe, environmental services from agriculture may be more valuable to society than the actual commodities produced. However, it is rare that the level of payments for non-commodity

7. Sullivan *et al.* (2004) examined the impacts of CRP on rural growth in the US in terms of rural employment and businesses, rural population and new farmers; and opportunities for recreational activities (including hunting and fishing). The study found that the CRP's aggregate rural economic impacts have been modest and largely transitory. Factors other than CRP determine long-run population and employment trends in rural America and in most cases CRP is seen to play a minor role in the economic and social trends observed in rural counties.

output is high enough to overcome the opportunity cost of farmland. In many cases the farmer receives very limited direct remuneration for environmental services, in comparison with the level of support which is based on commodity criteria.

In this zone, there are greater off-farm employment opportunities and incomes of farm households are usually more diversified than in other zones (Heimlich and Anderson, 2001).⁸ Many of these farm households derive considerable non-pecuniary benefit from their farms, so its non-commodity value is an important component for operating the enterprise. If non-commodity payments reinforce the life-style benefits already received by such pluriactive farmers, then they will be more likely to continue in farming.

The level of environmental services from agriculture is also typically high at the far margin. Farms at this margin are often found in areas of high visual amenity and, whilst distant from major urban centres, they may attract large numbers of tourists or be of value for wildlife preservation. By their nature, farms in this zone provide a relatively small share of national agricultural production, which suggests that policy to maintain farming in the far margin zone will be more easily justified and implemented through support for environmental services targeted to such areas.

8. Heimlich and Anderson (2001) argue that off-farm employment opportunities in the urban fringe can lead to either part-time farming or the setting up of recreational farms that eventually develop into full-time, part-time or retirement businesses.

Chapter 4. The Effects of Land-use Policies on Agricultural Land-use

4.1 Land-use policy and agriculture

The term “land-use policy” refers to the set of rules and regulations that directly influence the use of farmland, whether they are implemented by national or sub-national governments. Land-use policy provides an alternative mechanism for influencing agricultural land-use. Typically, land-use policy has not been seen as a key factor in agriculture. This, in part, reflects the prevailing assumption that the stock of farmland is largely fixed and that, while land-use policy might have some impact on the stock of farmland at the local or regional level, it has limited influence on the agricultural sector taken as a whole. By its nature, land-use policy is explicitly spatial in nature. While policies may be designed to deal with broad land-use issues, they have their impact on particular parcels of land.

While there are a few forms of land-use policy that employ financial incentives to alter the relative returns to farmers from agriculture and other uses, in most countries the majority of land-use policy uses the regulatory power of government to compel land owners to follow particular actions. In this sense, most land-use policy is not market-based.

In some OECD countries, the application of land-use policies regulating farmland is largely a national matter, while in other countries it is largely a local matter (OECD, 1996a; 1998b; 2008a). In some countries, there are strong controls on farmland conversion, while in others there is little to stop farmland being converted to alternative use. For example, while in **Canada** land regulations generally restrict farm splitting, in **Japan**, non-agricultural activities are prohibited for land that is designated as farmland-use.

In OECD countries, the concern with regulating farmland is usually limited to the broad definition of agricultural use, and there is no intent to regulate the specific type of agricultural production that takes place. However, in many regions there are prohibitions both on specific types of agricultural land-uses and on specific production practices, for example, bans on animal feeding operations in close proximity to high-density residential developments, or on the application of animal manure or fertiliser in ways that lead to high levels of run-off into waterways, are common.

Land-use policy influences agricultural land-use in two distinct ways. The first, and most common, way is through either imposing restrictions on farmers’ behaviour, or encouraging specific actions. This type of land-use policies may alter the costs of production, or the revenues from carrying out agricultural production, and thereby influence the viability of the farm enterprise. However, altering the amount of land in agriculture is not the basic premise of such programmes, and for the majority of farmers this type of land-use policy can be thought of as mainly influencing how farmland is to be used.

The second type of policy is designed to influence land-use at a larger scale – that is, to affect decisions to either bring land into farming or remove land from farming. Clearly, these policies are most important at the urban and far fringe, where land conversion is a relevant issue. By contrast, farmland in the agricultural core zone is, by definition, hardly affected by these programmes because there is little reason to modify the current land-use. These programmes can be thought of as influencing how much

land is available for farming. It is this latter class of programmes that is the focus of this part of the paper.

4.2 Land-use policy effects on farmland types

In this section the influence of a variety of land-use policies that are designed to control farmland conversion are discussed. These policies are broken into two broad categories depending on whether a policy uses financial inducements, or simply the regulatory power of the state, to achieve its objectives. Within each category, policies are ranked in terms of their ability to influence behaviour. Table 6 provides a summary of the spatial effects of land-use policies on farmland conversion.

Table 6. Ability of land-use policies to influence farmland conversion

| | Urban fringe | Agricultural zone | Far, or extensive, margin |
|--|---|--|---|
| Comprehensive zoning | effective, but can be costly unless government has clear rights to restrict conversion | irrelevant because land use is constant | impossible because farmers can not be compelled to work for no profit |
| Hard growth boundary | effective, but eventually has to adjust to accommodate population growth | irrelevant because land use is constant | irrelevant |
| Limits on providing basic infrastructure | stops commercial and large-scale residential development, but does little to stop building of individual homes and may increase fragmentation of land ownership | irrelevant because land use is constant | irrelevant |
| Right-to-farm laws | may slow conversion in areas where development is starting to accelerate, but has little value elsewhere | limited use if conflicts arise with neighbouring non-farm activities | irrelevant |
| Land purchase | feasible for small quantities with very high public value | infeasible | feasible for small quantities with very high public value |
| Purchase of development rights | effective, but expensive if permanent rights are purchased; limited value if only temporary rights are bought | irrelevant because land use is constant | irrelevant |
| Capital gain capture on conversion | may slow development, especially as distance from urban boundary increases | irrelevant because land use is constant | irrelevant |
| Use value assessment for property taxes | may slow development, but effect depends on distance from urban boundary | irrelevant because land use is constant | irrelevant |

Pure regulatory programmes

Comprehensive Zoning establishes acceptable land-uses for specific parcels of land. It is an explicitly spatial programme that determines what land-uses are permissible for each parcel of land within the zoning ordinance. While zoning schemes may allow a change of land-use, they typically require regulatory approval for each change. Authority for zoning can rest at any level of government. In some countries, land-use patterns are determined by national governments, while in other countries

zoning is a local government responsibility – and in certain regions may not exist at all. In some countries, zoning regulations are subject to legal challenge, while in others there is clear authority for government to regulate land-use.

Zoning can be highly effective in regulating land-use conversion in the urban fringe. If land-uses cannot be changed, then the existence of potential profit from conversion becomes irrelevant. Essentially, zoning takes away the opportunity cost of farmland, and as long as other factors of production earn an acceptable return, the land will continue in agriculture.

In the agricultural core zone, the introduction of comprehensive zoning has little effect. Since farmland has no alternative higher value uses, there is no pressure for conversion. At the far margin zoning may be considered as a way to block farmland conversion but it is likely to be ineffective. While a parcel of land may technically be zoned as agricultural land, it will not be used for farming unless it is profitable. Other regulations may be used to compel landowners to keep their land in a condition suitable for farming, but even in this case benefits are limited and enforcement costs can be high.

Hard Growth Boundaries limit urban expansion. Instead of zoning particular parcels of land, a government may designate a boundary beyond which urban development is not allowed. In essence, the government creates the hard edge envisioned by von Thünen between the city and agriculture. Obviously, this approach only deals with the urban fringe. It is also relatively simple to implement because only one line has to be established, with a list of acceptable uses on each side of that line. Similar to the case of zoning, a hard growth boundary removes the opportunity cost of farmland outside the boundary. As a city grows over time and uses up the interior land, the boundary has to be extended, but this process allows planned growth.

Limits on Providing Basic Infrastructure make high-density development difficult or impossible. A government can choose to limit farmland conversion by refusing to provide basic services to parcels of land. Higher-density land-use requires the provision of water and sewer lines, electricity and other public infrastructure. If a government refuses to extend these services beyond a designated territory, it may effectively limit development. While it may be possible to provide this infrastructure privately, the increased cost of doing so can make conversion of farmland unattractive. Once again, this approach is most applicable at the urban fringe, where high-density development is most likely and connections to existing infrastructure are feasible.

These infrastructure restrictions have the greatest impact on large-scale, high-density development. But their effects in blocking small-scale, low density conversion that does not depend upon public services are limited. As a result, it is possible that farmland could become fragmented under this approach if farmers sell parcels of a few hectares in size to individuals, with the cumulative effect being very dispersed, low-density residential incursion.

Right-to-Farm Laws reduce potential conflicts with neighbours. As development increases on land surrounding farms, the potential arises for farm practices to irritate neighbours. Nuisance-type activities associated with agriculture can include: late night and early morning farm operations, equipment blocking road traffic, odour from livestock, and dust from field operations. Similarly, farms can experience problems of trespassing, theft, and livestock being worried by stray dogs. Each of these problems makes it more difficult to continue to operate a farm and in the absence of clearly defined rights to undertake normal farm practices there is a possibility of local government placing restrictions on farming, or of civil law suits. Right-to-farm legislation clarifies the legal status of farming and thereby may provide a modest incentive for farmers to continue farming.

Right-to-farm laws are most useful at the urban fringe, where there is the largest interaction between farm and non-farm land-uses. In the agricultural core zone, while there is a much smaller amount of non-farm activity, this type of legislation can also be helpful in areas where there are second homes or

exurban residential development. In the far fringe, nuisance problems may exist but they are likely to be a minor factor compared to the problem of economic viability.

4.3 Land-use policies using financial inducements

Land purchase by a body that will maintain the land in agriculture can ensure it remains in an agricultural use. However, application of this approach faces two obvious difficulties. The first is the high cost of purchasing land and then the subsequent ongoing management requirement. While purchased land can be leased to farm operators, it must still be managed in order to preserve its value (*i.e.* still requires supervision to ensure it is being managed correctly). This makes direct purchase a viable strategy only in the instance of a small parcel of land that has a very high public value.

This is most likely to happen in the urban fringe, where land in a specific location may have a very high non-commodity value. Similarly, in the far fringe there may be special cases where farmland has unique amenity or wildlife value that leads to purchase. In the agricultural core zone, it is difficult to conceive of a situation where farmland purchase would be a realistic option.

The *Purchase of Development Rights* (PDR) provides a less costly way of controlling land conversion. Instead of purchasing the entire property, it may be possible to purchase only the development rights. Essentially, this means purchasing the opportunity cost of land so that the farmland owner retains the right to use the land for agriculture. Obviously, the value of development rights is a strict function of opportunity cost and may be far greater than the residual agricultural value. However, in other cases, development rights may not add much of a premium over the agricultural value of land.

PDR policies can either buy rights permanently or for a defined period of time. Permanent purchases are obviously more expensive than short-term purchases, but the latter allow a given budget to be used to acquire more rights. In addition if the purchase of rights is seen as a temporary solution until a more permanent policy is in place – say, zoning – then the strategy may be justifiable. However, since many developers acquire property several decades before they plan to convert its use, a temporary programme runs the risk of actually increasing the incentive for developers to build an inventory of land well before they plan on conversion.

In the neighbouring part of the urban fringe, PDR programmes face the same problem as direct land purchase. The market value of land is mainly set by its development value, so there is little saving from a PDR over direct purchase. In the more rural parts of the fringe, it may be possible to acquire development rights relatively cheaply, as a pre-emptive strategy to control long-term expansion. PDR programmes seem ill-suited to either the agricultural core zone or the far fringe, where conversion of farmland to a higher use is not an issue.

Capital Gain Capture reduces the incentive for a farmer to sell land for another use. The main motive for a farmer to sell land for conversion is the much higher price the land will command than at its current-use value. If all or a large part of the capital gain is taxed away, however, the motivation to sell will be greatly reduced. One argument for adopting this type of tax is that the increase in farmland value is a pure windfall from the farm owner's perspective. The increase in land value is not a result of any direct action by the landowner; instead it results from changes in the neighbouring community.

This type of policy reduces the returns to the farmer from selling for conversion, but it does not eliminate the demand for land. As a result, the programme is only effective if the opportunity costs of the farm household are low. Otherwise, to the extent that less farmland is made available for alternative uses, this type of policy could have the effect of pushing up bid prices for farmland as non-farm interests compete for the smaller quantity of land. If the policy is designed to control conversion then it is important to be able to isolate capital gains based on farming from capital gains stemming from a change in use. Once again, the policy is most likely to be effective in the urban fringe, where the

opportunity costs of farmland are highest and capital gains beyond normal agricultural appreciation are largest.

Use Value Property Tax Assessment reduces the cost of maintaining land in farming. Property taxes based upon current market value provide a strong signal to landowners about the opportunity cost of holding land in a lower-value use. Standard public finance theory suggests that market value assessment leads to more efficient land-use patterns, but this theory assumes that the full value of property is captured in its market price. In the case of farmland, where there may be environmental services that have no market value, it is possible that market signals could be faulty.

It is common practice to assess farmland at less than the market value. Typically, the value for tax purposes is determined by agricultural productivity and results in an assessed value that is significantly lower than the current market value. Clearly, this practice provides a large benefit to farms where the market value of farmland is largely determined by non-farm opportunity costs. Thus, the primary beneficiaries of this practice are in the urban fringe.

However, it is doubtful whether the reduction in property taxes provides a significant incentive to remain in farming when the potential capital gain from selling is high. As distance from the urban centre increases, the potential influence of a lower tax bill increases, but the effect is likely to decrease over time if development pressure increases. In the agricultural core zone, use value assessment provides no real benefit to farmers because land values are largely set by agricultural use. Similarly, at the far margin, use value assessment offers no benefit to farmers.⁹

Preferential Estate Taxes reduce the likelihood of a farm being sold when the operator dies. Farming in all countries is characterised by a high rate of occupational succession, where families try to keep a farm intact as it passes from one generation to the next. Because farmland is the single largest component of farm assets, there is a common problem of farm income being insufficient to maintain the next generation and pay estate taxes. Most countries have modified their estate taxes to make it easier for farm households to remain on their farms by exempting some of the estate from taxation, taxing it at a lower rate, or extending the payment period. Typically, to receive these benefits the farm has to remain in the family and in operation.

The result is an incentive to keep land in agriculture, at least for the duration of any required holding period. The longer-term effect of the policy is likely to depend upon the potential for capital gains from a sale and the family's interest in remaining in farming. At the urban fringe, the effect is most likely to be significant, with limited benefits for land conversion elsewhere.

9. A modified version of use-value assessment that includes claw-back provisions has the potential to be more effective at limiting conversion. With a claw-back, the farmer has to repay the tax differential if land is sold for non-farm purposes. Obviously, the longer the period where a tax adjustment is due, the more likely this provision is to limit sales for non-farm purposes.

Chapter 5. Farmland Conversion: Country/Region Examples

This chapter provides information on a range of programmes in five OECD member countries that have been designed to influence farmland preservation. Whilst the details of programmes vary from country to country, their common aim is to alter land management decisions by farmers in ways that will increase the flow of socially desirable outputs from farmland. Some programmes operate at the national level, while others are specific to a particular region. The five countries under consideration are Australia, Belgium, Canada, Finland and the Netherlands.

As Table 7 shows, these five countries represent a diverse set of agricultural conditions. Three have a relatively small share of arable land – but, of the three, both Australia and Canada are major food exporters. These two countries have both a large amount of arable land in terms of total area and a large amount of arable land per person, which allows them to produce far more than can be consumed domestically. Finland differs from Canada and Australia in that it has a much smaller arable land base and also a much smaller urban share of the population. In Belgium and the Netherlands arable land represents more than one-quarter of the total land area, but, because both countries are small with relatively large populations, there are well over 1 000 persons per square hectare of arable land. Nevertheless, the Netherlands is a major agricultural exporter.

Table 7. Background information on case study countries

| | Arable land | | Population | | Urban population |
|-------------|-------------|-----------------|------------------------|--------------------------------------|------------------|
| | Share | Km ² | (per km ²) | (per km ² of arable land) | Share |
| Australia | 6% | 460 938 | 2.6 | 43.8 | 88.2% |
| Belgium | 28% | 8 546 | 340.8 | 1 216.9 | 92.7% |
| Canada | 5% | 498 530 | 3.2 | 64.8 | 80.1% |
| Finland | 7% | 23 670 | 15.4 | 219.7 | 61.1% |
| Netherlands | 27% | 11 139 | 392.5 | 1 463.3 | 80.2% |

Notwithstanding these differences, there exists a strong interest in preserving farmland in all five countries. In the case of Belgium and the Netherlands this reflects an acute scarcity of farmland and the fact that the majority of farmland is located in close proximity to urban areas. As a result there is a strong interest in maintaining both commodity and environmental services from farmland. In Australia and Canada a very high share of the population is to be found in urban areas and, consequently, the existence of adjoining areas of open space is an important issue there. Most of the farmland in these two

countries is not subject to urban pressure, by virtue of its location at vast distances from the towns and suburbs. In Finland, a much smaller share of the urban population leads to a more uniform population distribution across the landscape, but adverse climatic conditions make agriculture more marginal. Access to green space is less of an issue than in Australia and Canada, but there is an interest in preserving open spaces and maintaining some domestic commodity production.

5.1 Australia: The Environmental Stewardship Programme

Australia is a major agricultural exporter despite the fact that only 6% of its land mass is arable. It is also a highly urbanised country with 88% of the population living in urban areas. Moreover, the majority of arable land is found in close proximity to urban centres. As a result, while Australia has a large land base, both urbanization pressures on prime arable land and a high percentage of pasture-land being on the margin of profitability are issues that need to be addressed. Despite harsh environmental conditions, agriculture is the most extensive form of land-use (OECD, 2008c). Farming operations in Australia consistently experience problems with drought and salinity – and the effects of climate change are predicted to exacerbate these problems (Cocklin, Dibden and Mautner, 2006). The need to address issues of land and water management, and biodiversity conservation has been recognised and a range of policies have been implemented to address agri-environmental concerns (Hajkowicz, 2008; OECD, 2008c).

In 2007, the Australian Government introduced the *Environmental Stewardship Programme* as a market-based complement to statutory and regulatory mechanisms to govern the management of land with high-value environmental and amenity characteristics (see www.nrm.gov.au/stewardship). This reflected a recognition that, while it is possible to achieve a significant amount of protection through the imposition of regulations, there is also a role for payments to private landowners to create incentive to go beyond the land manager legal requirements.

The objective of the Programme is to maintain and improve the quality and extent of targeted high public value environmental assets on private land. The Programme engages private land managers in long-term (up to 15 years) contracts to manage these assets, using a range of market-based approaches. Selected farmers and other private land managers will be paid to undertake agreed actions beyond their regulated responsibilities to achieve public benefit environmental outcomes that contribute to the long-term protection, rehabilitation and improvement of targeted environmental assets on private land. Relevant actions could include changing property management in relation to aspects such as: stocking and grazing intensity; implementation of a different fertiliser regime; and weed management. Land managers will be selected through auction, tender and other market-based mechanisms. Payments to landholders will be treated as income and will be taxable.

The Programme focuses on specific species (*e.g.* nationally endangered or vulnerable species, migratory species, etc.) and locations but does not dictate how land is to be managed. Individual landowners voluntarily submit land-use management plans and the compensation they expect for carrying out the work. Each submission has to show how it contributes to achieving the programme goals. These submissions are evaluated on the basis of: the scope of the proposal and its relevance to contribution to the goals; the capability of the landowner to carry out the work; whether there is a critical mass of contiguous land on which the work to be carried out is large enough to produce a worthwhile result; and the proposed cost. The Programme does not purchase land, and not all submissions are accepted.

The Programme will take four years to build its set of agreements and it begins with a small number of specific ecosystem types as the initial focus. Over time, new ecosystem types are to be added. A significant part of the Programme is a monitoring and evaluation function to determine if proposed actions are being followed and if expected results are occurring. Initial funding for the Programme is

AUS 50 million for the four-year establishment phase, with supplemental funding provided to pay for the remaining life of the contracts.

While still in its infant stage, the programme points to the perceived advantages of coupling market-based mechanisms with regulations, as ways to alter landowners' patterns of behaviour. By providing payments for the provision of environmental benefits, the returns from farming are increased, which should have the effect of lowering the rate of farmland conversion. By contrast, simply relying on regulations that do not take into account farm management practices typically increases production costs and has a negative effect on farm viability, especially where farmland has high opportunity costs.

The Programme does not focus explicitly on farmland, but, since the majority of private land in Australia is part of farms, the expectation is that farm-owners will be major participants. In particular, the Programme may be of considerable value in peri-urban areas, where there is continuous pressure for the intensification of land-use, which can lead to the conversion of environmentally significant land.

Houston (2005) estimates that perhaps one-quarter of the value of Australian agriculture is produced in the vicinity of cities. This land represents approximately 3% of the total Australian land base, but much of it has high agricultural and amenity value because the cities were initially established in the more desirable parts of the country. According to this study the majority of high-value crops – vegetables, fruit and grapes, horticultural products – are produced in these regions. The author notes that the land has competitive uses and that there are important environmental issues associated with intensive agriculture.

5.2 Belgium: Agricultural diversification in Flanders

Flanders is one of the three regions that constitute Belgium. At 13 522 square kilometres, it comprises about 45% of the national territory. The majority of this land base is agricultural land, but according to the OECD's definition of "rural", less than 10% would be categorised as predominantly rural. Indeed, a significant share of agriculture is conducted in what would be considered the predominantly urban zone. Agriculture in Belgium is shifting to larger farms on a smaller land base, with less pasture and more arable land and permanent crops. This reflects increasing land values, both in agriculture and in non-farm uses. As noted by Cazaux, Carels and Van Gijsegheem (2007), Flanders can be characterized as a peri-urban area where agriculture has always been, and remains, a significant economic activity.

The key forces affecting agriculture in Flanders are urban pressure and concerns with the environmental impacts of farm production. In addition, there are increasing problems associated with fragmentation of land holdings as ex-urban residential and other land-uses break up parcels of farmland (Cazaux, Carels and Van Gijsegheem, 2007). This results in adverse consequences for both agricultural production and wildlife habitat.

Because agricultural policy within Flanders largely operates within the boundaries set by the CAP there has been a significant effort to find ways to implement revisions to CAP policy in ways that suit the particular requirements of peri-urban farming. In particular, the Single Farm Payment provides a way to couple the income stream to environmentally benign agricultural land-use. In addition, the Second Pillar of the CAP provides additional opportunities to grant farm support for diversification activities.

Key concerns in Flanders are farm consolidation and farmland conversion, both of which practices alter the fundamental rural landscape in adverse ways. The former leads to either the abandonment of historic buildings or opens the way for ex-urban residential development or both. Consolidation can lead to more intensive farming practices (with adverse environmental consequences). Farmland conversion

implies a reduction in the critical mass of farmers and a change in the landscape, as well as possible problems for wildlife habitat.

To address these concerns, the government of Flanders has linked agricultural policy with land-use policy. Agricultural policy, although largely derived from the CAP, is focused on maintaining farm numbers and farm viability. Land-use policy (through the 1997 Spatial Structure Plan) provides mechanisms for maintaining open space and managing the path of urban development (Cazaux, Carels and Van Gijsegheem, 2007). The plan has been in effect for almost ten years, with mixed results.

It appears that the broad land control measures are largely effective, with development following the projected path (Celen, 2007). There has been difficulty in achieving mixed use of land that combines farming with rural landscape. Farmers are reluctant to enter into long-term commitments that may constrain their production decisions. On a more positive note, the range of payments available under 2003 CAP reform has encouraged farmers to adopt practices that result in additional income.

Flanders has actively encouraged farm diversification as a way of increasing the returns to farmland and at the same time, reducing the incentive for farmers to consider farmland conversion. Aspects of this programme include adjustments in the production and marketing of normal commodities, the production of non-traditional outputs (including energy and agro-tourism) and the provision of environmental services. In the case of normal commodities, there are incentives for farmers to adopt organic production methods and to use direct marketing techniques and local branding. Non-traditional activities include the production of energy (solar/wind/wood) and services provided for domestic animals owned by urban residents, as well as agro-tourism and agro-education. Finally farmers are encouraged to provide “green services” through habitat provision, storm water retention and the provision of visual amenities.

Cazaux, Carels and Van Gijsegheem (2007) reviewed studies of the impact of diversification schemes in the vicinity of Brussels. They find that: the interest of farmers in diversification decreases with distance from the city; the interest decreases as diversification adversely affects agricultural performance; and that farmers’ interest increases with either a positive environmental attitude or past experience of diversification measures. They note that some of the restrictions put in place to block non-farm development can also have adverse effects on farm diversification. In a parallel study investigating the impact of on-farm diversification as a survival strategy in Flanders, Vernimmen, *et al.* (2004) determine that on-farm diversification is ineffective in supporting farms with marginal viability, but that it can be effective in augmenting the income of farms that have some critical mass.

The approach in Flanders seems to be evolving over time and finding ways to provide more market-oriented incentives to persuade farmers to adopt either diversification or agri-environmental measures. This reflects the inherent difficulty in obliging farmers to engage in these activities. While it is possible to establish regulations that prohibit certain actions, it is clear that the incentive of price signals is a more effective way of producing the outcomes that are socially desirable.

5.3 Canada: The Greater Toronto Greenbelt

In Canada, land-use is a provincial responsibility and each province has its own legislation, policies and programmes regarding land management and use (George Morris Centre, 2005). Ontario is the most populous province in Canada, and Toronto is by far the largest city, with a metropolitan population of 5.5 million in 2006. Moreover, the Greater Toronto Area (GTA) has grown to this level from 4.2 million in 1991. Prior to 1991, the GTA was not a defined administrative unit, but in 1971 the Toronto metro area had a population of 2.8 million, which suggests a GTA population of about 3 million. This means the population of the GTA has increased by roughly 50% in 25 years. The GTA is the main urban

centre in a region known as the “Golden Horseshoe” that curls around the west end of Lake Ontario and has a population of about 8.1 million people, approximately one-quarter of the population of Canada.

Southern Ontario also contains just over half the Class 1 land in Canada and much of this land is within the urban shadow of the GTA. Between 1971 and 2001 the share of Class 1 land occupied by urban areas increased from 5.5 to 11.2%, with expansion of the GTA accounting for the majority of this change (Labbe, *et. al.*, 2007). In addition, land in the Golden Horseshoe has specific micro-climate characteristics that make it one of only a few areas in Canada where tender fruits and vegetables can be produced.

The Greenbelt Protection Act in Ontario was created by the Ontario provincial government in 2005 to designate and limit development on a significant portion of rural land in close proximity to the Greater Toronto metropolitan region. The designated land consists of approximately 1.8 million acres with the potential for adding additional land. The Greenbelt includes lands that were designated for protection under the Niagara Escarpment Plan of 1973 and the Oak Ridges Moraine Conservation Plan of 2001. Additional land was added to that previously designated by these two acts to provide a continuous band around the largest urban concentration in Canada. Provisions of the Greenbelt Act require all other agencies to conform to its requirements for land that is protected by the Act.

The Greenbelt Plan, which was established under the Greenbelt Protection Act, initiated to address the following issues:

- Urban sprawl: to keep development within specific urban boundaries and support infrastructure within those boundaries;
- Preserving agricultural land: prevent further encroachment of the urban shadow; and
- Environmental protection: protection of wetlands, natural environment and natural resources.

The key objective of the Greenbelt Plan is to enhance the rural areas and the overall quality of life through: agricultural protection; environmental protection; culture, recreation and tourism opportunities; support and sustain a vibrant rural community; support infrastructure and recognise the benefits of protecting renewable and non-renewable resources.

Participation is mandatory and the legislation is scheduled for review every ten years. The target audience of the Greenbelt Plan are the municipalities (to help deal with and better manage urban sprawl); environmentalists and rural owners for the protection of green space; developers for an understanding of where they can and cannot develop in the future); and farmers to identify where in the province agricultural land will be protected for production.

The land in both the Niagara escarpment and in the Oakridge Moraine contains some of the most fertile farmland in Canada, but these areas also contain significant amounts of undeveloped land that provides important environmental services. The intent is to manage the development of the entire designated zone in such a way that agricultural and other natural land-uses are preserved. A major factor in the development of the Greenbelt Plan was the growing concern that the expansion of Toronto and other neighbouring cities was making it increasingly difficult for urban residents to have access to open spaces.

Potential impact on agricultural land-use

The Greenbelt Plan postulates to achieve agricultural protection, which is one of its core objectives, in the following manner:

- Protect the Specialty Crop Area land base, while still allowing for infrastructure and value-added uses that are necessary for sustainable agricultural uses and activities, normal farm practices and an evolving agricultural economy;
- Support the Niagara Peninsula Specialty Crop Area as a destination and centre of agriculture focused on value-added uses for the agri-food sector and agri-tourism related to grape and tender fruit production;
- Protecting prime agricultural land by preventing further fragmentation and loss of agricultural land caused by lot creation and the re-designation of prime agricultural areas; and
- Creating certainty for the agricultural sector to foster long-term investment in improving the management of land.

While preserving farmland is a major objective of the Greenbelt Plan, many of its provisions are fairly broad in description and their interpretation might not be unambiguous (George Morris Centre, 2005). Nevertheless, considerable concern within the Ontario farm population has been expressed (Bunce and Maurer, 2005). One concern is the decrease in land values of farmland within the protected area, because the option for development has been removed (Amborski, 2005). This has had a significant effect on the net worth of those farmers affected. A second concern is the “leapfrog” effect on farmland outside the protected area, especially in those regions that are already within the urban influence of Toronto.

Farmers are also concerned because in many parts of the protected area there are restrictions on management practices and, in addition, a large share of the land has already been converted to non-farm uses. These two factors make it difficult for the remaining farmers to remain economically viable. In this case, the land is kept undeveloped, but the objective of a viable agriculture is not met. To a considerable extent, the focus of the Act was to preserve high-quality farmland, but without taking into account consideration whether farming would be a viable economic activity.

While the grape industry in the Niagara Region has prospered, it benefits from being part of a tourism complex. Other fruit producers are not as fortunate, because their costs are relatively high, compared to U.S. competitors. Similarly, commodity producers, such as corn and soybean growers, can face significant constraints as a result of the environmental protection aspects of Greenbelt Act and other regulations in the province. Bunce and Maurer (2005) note the problem of low returns and a “cost-price squeeze” facing farmers in the Greenbelt region. This suggests that land-use regulation can prevent farmland from being converted, but it cannot assure farmers of a profitable enterprise.

5.4 Finland: Farmland conversion in Åboland

Agriculture in Finland is a marginal activity, primarily due to climatic conditions. Nevertheless, Finnish farmers occupy a significant portion of the land where farming is possible. With a large territory and a small population, the average population density in Finland is relatively low, but population per hectare of arable land is moderate, because the area of arable land is limited (Tomsik and Rosochatecka, 2007). Of the five case study countries, Finland has by far the lowest share of urban population, at 61% and is one of the most “rural” countries within the OECD (OECD, 2008*d*; Vihinen, 2005). Finland also has relatively weak land-use controls, reflecting its low population density and limited experience with large-scale changes in land-use.

Because Finland is characterised by a low population density, a relatively low urban share of population and only one major city, access to open space has never been a major concern. However, Finland does have somewhat limited amounts of true open space – land that has been cleared and that

provides open vistas. In this respect, arable land, which offers good opportunities for open vistas, is of particular significance, as it accounts for only 7% of the Finnish territory (Yrjola and Kola, 2001).

This suggests that Finland, like the other Nordic countries, faces a somewhat different concern with farmland loss than is the case in other parts of Europe. Farming in Finland is largely farming at the far margin, where the economic viability of the enterprise is always at risk and abandonment is likely. Farming, by its nature, prevents trees from taking over the land (the loss of agriculture typically leads to the growth of forests). In the Nordic area there is less concern with simple access to nature, and more concern with the loss of land that is not forested. By contrast, the main concern in other parts of Europe (where population densities are higher) is that if farming is discontinued, land will be converted to urban use and green space will be permanently lost.

The case study of Åboland reflects a predominantly rural region in south-west Finland that is close sufficiently to urban centres to be experiencing a demand for recreation and tourism, as well as the construction of summer homes. About 3.4% of the territory in Åboland is used for agriculture, and agriculture accounts for 8% of local employment (Andersson, Eklund and Lehtola, 2006). Because Åboland is an archipelago, agriculture is only possible on the larger islands and even there the size of farms is limited by the topography. The region does, however, have micro-climate advantages that bring about an earlier growing season than in other parts of Finland.

Åboland has a strong second-home and summer tourist industry that provides significant income for the permanent residents during the tourist season. For the farming community the negative impacts of tourism are higher land values and competition for land. On the positive side, tourism provides opportunities for off-farm income and agro tourism, and has been a source of demand for local foods (Andersson, Eklund and Lehtola, 2006).

Because Åboland has developed a strong tourism industry, farming could remain viable through diversification. The combination of EU support for rural development and the presence of tourism provide an opportunity for farm-households to diversify their incomes. More recently, a coastal land planning system has been implemented which has reduced the pressure to convert farmland to second homes (Andersson, Eklund and Lehtola, 2006). Farmland provides an open vista that complements other natural environments in the region, which enhances tourism opportunities. Because tourism only provides seasonal employment, there is a need for other alternative employment opportunities in the remaining months of the year. In this context, farming has the potential to help maintain the local labour market.

5.5 The Netherlands: Agriculture in the Randstad

The Netherlands is a small, densely populated country that has significant and traditionally export-oriented agricultural sector. It has one of the highest populations per square kilometre of arable land in OECD countries, and a large number of small – but highly productive farms. Moreover, its relatively small size means that a city can be reached within half an hour almost everywhere in the Netherlands. Land-use in the Netherlands is highly urbanised in comparison with many EU countries, and in large parts of the country the differences between urban and rural landscapes are disappearing (OECD, 2008e).

The Netherlands has known a long tradition of land-use planning in which separation of urban and rural areas was a key concern. Zoning policy has been used to manage the spatial demands of diverse interests. This holds in particular for the demand for houses and business sites on the one hand, and agricultural land-use on the other (Overbeek and Vader, 2006).

The Randstad is the most urbanised part of the Netherlands. It contains the major cities of Amsterdam, Rotterdam, Utrecht, The Hague and Delft, as well as a number of satellite urban areas.

These peri-urban areas are often embedded between several cities and are used for work and recreation not only by urban citizens that live closest, but also by citizens of several nearby cities. However, the Randstad is a major agricultural producer, especially for green-house agriculture, and also has a significant dairy sector.

Dutch spatial policy established eight buffer zones in the region in 1958 as a way to control urban sprawl and maintain green space (van Rij, Dekkers and Koomen, 2008). While there has been continual pressure for urban expansion, these buffer zones continue to provide accessible green space to a large urban population (OECD, 2008*e*).

A key factor to success has been strong land-use controls accompanied by government purchase of land (Alterman, 1997). On acquiring land, the government guarantees that its use will not be changed. This, combined with a comprehensive land plan that originates at the national level and is reinforced at the provincial and local level, assures that development pressures are shifted away from land designated as green space.

In general, the Dutch system has been successful in controlling farmland conversion and in maintaining agriculture. Agriculture in the Randstad falls into two broad categories (Alterman, 1997). The first is what might be called conventional open-air farming, primarily dairy. The second is highly intensive controlled environment agriculture that takes place in greenhouses. Of the two types the first has high amenity values, but low profits, while the second has low amenity values but high profits. Greenhouse, or glass-house, agriculture is carried out in high concentrations, has a physical appearance of an industrial facility and provides no visual or open space amenities. Meanwhile, the dairy industry in the Randstad faces challenges due to: its urban location, small herd sizes and problems associated with drainage and manure management.

Van Rij, Dekkers and Koomen (2008) reviewed development in the Midden-Delfland buffer zone in the Randstad between 1995 and 2004. The main objectives of management of the zone are: to preserve open space, develop recreational areas and improve farming conditions. The area consists of 6 600 hectares that were originally used for dairy farms. Dairy farms still occupy 4000 hectares in the middle of the zone, but the periphery has been converted to recreation areas, nature uses and greenhouses. These provide a buffer within the buffer for animal agriculture and allow higher-value land-uses close to urban demand. Land purchases were concentrated at the edge of the zone to most effectively limit urban encroachment. In the remainder of the zone land-uses are established through a consensus-based process that incorporates local groups and property owners. It is important to note that comprehensive zoning is not used to establish land-uses (Van Rij, Dekkers and Koomen, 2008).

While land-uses changed on 12% of the land in the study period, only 0.04% of the 6600 hectares went to built-up urban uses. Greenhouse expansion accounted for 3.5% more of the change in use, while 5.6% more land went into nature uses. From their perspective, Van Rij, Dekkers and Koomen (2008) conclude that two of the three management goals were clearly achieved. However, they note that conditions in the dairy sector are still difficult, so the third goal of improving farming conditions was only partially achieved.

Overall, future developments will increase the demand for rural land and agricultural land-use is very likely to become more differentiated according to proximity to cities (OECD, 2008*e*). Farmland near cities might remain farmland, but farmers will increasingly have to provide services demanded for by society, ranging from landscapes, nature values to regional identity. Rural areas further away from cities might continue to be areas of export-oriented agriculture, although further CAP reform and trade liberalisation might shift the comparative advantages, leading to changes in the rural landscape. An important policy challenge is management of rural landscape management and biodiversity as both are impacted by intensive agriculture and urbanisation.

5.6 Overview

The five case studies demonstrate that different countries influence the value of farmland preservation in different ways. It appears, however, that in all OECD countries there is a concern with farmland loss, at least in some regions of each country. The case studies also suggest that it is much easier to maintain land as open space than to maintain the viability of farming, even though maintaining viable farms is a stated goal of most programmes. However, the case studies also suggest that in the peri-urban area it is not simply enough to raise farm incomes. Without some sort of land-use controls, it is unlikely that agriculture can compete for land when it faces urban development pressures.

A second and important observation is that it is more than commodity production that drives the interest in farmland preservation. In most of the examples, the main concern was to preserve access to green space for urban residents. But, in the case of Finland, the value of agriculture was considered to be the determining factor which keeps landscape open to provide a locally scarce visual amenity. In all these countries, a significant reason for maintaining farmland is that it provides an important habitat for desirable species of plants and animals. Thus, the provision of environmental services from agriculture plays an important role in the farmland conversion debate. Finally, the Randstad offers the example that it is possible for farming to be highly profitable in an urban environment, but, in the process, the commodity outputs of farming become separated from the provision of environmental services. Controlled environment agriculture in glass-houses is profitable, but produces no amenities.

Chapter 6. Conclusions

Rural areas are extremely diverse and the relationship between the management and use of land, and the development of rural economies, is complex. Increased demand for environmentally friendly, farmland-based countryside amenities may, in some circumstances, result in conflict between farm and non-farm activities. Intensification and specialisation of rural land-management practices in environmentally-good land, in economically integrated rural areas, could be threatening to the provision of ecological services, although it could improve eco-efficiency (as it uses smaller amounts of chemical inputs per unit of output). On environmentally-sensitive land, on economically marginal remote rural areas, low input and production could contribute towards preserving the diversity of the cultural landscape, but they could also be adverse effects: neglect of land management; abandonment; and afforestation, with variable consequences for the provision of farmland-based environmental rural amenities.

In virtually all OECD countries there is a concern with farmland-use management, as farmland provides benefits that go far beyond its ability to produce food and fibre. Agriculture, as the largest user of rural land in OECD countries, not only serves as a source for economic returns, but also preserves habitats and biodiversity, provides a carbon sink and contributes to the conservation of water and soil resources. It also contributes to the preservation of open rural space and the maintenance of characteristic landscape features, which are largely responsible for the recreational value of agricultural land. Changes in land-use and land cover are important driving forces in global as well as localised environmental change.

The preservation of an environmentally sustainable rural environment is a key ingredient in harnessing the long-term development potential of rural areas. The ecological balance and the scenic value of a landscape can make rural areas attractive for the establishment of enterprises, as places to live, and for the tourist and recreation businesses. The environmental and landscape assets generated through agricultural land management often have the characteristics of public goods, and as such policy measures are required to ensure delivery at socially desired levels.

Historically, the focus of agricultural policy has been on the level of production of commodities and the well-being of farm families. In this context, the farmland in itself has been a relatively minor policy issue. The current interest with farmland-use management appears to be driven to a considerable extent by the potential effects on the provision of environmental services associated with the management of farmland. While the food supply is noted as an issue, the main factors are typically the loss of green space, loss of wildlife habitat and loss of other non-market outputs.

The essential feature of this new policy environment is the increasing importance being given to the spatial dimension of agriculture. The question of where commodities are produced has now been added to existing policy concerns with what commodities are produced and how they are produced. In the concern with space, two key points stand out:

- The production and value of many of environmental services from agriculture is specific to particular farming practices in certain locations. Because these are largely non-tradable their value depends upon the local demand for those outputs.

- The conversion of farmland is also spatially determined. While the vast majority of farmland is very likely to remain in agriculture, there are two situations where the loss of farmland is concentrated. These are the urban fringe (where farmland is lost to urban uses) and the far fringe (where the returns from farming are marginal, due to a combination of remoteness and low productivity).

There is also a link between these two factors. It is typically the land that is most subject to conversion that provides the highest level of farmland-based environmental amenities. Thus, the loss of farmland at either fringe is significant, not because of lost commodity production, but mostly because of lost non-commodity production.

Given the concern with farmland conversion that is driven by economic forces, what are the possible policy responses? Two broad sets of policy seem most relevant: i) agricultural policy – if only because governments are concerned with the loss of farmland; and ii) land-use policy. Every country in the OECD employs both of these policies, but they tend to operate in a rather un-co-ordinated manner.

The lack of co-ordination stems from a number of factors. The first is a general lack of recognition that both types of policy can be used to manage farmland conversion. Second, the two policies are designed and operated by different departments of government, and, in many countries, at different levels of government. Third, there is only limited awareness that the range of influence that can be exerted by policy varies, depending on the spatial location of agriculture.

While there is a growing recognition that policy has different impacts on farm household incomes, there is less recognition that policy has different spatial impacts. The use of three spatial zones in the paper is a gross simplification of the spatial distribution of agriculture across OECD countries, but even this level of abstraction is capable of showing how policy effects can vary with geography.

In general, recalling the specific results of the previous parts of the paper, the following broad conclusions may be drawn:

- Farmland conversion to non-agricultural uses is largely an issue at the urban fringe and the extensive margin, where the economic returns from farming are inadequate to maintain land in agriculture. For the majority of farmland, found in the agricultural zone, the amount of land at risk of leaving agriculture is relatively small. In the agricultural core zone, the main cause of loss is land at the Ricardian margin. This land may be idled by farm operators, but it is typically not sold and can be returned to farming should economic conditions warrant this.
- A potentially key aspect of farmland conversion in the two margins is the amenity and wildlife benefit associated with the provision of environmental services from agriculture. Because these outputs are valued by society, but the farmer receives no remuneration, there is a wedge between the returns to the farmer from maintaining land in agriculture and converting it. If society compensates farmers for the social value of environmental services this can keep some of the land at risk of conversion in farming.
- In the urban fringe, the opportunity costs of farmland can be high. This makes spatially untargeted agricultural policy and those forms of land-use policy that use payments, exceedingly expensive instruments. In response, the common practice has been the use of the regulatory power of government to prevent farmland conversion. This clearly imposes a cost on farmers when compared to a *laissez faire* regime.
- At the extensive margin, the use of financial incentives can maintain land in production, because alternative uses of land generate very little revenue. At this zone, the problem may well be limited returns to labour and capital, rather than limited returns to land. Land-use policy is largely impotent at the far fringe because it acts mainly to block changes to higher-value uses. While some forms agricultural policy can be effective, traditional payments to

commodity production have limited effectiveness because the level of commodity production per farm is typically small.

- By its nature, agricultural policy has largely focused on the agricultural core zone. It is within this zone that the standard assumption of a fixed stock of land is most valid. The result has been a set of policies that provide incentives for farmers to alter the mix of commodities they produce and the management practices they adopt. Within the zone, the opportunity cost of farmland is low, which implies that conversion is not an issue.

Given this situation, how should the policy concern best address the issue of farmland loss at the two margins? It is clear that broadly applied policies are not the answer. If the majority of farmland is not at risk of conversion, a general programme will be inefficient. This means that separate policies need to be defined for the two margins. At the urban fringe, the interaction between urban policy and rural policy (including agricultural policy) has to be considered. The motivation for restricting farmland conversion mainly stems from urban development rather than from related with farming. This means that better co-ordination between urban policy and agricultural policy is important. In terms of policy, it would seem that the current application of land-use regulations will continue to be the dominant way for society in OECD countries to manage farmland conversion.

At the extensive margin, the central issue is the value society places on maintaining a managed environment. Habitat change can have important ecological consequences, but not all habitats are equally important. If farm policy continues to evolve in a way that includes increased support for environmental services from agriculture, then there is an obvious mechanism for maintaining farmland. Whether similar ecological benefits could be maintained using another policy instrument at a lower cost, is of course, an issue that should be addressed.

A large impediment to undertaking this type of targeted programming is the current lack of information. The OECD and many member countries have invested considerable time and resources to develop a rural typology, and have collected a variety of rural indicators. However, the indicator set is remarkably weak in its coverage of agriculture. This inability to provide strong spatially defined statistics for agriculture by degree of rurality is symptomatic of the current focus of agricultural data. Because there has been little interest in the spatial distribution of agriculture in the past, little effort has been made to assemble this type of data.¹⁰

Finally, it is important to recognise that the removal of land from agricultural uses may result in a new use of farmland (*e.g.* for forest, parks, etc.) which could enhance social welfare. This could occur if the new use of farmland leads to more benefits than are lost from the reduction in commodity and non-commodity production. In particular, it is important to distinguish where farmland is being lost and what it is being used for.

This requires a clear definition of the quantity and quality of public goods provided through agricultural land management in different types of rural areas that should be supported through agri-environmental policy, including programmes to protect farmland from conversion to non-agricultural uses. It is paramount that the selection of a particular policy approach should be based on efficiency considerations. Overall, the contribution – particularly in quantitative terms – of farmland-based environmental services to the development of rural areas, including the development of sectors such as rural tourism warrants further empirical analysis.

10. Although in several OECD countries sub-national data are available on the basis of political or administrative units, these units do not typically correspond with the key OECD rural typology of predominantly urban, intermediate rural, and predominantly rural.

Annex 1. The von Thünen Model

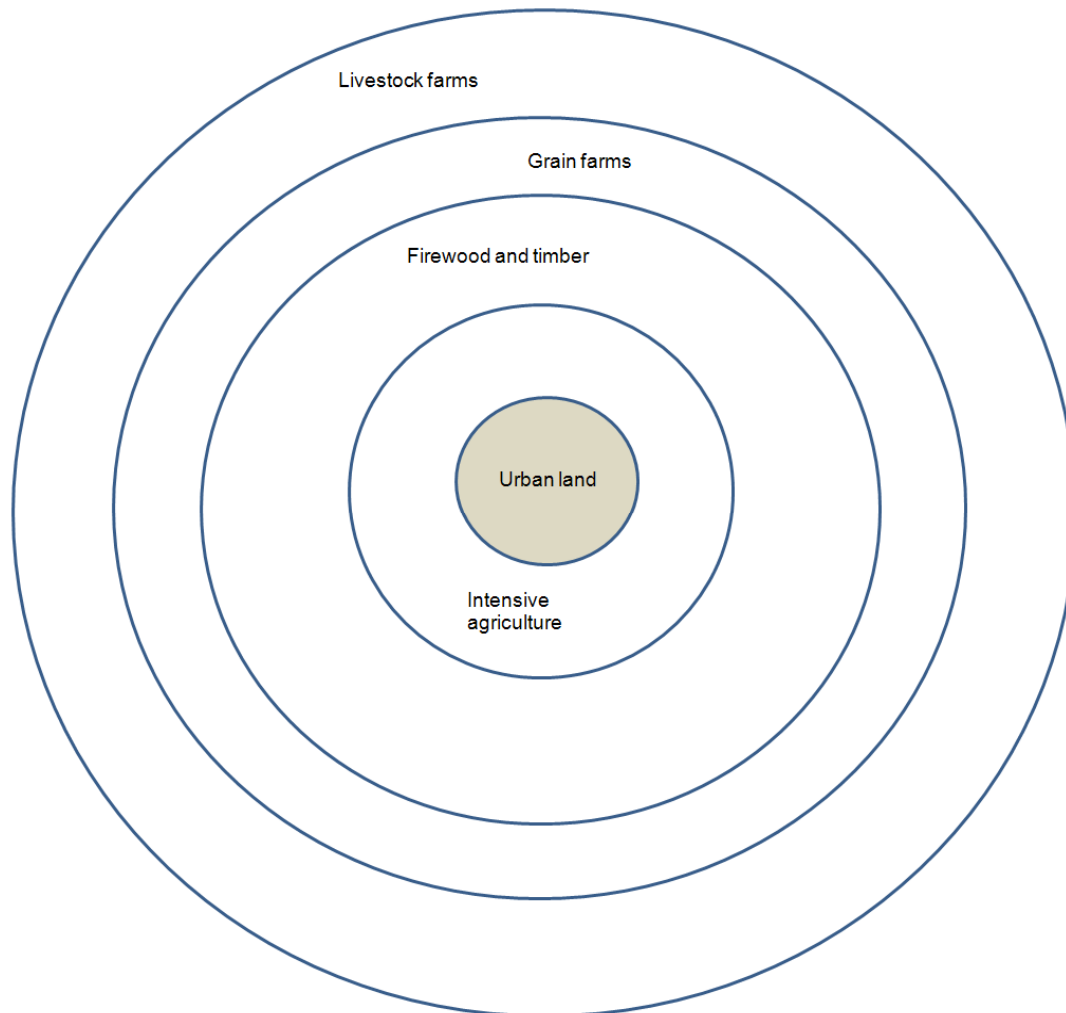
The starting point for the discussion of farmland-use is the standard von Thünen model of land allocation on a homogeneous plain (Capello, 2007; Edwards, 2007). Von Thünen developed his model of the spatial distribution of agriculture more than 200 years ago from observations on the distribution of activities on farmland surrounding towns in southern Germany. His ideas have become the basis for much of the literature on the spatial distribution of activity, but until recently there have been few attempts to develop analytical support for his observation.

To take an example, suppose a city, which serves as the market point for all agricultural production, is surrounded by a homogeneous plain – how will the land be allocated? Von Thünen showed that, with positive transportation costs and different net returns per hectare for agricultural output, the most likely outcome is a series of concentric rings, with bands of production within them (Annex Figure 1). Commodities with higher unit returns and high unit transport costs will occupy the inner rings and commodities with low returns and low transport costs will be further out. The interesting aspect of von Thünen’s analysis is the clean edge between land-uses. At some point, increasing transport costs overwhelm higher net returns per unit of land from one commodity over another and land switches to the next lower net return commodity, because its transport costs are low enough to just offset its lower selling price. The result is a sharp edge between rings. Production ceases at the extensive margin where transport costs fully exhaust the net return for the commodity produced in the final ring. The analysis shows that a change in either relative net returns per area or in transport costs will alter the transition zones, but in ways that preserve precise edges.

While von Thünen himself is silent on the issue, a similar process must determine the boundary between the city and the highest return from an agricultural commodity. At some distance from the place of work, the cost of a house, including the cost of travel to work, must increase to the level where it no longer makes sense to build houses. At this point agriculture begins, assuming that housing is a more valuable land-use than agriculture (Capello, 2007). Specific and localised types of farming, such as vineyards near Dijon, glass-houses near Amsterdam and thoroughbred farms near Lexington, are able to effectively compete with housing for land, but this is not the case for high-volume agricultural commodities.

As von Thünen noted, if conditions change, the boundaries should also change. An increase in urban population or an increase in urban income that drives up demand for housing should lead to an outward movement of the urban land zone and a rippling effect through other agricultural zone boundaries. Conversely, an increase in the price of food or a decrease in transportation costs for various farm commodities has a more ambiguous effect. While there is some likelihood that the zones of agricultural production might shift, there is less likelihood that the boundary delimiting the urban fringe would move significantly.

Annex Figure 1. Original depiction of land-uses by von Thünen



Food represents a relatively small share of household budgets and housing, once it is established, is not easily removed. In addition to acquiring the land there are major expenses in adding infrastructure, such as roads, power and water lines, as well as the cost of constructing buildings. These large investments, although they are in principle sunk costs, effectively stop land from reverting to farming. The principle reason is that the cost of removing the developments in order to make the land suitable for agriculture again is so high as to preclude reconversion. Thus, it is more likely that the urban boundary is sticky with respect to a relative increase in the returns to agriculture. This suggests that once housing is established, higher farm commodity prices will not result in reconversion of land to agricultural uses.

This is an important difference from the far, or extensive, frontier. There, it is possible for land that was once in farming and then abandoned to return relatively quickly to farming if commodity prices rise. The cost of converting from higher to lower value uses, and *vice versa*, is relatively low, which should make the boundary much more flexible. A possible caveat to this conclusion exists if conversion of use leads to significant ecosystem changes that alter the viability of specific species. Then reconversion will not result in the same species mix as that existed before the first change in land-use.

Box 2. Indirect agricultural land conversion

The main way people think of urban-induced farmland conversion is when land is directly converted to an urban use. This is most common at the urban fringe. However farmland that is more remote from cities can also be indirectly converted to another use by urbanisation. In this case the land is not transformed into urban space, but its agricultural use is either reduced or eliminated.

One way that this can happen is if water rights associated with farming in arid regions are either sold or re-allocated to urban uses. Typically, urban users can bid water away from agriculture in an open market, and in periods of water scarcity residential demands will more likely be met than the needs of crops or livestock. If access to irrigation water is reduced or eliminated to satisfy increasing urban needs, the effect could be farm abandonment. In a sense, the extensive margin of agriculture changes because urban interests have increased the cost of production.

A second way urban influence can alter farmland availability is through requirements for more stringent agri-environmental measures. An urban population that has strong preferences for more wildlife may cause agricultural policy or environmental policy to be defined in a way that either prohibits certain farming practices on certain types of land, or alters payments to farmers in ways that make it financially unattractive for them to continue certain types of activity. In some cases this can have the effect of shifting land out of agricultural uses, even though there is no direct pressure to convert the land to urban uses. Once again, the effect of a growing urban population is to alter the extensive margin and cause certain types of farmland to leave agriculture.

Fuzzy urban boundaries

In practice, the boundary between urban and agricultural uses is less than clear. This reflects a variety of factors. The most obvious is that von Thünen dealt with a homogeneous plain. In reality, land varies across space in a number of ways including, soil quality, topography, access to water and, most importantly from the von Thünen perspective, access to transportation. These factors make it unlikely that there will be a clear break between any two land-uses at a constant radius from the city centre. For the purpose of this analysis the important implication is that with a fuzzy boundary there is far more interaction between urban individuals and agriculture in the first ring of farming than a von Thünen model would suggest.

A second factor leading to a fuzzy boundary is an uneven urban expansion path. If urban land-uses increase, they may not move out in a gradual manner. Some farm owners may not immediately sell their land, in the hope that they will receive even higher prices in the future. Similarly, some urban land developers may purchase land well beyond the current boundary to take advantage of currently lower land prices further out, in the expectation that the city will soon grow out to them and provide capital gains. Once again, the result is a mix of agricultural and non-agricultural uses.

An additional factor is the changing nature of the urban form (see Annex 2). The von Thünen model assumes a central market, with other urban activity clustered around it. This notion of a central market is common to many urban models, particularly those assuming a central business district. These monocentric models use bid-rents to develop the urban equivalent of a von Thünen solution with concentric rings of urban land-uses. However, a competing model of urbanization is based on the idea of a polycentric city. In this structure there is no single central business district, but instead, a number of smaller business districts are distributed throughout the city and provide a similar function. The result on the city boundary is obvious. With a polycentric city, land-use patterns intersect and the urban boundary bulges further into the agricultural core zone because exurban commuting becomes easier.

Annex 2. Spatial Concepts

A.1 Urban-rural dichotomy?

The traditional – and still common – perspective is that rural and urban are distinct but linked spheres with a well-defined boundary. This perspective stems from a vision of the urban form that is based upon a central business district that serves as the focus for economic and social activity in the city with residential and other less valuable activity surrounding this core. At some point the city neatly ends and the countryside begins. In the countryside, agricultural activity is the dominant use of land, and small urban settlements exist as market towns to serve the needs of the farming population. Thus, rural can be seen as agriculture and *vice versa*.

More recently, this dichotomy has been challenged by a group of different perspectives. The first is the rural urban continuum. Instead of a distinct break between urban and rural there is a transition zone where rural and urban activities are both found. Within this zone the relative share of urban to rural activity declines with distance from the core urban area. A second idea is the poly-centric city. Instead of a city having a single central business district, there are multiple locations in the city where business activity is concentrated. The result is a distribution of economic activity and a reduction in commuting and congestion costs.

The final idea combines the two previous ones to expand the idea of a city to something more than urban activity. Two descriptions of this concept are, the regional city proposed by Calthorpe and Fulton (2001), and the galactic city proposed by Lewis. The two models share the common ideas of:

- integration of urban and rural functions into a symbiotic whole within the larger urbanised footprint,
- distribution of industrial, retail, commercial and residential activity across the total space of the city,
- patterns of interspersed high density and low density land-use,
- the desirability of ready access to green space,
- recognition that automobile based transport systems provide the individual firm or citizen with locational choice and that this choice is reinforced by modern telecommunications, and,
- a major value of agriculture is its ability to produce public good amenity services, as well as typical food and fibre commodities.

While the ideas proposed by Calthorpe and Fulton (2001) and Lewis remain controversial they provide a useful way to examine the role of agriculture in peri-urban areas. In this structure agriculture is as much an urban as a rural activity. It is a land-use that provides both market-based and public goods, and the relative importance of these two types of good can vary considerably across space.

Box 3. Urban agriculture

A potentially important phenomenon for agriculture is its increasingly urban nature. Where cities have grown beyond a compact nucleus they inevitably take in a considerable amount of farmland. Urban administrative boundaries often extend beyond the point where actual settlement stops as a means to manage urban growth. Urban areas contain a “land reserve” for future development and farming is common on this reserve. Hence a significant number of farms are found within urban boundaries. In addition the share of farms found in close proximity to the edge of urban settlement in terms of total farm numbers is larger than might be expected, because average farm size tends to be smaller close to the urban fringe.

This latter point reflects a number of factors. First, land is more expensive reflecting its locational advantage. The land also tends to be of higher quality because many urban places developed initially in those areas most favourable for farming. Second, the types of farm activity carried out on this land tend to produce high per hectare values, but also require high levels of labour input per hectare and reach minimum efficient scale with a relatively small quantity of land. Third, and finally, unlike more remote farmland, farm households in close proximity to urban areas have considerable opportunity to allocate their labour to off-farm activity. This means that part-time farms are more prevalent, and part-time farm households tend to operate smaller farms because they have less labour available for farming.

In those countries that define urban areas in terms of commuting flows the overlapping effect can be very large. Metropolitan is commonly used in the United States as a proxy for urban. The result is multicounty aggregations that contain large amounts of undeveloped land, which is mainly agricultural. Exurban development leads to new residents with long commuting patterns. Currently approximately 42% of U.S. farms are in the peri-urban areas of metropolitan counties and are thus considered urban agriculture. Isserman (2005) shows that in the United States a large part of the land area of many states would become metropolitan even though the vast majority of this land would not change its current use. He notes that a major reason for the apparent decline in rural areas is the effective annexation of rural territory as expanded commuting patterns cause counties to be reclassified as part of metropolitan agglomerations, even though they have only weak economic ties to urban areas other than commuting flows. This suggests that a far higher share of farm numbers is found in close proximity to urban areas than would be expected in terms of the share of total farmland in proximity to urban places.¹¹

With the automobile and a more extensive road system the constraint of a limited number of entry points to transport is eliminated. People and firms are able to locate where they want, rather than where the transport system is established. As a result the logic of a central downtown as the focus for all economic and social activity is weakened. Opportunity for a distributed system with less congestion and crowding, and a better match of locations with individual needs is created. A part of this process is the thickening of the urban fringe.

Automobile transport allows those who desire a more rural setting to move outside the traditional city boundaries and commute to the city when they choose. It also allows businesses that need more space and better access to logistics resources, like airports, inter-city highways and rail lines, to move to exurban areas as well. The result is a city-region that contains a mixture of land-use densities and variety of locations for residential, retail and manufacturing activity (Calthorpe and Fulton, 2001); Lewis, 1995). In this regional city (Calthorpe and Fulton, 2001) or galactic city (Lewis, 1995) all the

11. This outcome is predicted in the von Thünen model, because land further out is used by farm activities that tend to: produce lower-value outputs per hectare, have a larger minimum efficient land base, and produce commodities that have low unit-transport costs. The other factors identified above act to reinforce the logic of the von Thünen model.

functions of the old nucleated city based upon the railroad are replicated but are distributed across a much larger space. The new city form can be thought of as a network of horizontal spatial relationships in contrast to the vertical hierarchy associated with the older nucleated city.

A consequence is that the boundary between urban and rural is no longer distinct, and the urban fringe becomes a large area where urban and rural functions, including agriculture, are found. For Calthorpe and Fulton and Lewis the fringe is an integral part of the city, and coincidentally, most city governments would also see this hinterland as part of their city. The difference between the perspective of Calthorpe and Fulton and Lewis, and that of city administrators is that the former see the entire territory in terms of a functional relationship among peers, while city administrators tend to see the “rural hinterland” as a development reserve, but not part of the true city.

The implications of this change for agriculture are important. If there is no longer a clear line between urban and rural, then agriculture is no longer just a rural industry. The dispersed nature of development in the modern city leaves large amounts of vacant land, typically without road frontage, that may eventually be used for infill development, but which can be farmed in the interim. While some types of farm products are improbable on this land; such as, those requiring large fixed capital investments in buildings or land improvements, others such as row crops, forage crops or horticulture are possible. An interesting question is the extent to which these farms produce non-commodity as well as commodity outputs. They provide green space but, because they operate on a temporary basis, they may not provide many of the other amenities associated with agriculture conducted in a more rural setting.

A.2 Rural, agriculture and the countryside

If rural is no longer just agriculture and agriculture is no longer just rural, how are they related? To assess the relationship between agriculture and rural today three linked but distinct concepts are needed. They are, agricultural, rural and countryside. While they can be used interchangeably in some circumstances, generally each term has a different meaning than the others. Agricultural refers to a specific land-use that involves the production of food and fibre. Rural is typically defined as the opposite of urban, that is, land which is outside the boundaries of a settlement that exceeds some definition of a minimum number of people and a minimum population density. Countryside is a less precise term that typically applies to that part of rural space that has been occupied by people, but not in a way involving a large population density. The countryside may include urban places if the definition of an urban centre is small enough. It includes agriculture and other human managed land-uses, but excludes wilderness and land that is remote from urban settlement.

The three concepts also tend to be used for different policy purposes. Agricultural policy largely focuses on the production of commodities and the economic well-being of full time farmers. Rural is typically defined as “not urban” and includes all territory that has a low enough density to fall outside the urban category. Thus rural includes open land that might be used for farming, as well as small settlements. Thus technically agriculture continues to be an activity found in some rural territory. However, rural policy increasingly ignores farmers and agriculture to focus on non-farm economic development opportunities in smaller settlements. A rationale for this is that agriculture has a well funded policy set dedicated to improving its condition, but there is no other sector specific focus for rural sectors. More importantly agriculture typically accounts for a relatively small share of rural income and employment, even in those rural areas where the majority of the land is in agriculture.

A.2.1 *The countryside*

Countryside policy tends to focus on the preservation of current scenic land-uses that involve a mix of low density, human influenced landscapes. There does not appear to be a precise definition of what constitutes “the countryside”, but there seems to be a tendency to include a majority, if not all, of the following factors:

- A relatively open visual perspective, but with trees in the mid-ground or background;
- The presence of water;
- Evidence of low density human settlement;
- the presence of domestic livestock but with low stocking rates;
- An absence of any distinctly urban influence, such as, roads or industrial facilities, and;
- If arable agriculture is present, it should be carried out on small fields with no evidence of intensive monoculture.

Not all of these features have to be present. Not only is countryside policy concerned with preserving farmland, but it also is interested in preserving small fields with uncultivated boundaries that can provide habitat for wildlife. It would seem that countryside policy tends to focus on the portion of rural that is close to urban areas where people can directly experience the visual amenities that appear to define the a pleasant countryside.

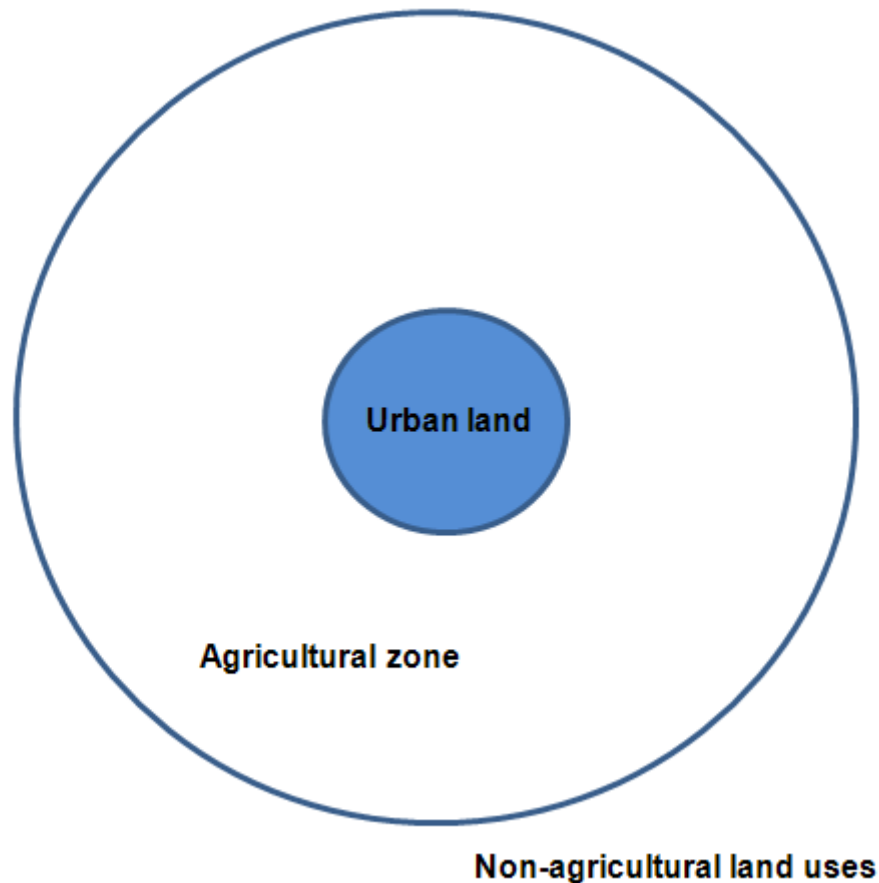
Annex Figure 2a provides a schematic of the old relationship between urban and rural the follows von Thünen. In it the city comes to a clean edge and the rural zone commences with fields starting at this edge. Annex Figure 2b provides a boundary that is more typical of the current relationships as defined above. The urban core is defined as the place of highest population density and the spatial centre of activity. Surrounding the core are less densely settled suburbs that contain housing as well as retail, commercial and manufacturing activity. These two zones comprise what is typically called urban activity. A distinguishing feature of this high density aggregation is the absence of agriculture.

As density declines and distance from the core increases the peri-urban zone occurs. Here a mix of urban and rural activity are found, but at relatively low densities. A characteristic of the peri-urban zone is its attachment to the urban core. Indeed part of the peri-urban zone may be within the administrative boundary of the city. In the case of cities that have political and administrative control of a large hinterland a large portion of the territory of the city may be in this zone. As a result agriculture becomes an urban activity. Beyond the peri-urban zone is the far countryside. In this region there are few direct ties to the urban aggregation, but distance is low enough that urbanites have ready access to this part of rural territory. The peri-urban zone and the far countryside together can be thought of as being the countryside.

Beyond the edge of the countryside is the remote rural region. It is defined by being outside the influence of the urban agglomeration. It is this area that is typically the focus of rural development policy. The urban population may have an interest in the conditions of his region, but it is a not a region that they typically visit and have a direct experience of. Consequently urban dwellers may place “option demands” on the landscape or wildlife or cultural amenities, but unlike the countryside there is little direct experience.

Annex Figures 2a and 2b. Representations of urban boundaries

Annex Figure 2a. Simple von Thünen boundary

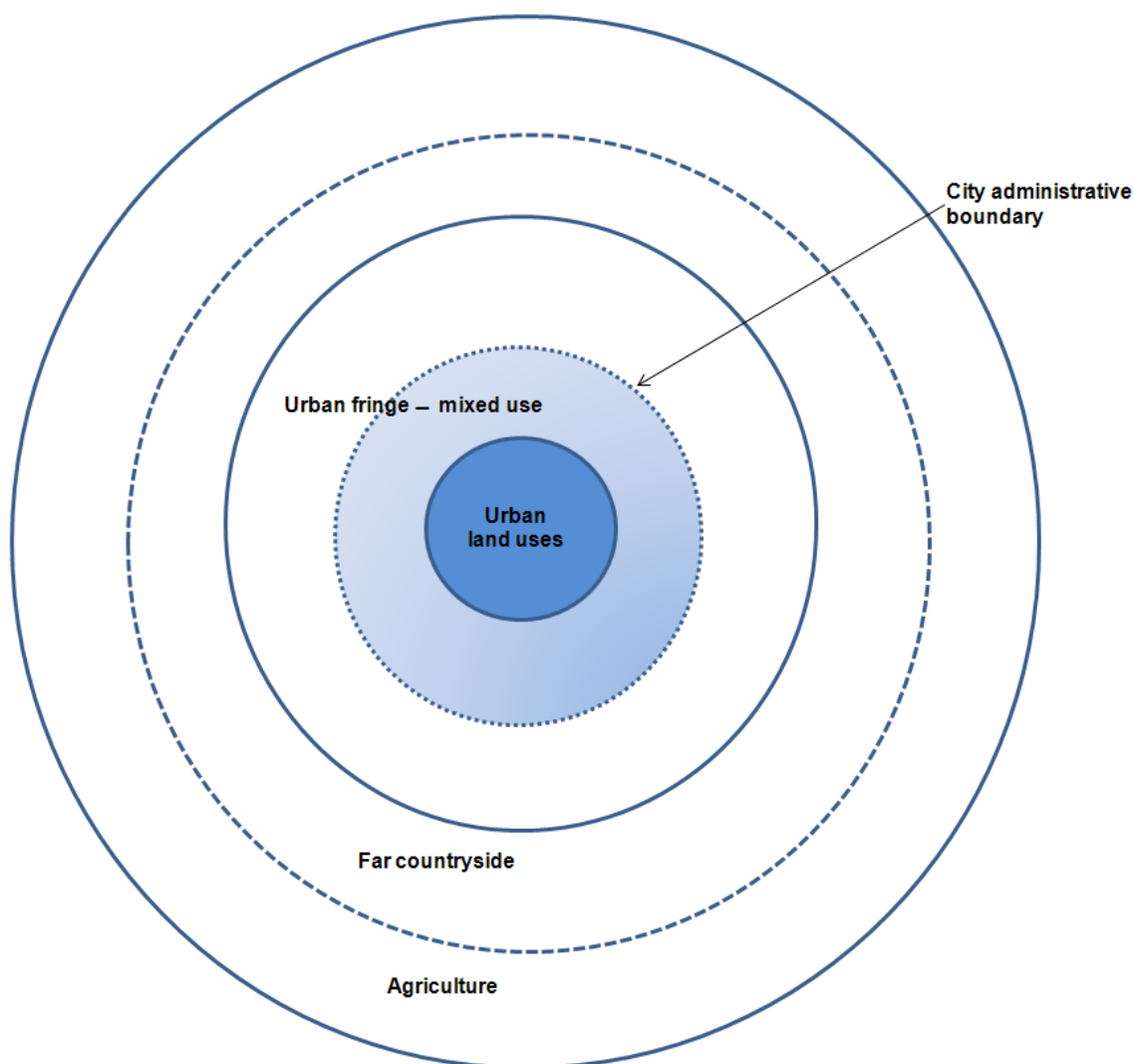


A.2.2 Agriculture and the countryside

The idea of the countryside is perhaps the best way to capture the status of agriculture on the rural urban fringe. Like agriculture, the concept of the countryside focuses on land-use and because agriculture is by far the largest use of land in the countryside, the relationship between agriculture and the countryside is crucial. The focus of countryside policy can be linked to agriculture through the idea of multifunctionality. The majority of the positive externalities and local public good associated with farming are of interest to those focused on preserving the countryside. Wildlife habitat and visual amenities are the two central issues.

Importantly the concern with these issues comes largely from people who do not live in the fringe. While local residents may also value wildlife and other aspects of the countryside they have the potential to be directly engaged in local decisions about land-use. By contrast, individuals in an urban setting have no direct financial investment in the region and a less direct political connection. Moreover, while urban residents may commonly visit the countryside in close proximity to their place of residence, their connection to other parts of the countryside is less concrete and might be considered either an “option demand” or an “existence value.”

Annex Figure 2b. Boundary incorporating urban fringe and far countryside



This means that there are several levels of connection to land-uses in the countryside. Consider a specific farm. At the first level are the land owners who have a direct financial investment in this particular parcel of land and whose financial returns from their investment vary with the uses the land is put to. At the next level are individuals who own land in close proximity to the farm in question. Certain uses of the farm may either positively or negatively affect the value of these neighbours' investment in adjacent land. Third are urban residents who live close enough to the farm that in their travels they have visual or some other contact with it. They have a direct experience from these contacts, even though they have no financial investment, and their level of welfare can be directly affected by certain uses of the farmland. Finally there are other citizens who exert a policy influence but who have little likelihood of being in direct contact with the farm. This does not mean they are uninterested in its fate, because they may place an existence value on certain characteristics of the farm and desire that they be preserved even though many of the members may have no expectation of ever actually directly experiencing these characteristics.

In terms of numbers of people in each group it is clear that the first group is very small – only those with a direct financial interest; the second group is somewhat larger, adjacent property owners, the third groups can be quite large, potentially thousands of individuals, and the last group is potentially the population. While the farm owners have the most intense concern it is possible from a social welfare perspective that any of the other three groups could collectively have a larger interest in how the farm is used. If the interests of the four groups diverge the crucial policy question is whose interests count. Agricultural policy largely develops in isolation from this trend even though it has major implications for the behaviour and viability of farms in close proximity to urban places.

A.2.3 Rural development and the countryside

It is common to ignore the countryside in discussions of rural development and rural policy. This reflects the focus in the rural development literature on stimulating indigenous growth. In the countryside the common issues are growth management and limiting the external influence from the nearby urban area. Thus while the countryside is rural in terms of population density it faces the challenge of maintaining a mix of urban and rural functions in the face of pressure to increase density and become part of the high density urban agglomeration. Pressure for conversion to urban comes from two sources – an increase in urban population and a desire by urban residents for more living space.

In the OECD countries there has been a steady increase in the urban share of the population both in those countries that continue to experience significant population growth and in those countries that have a relatively static population. Initially this change was driven by rural outmigration, particularly from farms, but the main factor now is the tendency of immigrants to settle in urban areas. Moreover the major growth in urban population has tended to be in the larger urban centres, so a relatively small number share of cities in most countries account for a growing share of the urban population.

Further, there are strong trends in all OECD countries for households to favour larger homes with more open space. Housing, unlike food, is a luxury good and as income increases people continue to spend a significant share of income on improved housing. Thus in all OECD countries steady increases in income leads to urban growth pressures. These pressures are exacerbated in those cities where the population is growing, but still exist in places where population is static. Preferences for larger detached housing has been ratified by increased access to automobiles, which have allowed people to live a considerable distance from their place of work, and by structural change in cities which have replaced a single central business district with a number of smaller business districts that are spread throughout the urban space. These last two changes have made it much easier to live in an exurban setting and commute to work, because most of the travel takes place outside the central city.

In many, but not all countries, one consequence has been a process of urban decline as employment, population and income move out of the city centre to the suburbs. In most, but not all countries, there has been a parallel movement of residential and some commercial development into the urban periphery leading to an interspersion of urban and rural activities. While there has always been some mixed use at the urban fringe, both the volume of activity and the spatial reach into rural areas has increased considerably. The result is a large mixed use of land that is neither rural nor urban in nature.

A.3 Urban renewal and urban sprawl

With peri-urban expansion has come a reaction. The reaction takes on two main forms. The first is an effort to prevent the conversion of farmland and preserve the rural nature of the countryside. It is championed by those who want to see farming continued and who see urban land-uses as incompatible with sustainable agriculture. The second form is urban revitalisation. The focus here is on reversing the outward movement of employment, population and income from the urban centre. Urban advocates

argue that while individuals may perceive themselves as better off in a lower density setting they are actually imposing large externality costs on society.

It is useful to recognise the link between efforts to preserve farmland in the urban fringe or peri-urban areas and the sustainable urban development effort. In a sense one can think of these two value systems as having a dual function. Both systems favour strong urban-growth boundaries and both justify their values by appealing to the same underlying problems. Finally, successful implementation of either policy inherently results in the implementation of the other.

Sustainable urban development is concerned with revitalisation of the urban core as an alternative to the steady diffusion of economic activity and people to the periphery of cities that has taken place since the advent of the automobile age and individual transport. Justification for a revitalised urban centre and a compact city comes from the following values. The first is a belief that society has made major investments in developing the urban core and that the useful life of these investments is not over and so it is a waste to abandon the core for the periphery and undertake replacement investments.

A second argument is that spontaneous development in the periphery is more expensive than infill development or replacement activity in the central core. Lower density development leads to higher costs of public services, such as sewage works and public transport. It also leads to increased use of the automobile and potential problems with road congestion and air pollution. Finally proponents of sustainable urban development argue that a more compact city preserves farmland and offers the opportunity for “local food” that has a lower transport cost, that can be healthier, and that offers opportunities for increased social cohesion between the urban and rural population.

The objective of the farmland preservation movement is to limit exurban development and ensure that farming can continue to operate in close proximity to urban centres. The primary argument of the farmland preservation movement is the maintenance of the food supply. This includes arguments that land in close proximity to urban areas is typically more productive than any land that might be brought into production to offset land conversion in the fringe, the opportunity for local food production, and the amenity benefit of having farms as green space. In addition there is often a recognition that limits on the conversion of farmland force urban development to stay within the growth boundary.

Annex Table 1. Relative importance of agricultural land in rural areas, 2005

| | Distribution of agricultural land by type of region (%) | | | Contribution of agricultural land in different regions (%) | | |
|----------------------------|---|-------------------|-------------------|--|-------------------|-------------------|
| | P.R.* Regions | Inter- mediate | P.U.** regions | P.R.* regions | Inter- mediate | P.U.** regions |
| Australia | 14.4 | 85.6 | 0.0 | 45.3 | 60.6 | 20.4 |
| Austria | 71.0 | 28.7 | 0.3 | 37.8 | 43.7 | 20.8 |
| Belgium | 10.6 | 23.4 | 66.0 | 33.2 | 43.2 | 49.7 |
| Canada | 40.1 | 59.9 | --- | 5.9 | 9.2 | --- |
| Czech Republic | 10.7 | 88.3 | 1.0 | 56.1 | 43.5 | 70.7 |
| Denmark | 70.1 | 27.5 | 2.4 | 62.2 | 59.7 | 31.9 |
| Finland | 71.3 | 23.4 | 5.3 | 6.0 | 17.6 | 18.8 |
| France | 41.5 | 55.1 | 3.5 | 51.3 | 50.9 | 39.0 |
| Germany | 5.5 | 67.8 | 26.8 | 46.4 | 50.3 | 42.4 |
| Greece | 69.9 | 28.7 | 1.4 | 29.6 | 34.7 | 15.1 |
| Hungary | 60.1 | 38.9 | 1.0 | 47.6 | 43.0 | 80.0 |
| Ireland | 99.2 | --- | 0.8 | 62.0 | --- | 38.5 |
| Italy | 27.8 | 48.3 | 23.9 | 42.3 | 42.7 | 39.7 |
| Japan | 25.0 | 58.7 | 16.3 | 10.0 | 14.0 | 13.5 |
| Korea ¹ | 60.4 | 36.1 | 3.5 | 18.2 | 22.0 | 15.8 |
| Luxembourg | --- | 100.0 | --- | --- | 49.9 | --- |
| Netherlands | --- | 39.7 | 60.3 | --- | 67.4 | 53.1 |
| New Zealand | --- | 95.5 | 4.5 | --- | 44.7 | 42.7 |
| Norway | 67.0 | 32.9 | 0.1 | 2.7 | 7.1 | 2.0 |
| Poland | 58.4 | 39.6 | 2.0 | 47.5 | 47.8 | 33.2 |
| Portugal | 80.3 | 14.1 | 5.6 | 46.0 | 25.9 | 26.0 |
| Slovak Republic | 37.8 | 58.0 | 4.1 | 45.0 | 35.0 | 37.7 |
| Spain | 49.6 | 37.7 | 12.7 | 54.6 | 44.5 | 45.4 |
| Sweden | 63.8 | 33.1 | 3.2 | 5.5 | 30.2 | 15.4 |
| Switzerland | 15.2 | 64.7 | 20.1 | 10.4 | 35.2 | 44.2 |
| Turkey ² | 52.1 | 27.7 | 20.2 | 24.4 | 23.8 | 23.0 |
| United Kingdom | 22.9 | 59.5 | 17.6 | 62.0 | 72.0 | 53.6 |
| United States ³ | 73.4 | 11.8 | 14.8 | 38.1 | 50.5 | 46.7 |
| EU15 | 39.9 | 46.3 | 13.8 | 31.6 | 48.8 | 43.1 |
| EU19 | 41.6 | 46.6 | 11.8 | 33.9 | 48.0 | 43.0 |
| OECD ⁴ | 40.9 | 51.9 | 7.3 | 27.6 | 40.4 | 42.6 |

Notes: * Predominantly rural; ** Predominantly urban; ---: No region is classified within this type; 1. 2004; 2. 2001; 3. 2002; No data available for Iceland and Mexico.

Source: OECD Secretariat calculations based on EUROSTAT *Farm Structure Survey* and national sources.

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