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Notes on the Economics of Control of Wildlife Pests

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Notes on
The Economics of Control of Wildlife Pests

ABSTRACT

Some wildlife species are agricultural pests but these populations are often valued by other than agriculturalists. For non-farmers, the population levels of such wildlife are frequently pure public goods. This is one source of market failure in the economically optimal social control of an agricultural pest of this type. Secondly, if the species is geographically mobile, externalities occur between farmers in the control of the species, and this reduces the incentives of farmers as individuals to control the pest species. It is shown that depending on the relative strength of these opposing types of market failure, farmers may excessively reduce or insufficiently decrease the population of a species from a social economic point of view.

Keywords: agriculture, market failure, mobility of pests, pest control, pure public goods.

JEL Classification: Q57

Notes on
The Economics of Control of Wildlife Pests

1. Introduction

In many cases, wildlife species that are agricultural pests to farmers are valued by non-farmers. Some have existence value for non-farmers and can sometimes be regarded as pure public goods from their point of view. The African buffalo is one species that has these joint attributes but many other wildlife species, such as elephant species, also do. Nevertheless, in most cases, wildlife species are mixed goods (Tisdell, 2009, pp. 82-83) from the point of view of non-farmers. As discussed by (Tisdell, 2005, section 5.2) the total economic value of many wildlife species consists of diverse economic components or categories of types of economic goods. For example, the species just mentioned apart from having passive or non-use values have use values both of a consumptive and non-consumptive nature. For example, a consumptive use value of the African buffalo is its utilization for edible dry meat (biltong) and the meat, tusks, hides and other parts of the elephant can be used. The utilization of the species for tourism, other than that involving recreational hunting, constitutes a use value for them. In this analysis, it will be assumed that any benefits obtained by non-farmers from the population of a wildlife species cannot be appropriated by farmers. For farmers, this benefit is an external benefit.

Several economic questions arise in such cases. These include the following: To what extent is it economically optimal to reduce the population of such a species given the conflicting interests of farmers and non-farmers in its population? What factors are likely to influence decisions by individual farmers to reduce population of the species which occur on their property? It will be argued that decisions by farmers in this respect are influenced by the geographical mobility of the species and in addition, they fail to take into account the value placed by non-farmers on the presence of the species. These two types of failures (depending on circumstances to be discussed) can result in excessive or insufficient reduction in the population of the species by farmers from a social economic point of view. In turn, the factors will be considered that influence decisions of individual farmers to reduce agricultural wildlife pests on their properties and then socially optimal decisions for reducing the populations of such wildlife will be examined. This analysis is followed by a discussion and conclusions.

2. Decisions by Individual Farmers to Kill Wildlife Pests on their Property

In deciding on whether to kill pests on their property, individual farmers will compare the economic gains from this action with the cost to them of killing the pest. In Figure 1, for example, line ABC might represent the marginal benefit to a farmer of killing a pest on his/her property and line OBD might be the associated marginal benefit to the farmer. In the case shown, the farmer maximizes his own net gain by killing K_1 of the pest population on his property. It does not pay the farmer to kill all of the pest animals that come to his property.

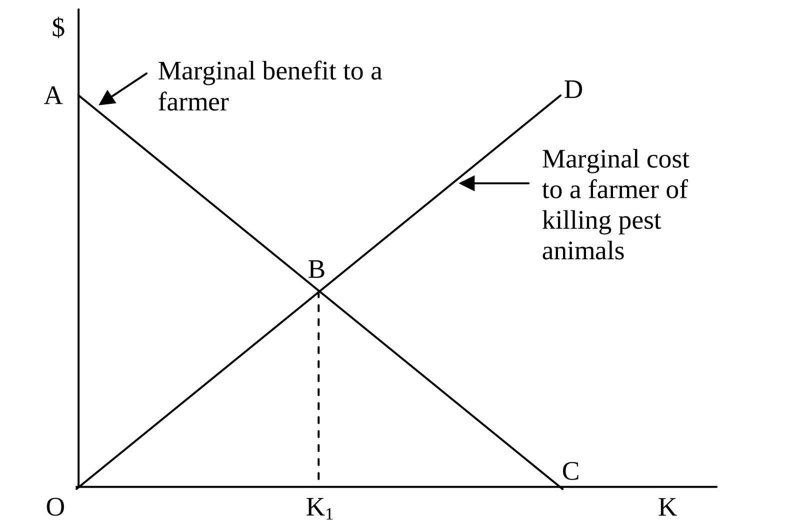

Figure 1: An illustration of the most economic kill of a pest by a farmer on his property. Only the farmer's net benefits are considered.

Note that the mobility of the pest population and the natural rate of population replacement will affect the level of kill that is optimal from the farmer's point of view. The more rapid is the replacement of killed animals by those from other properties, the lower is line ABC. Therefore, the less economic is control. In general, the greater the geographical mobility of animals, the less economic is control from an **individual** farmer's point of view (Tisdell, 1982, pp. 367-372). Also this is so the faster the population increases after its numbers are reduced (Tisdell, 1982, pp. 372-374).

It is also true that what is economically optimal from an individual farmer's point of view as far as pest control is concerned is not necessarily optimal from the point of view of farmers collectively. For example, individual farmers are likely to exert insufficient control of a pest from the **collective** viewpoint of farmers if the pest is mobile. When the pest is mobile, other farmers obtain a favourable externality from its control by an individual farmer. However an individual farmer will not take this into account in his decision to control the pest population on his property. There is, therefore, insufficient control from the collective point of view of farmers. This can be illustrated by Figure 2.

In Figure 2, line ABC is the private marginal gain to an individual farmer of reducing the population of the pest found on his property and line EFG represents the marginal collective benefits (benefit to all farmers only) of doing this. The difference between these two lines represents the external (spillover) benefits to other farmers of the individual farmer killing the pest population on his property. The marginal cost to the farmer of killing the pest is represented by line OD. Given the situation shown in Figure 2, the individual farmer will only kill K_1 of the pest found on his/her property whereas it is optimal from the viewpoint of all farmers to kill K_2.

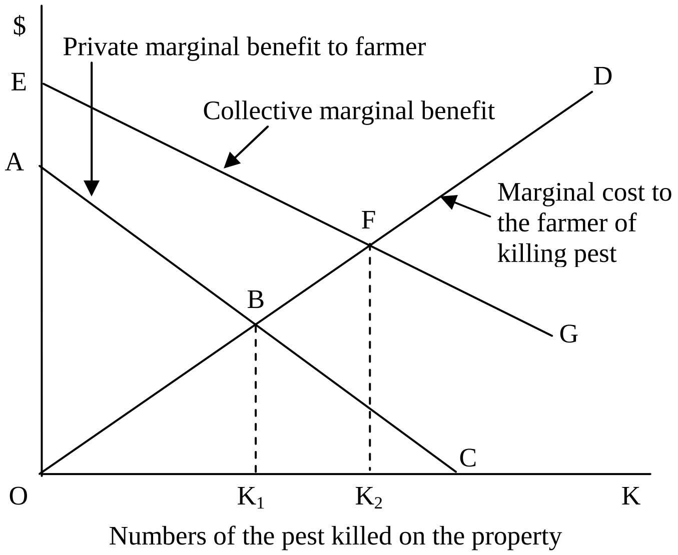

Figure 2: Figure to show that because of external benefits to other farmers, individual farmers may under control a pest on their property (if the pest is mobile) when the collective benefits of all farmers are considered.

A complex interdependence problem arises when pests are mobile. The amount by which a farmer finds it profitable to control a pest varies with the amount of control that other farmers exert. Therefore, modelling this problem is complex! However, it is not completely hopeless.

3. The Socially Optimal Reduction in the Population of a Wildlife Pest

Consider a wildlife species that causes damages to farms but is also valued by non-farmers. For non-farmers, the level of the population of the wildlife species may be a **pure public good**. What is the socially optimal level of control of this agricultural pest? Figure 3 can be used to consider this issue. In this figure, X represents the level of population of the wildlife species and the Y-axis indicates monetary values for example in dollars. Relationship ACD represents the extra value placed by non-farmers on the level of population of the focal species (for instance, the African buffalo) and line OE specifies the extra losses incurred by farmers as the level of population of the species increases. Non-farmers do not place any extra value on populations of the focal species in excess of X_3.

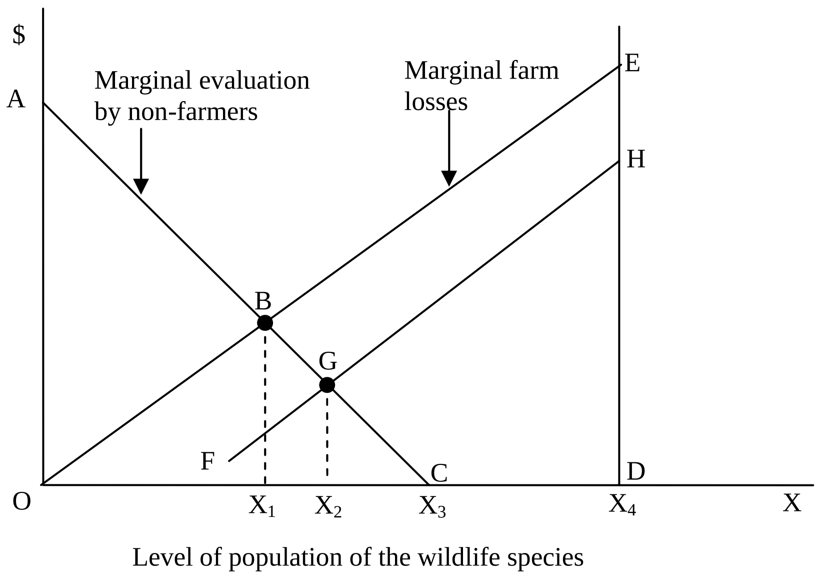

Figure 3: An illustration of the socially optimal control of a wildlife species which is an agricultural pest for farmers but which is valued by non-farmers.

Suppose that the focal species has a population of X_4. Although farmers would like to see the population of the pest reduced to zero, it would only be socially optimal to reduce it to at most X_2. A reduction to X_2 would be optimal in the unlikely event that the level of the population of the species can be reduced at zero cost. X_2 corresponds to point B, the point at which the marginal value of the species to non-farmers just equals the marginal loss that their population causes to farmers. If the marginal cost of killing numbers of the species or otherwise reducing its population is positive, it is socially optimal to reduce its population by less than $X_4 – X_1$. Furthermore, the larger the marginal cost of reducing the population of a species, the smaller is the socially optimal reduction in the level of its population.

For example, suppose for simplicity that the marginal cost of reducing the population of the species is a constant equivalent to EH in Figure 3. Then line FH represents the net marginal benefits to the farm sector from reducing the population level of the species when movements from right to left in X are considered. In this case, the socially optimal level of the population of X corresponds to point G and reduction in the level of population of the species from X_4 to X_2 is socially optimal.

4. Discussion

Note that if the population of the species is less than X_3, (see Figure 3) non-farmers will be opposed to any policies that reduce its population and therefore, will be in conflict with farmers. Furthermore, because of the externality issues mentioned above farmers may, by their individual actions, reduce the population of the focal species by too little or by too much from a social point of view. Opposing forces come into play. The failure of farmers to take into account the preferences of non-farmers tends to lead to a socially excessive level of reduction in the population of the species by farmers. On the other hand, when the species is mobile between farms, this reduces the economic incentive of individual farmers to reduce its population. The final outcome depends on the relative strength of these forces. If the mobility of the species is low, if the costs to individual farmers of reducing populations on their properties are low and if the losses caused by the species are high, this is likely to result in an excessive economic reduction in the population of the species at the hands of farmers. On the other hand, if the species is highly mobile, less than a socially optimal level of control of its level of population is likely to be undertaken by farmers.

It is clear that depending on the circumstances, farmers can excessively or inadequately reduce the population of wildlife species which are agricultural pests. Market failures occur of the type specified above. These failures tend to operate in opposite directions. On the one hand, failure of farmers to take into account the marginal value that non-farmers place on the population of a focal species encourages farmers to reduce its population by a socially excessive amount if it is an agricultural pest. On the other hand, the externalities that arise when the agricultural pest is mobile reduce the incentive of individual farmers to control its population. The net effect on the population of the species depends on the relative strength of those counteracting forces.

Note that in the above discussion, wildlife that is killed has been assumed to have no market value. If it does this will reduce the net cost of killing it and in Figure 3 this will shift the line FGH upwards. If in fact, it is profitable to harvest it, line FG will rise above line OE and therefore it may become socially optimal to reduce the population of the wildlife species by more than $X_4 - X_1$.

5. Conclusion

The above theory helps to explain why in some jurisdictions landholders are legally obliged to reduce wildlife agricultural pests on their properties and to refrain from doing this in other cases. The former seems likely when little or no value is placed on the wildlife species by non-farmers, as is the case of some feral animals (for example, feral pigs) and the species is very mobile (Tisdell, 1982). The latter seems more likely in cases where non-farmers value the wildlife species significantly and it is relatively immobile.

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