Investigating citizens' preferences for recycling residual organic products in agriculture : a choice experiment approach

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Abstract

This paper presents the results of an empirical study recently conducted in the Paris Basin, aimed at estimating the economic value of using Residual Organic Products (ROPs) as fertilizers, compared to a standard mineral fertilization. A Choice Experiment approach allows to assign monetary values to the positive and negative environmental externalities associated with different modes of fertilization by ROPs or mineral fertilizers. The paper addresses in particular 3 environmental effects: the organic waste recycling, the soil erosion closely linked to a potential long-term modification of fertility of soils, and the pollution of soils.

Introduction

With nearly 41 million tons of urban organic waste produced every year in France (excluding agriculture waste) [1], the recycling of urban organic waste is a strong environmental and societal issue. Used in agriculture as a fertilizer, Residual Organic Products (ROP) may have some positive effects, as agronomic effects or preservation of non-renewable natural resources. But it may also lead to negative effects such as the pollution of soils if the safety of ROP is not guaranteed. Therefore, the development of the agricultural recycling of ROP would raise societal issues (waste management practices, level of taxes).
Meanwhile, mineral fertilizers have some negative effects associated to the extraction of non-renewable natural resources for their production. The exclusive use of mineral fertilizers may lead to potential negative externalities such as long term soil erosion due to the slow disappearance of organic matter in agricultural soils.

This study is the economic part of the ADEME project PRO-EXTERN which aims at assessing the agronomic, environmental and socio-economic impacts of the use of ROPs as fertilizers. It thus focuses on the elicitation of social preferences for the spreading of ROP compared to another mode of fertilization: the mineral fertilization (named *status quo*). For instance, relevant issues that we want to be studied are: is there a positive willingness-to-pay for a change in the *status quo* fertilizing practices? What are the preferences of the citizens for the fertilization of soils? And what are the most important effects (among the studied effects) that influence the preferences? How and why would public decision-makers be inclined to favor alternative fertilizing options based on the recycling of organic material?

For this purpose, we deployed a Choice Experiment (CE) approach, interviewing citizens in Paris and its Basin. The CE survey took place in the Paris Basin, France, with the aim of providing estimates of the willingness-to-pay (WTP) of citizens to achieve improvements in the management of different fertilizing modes.

A CE approach to value alternative agricultural fertilizing scenarios

This study aims to assess people's preferences for alternative agricultural fertilizing options with regards to certain categories of environmental effects. But the elicitation of a citizen's economic valuation of that kind of impacts remains a difficult task because there's no proper market for the prevention of soil erosion or against the soil contamination; hence, no price to observe.

If there's no possibility to study the actual citizen's/consumers preferences, then we must use stated preferences non-market valuation techniques which rely on the observation of people's choices in hypothetical experimental circumstances. CE is one of those techniques.

CE is based on the observation of people's preferences among a set of alternatives described by a set of relevant attributes [2].

The CE Survey

The Questionnaire

The questionnaire was developed in collaboration with experts in agronomy, and experts in this waste management profession. It was then tested on several groups of people in order to see if the attributes were all equally understandable and the levels appropriate. That step permitted to adjust the survey and then the final survey was carried out in Paris and its Basin, between July and September 2011. The survey questionnaires were filled during face-to-face interviews in order to answer the potential questions raised associated to a quite complex issue. Overall, 257 interviews were conducted leading to 245 usable questionnaires (the others were not usable because they were not filled completely, and the survey misunderstood by the respondent).

The questionnaire consisted of five sections.
The first section was an introduction presenting the PRO-EXTERN project and the environmental issues associated to the use of ROPs in agriculture as fertilizers. People were informed of the consequences of the different modes of fertilization: exclusive use of mineral fertilizers and then introduction of ROPs and the potential consequences of different alternatives. They were given information to indicate both their benefits and risks. In particular, the questionnaire focused on three environmental dimensions potentially affected by the fertilizing mode: the impact on the amount of recycled organic wastes and on the amount of extracted nonrenewable resources; the impact on the pollution of soils; the impact on the risk of long-term decrease of fertility of the soils. These three effects are relevant attributes to describe the different practices of fertilization. A last attribute is a monetary attribute, necessary in order to assign some monetary values on the attributes: the chosen payment vehicle is local taxes.

The second section of the questionnaire was a short one dedicated to the respondents' opinion about the environmental issue in general and its relative importance in comparison with other societal problems. It also asked questions designed to assess the respondent knowledge on specific environmental issues, in order to understand the awareness about the fertilization issues.

The third section of the questionnaire contained the CE exercise.
Preliminary to the CE questions, we informed the respondents that they would be asked to compare a *status quo* scenario corresponding to the exclusive use of mineral fertilizer with potential alternatives of fertilization, able to influence the values of the attributes (that reflect the assessed environmental effects). However, this could affect the level of taxes. For instance, any improvement of the environmental variables could lead to an increase in tax rates.

The fourth section of the questionnaire gathered socio-demographic information in order to obtain a clearer image of the respondents' profile.

A final section debriefed the survey, in order to explore whether the respondents had a reasonably good comprehension of the survey material and choice tasks.

The CE questions

The CE fertilization scenarios were described by the following four attributes: i) amount of recycled organic wastes and amount of extracted nonrenewable resources; ii) risk on loss of fertility of

agricultural soils; iii) accumulation of pollutants in agricultural soils; iv) level of taxes linked to waste collection.

Those attributes were constructed with a team of agronomists, LCA (Life Cycle Assessment) and risk-assessments experts and waste managers. For each attribute a realistic range of values was proposed, based on scientific calculation. The attributes and the attributes' levels are described in Table1.

Table 1. Attributes and attributes' levels in the CE questionnaire

Attributes	***Level 1***	***Level 2***	***Level 3***	***Level 4 (only for 1 attribute)***
Amount of recycled organic wastes and amount of extracted nonrenewable resources	No recycling Exclusive fertilization with mineral fertilizer	Recycling :+5 % Consequence on decrease in extraction (relative proportion)[1]	Recycling :+10% Consequence on decrease in extraction (relative proportion)	Recycling :+15% Consequence on decrease in extraction (relative proportion)
Risk of loss of fertility of agricultural soils	0 %	25 %	50 %	/
Pollution of agricultural soils	Fluxes of metals equivalent to fluxes associated to mineral fertilizers	Fluxes of metals from A to B[2] higher / ha / yr	Fluxes of metals from C to D[2] higher / ha / yr	/
Level of taxes linked to waste collection	Current cost (220 /yr/family)	Increase of 30€/yr (250 /yr/family)	Increase of 65€/yr (285 €/yr/family)	/

Using a cyclical design based on an orthogonal fractional factorial, we generated 9 choice sets, each consisting of three alternative profiles: the status quo and two alternatives varying from one choice set to another. All combinations were asked in roughly equal frequencies. Respondents were instructed to select the most preferred one (see Fig 1).

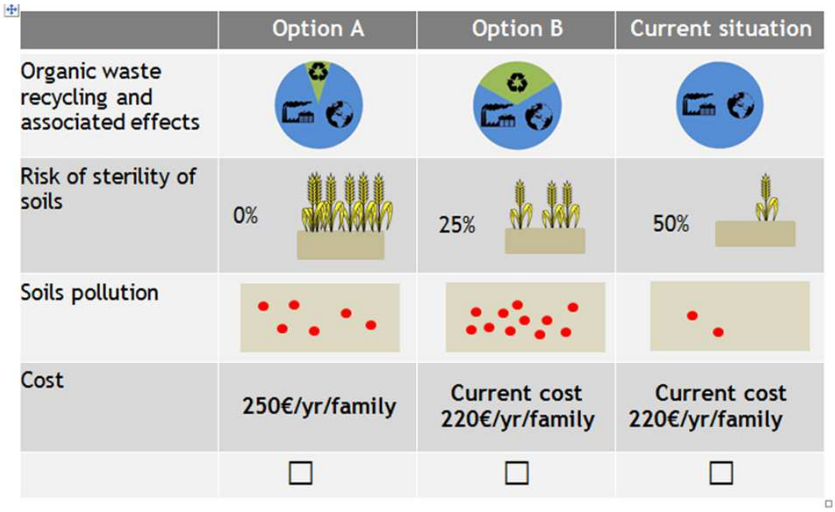

Figure 1. Example of a choice set

[1] The values are represented by a visual picture, and some values are defined by LCA-experts, but not indicated in the survey

[2] A, B, C and D are real indicative numbers in the survey

Modelling

The responses to the surveys are then examined with an econometric analysis, in order to assess the effect that each attribute can have on the respondents' utility. Our analysis uses Random Utility Modelling (RUM). The model is then estimated with a nested logit [2]. As a plausible nesting for the *status quo* scenarios model, we assume that a respondent decides whether to keep the status quo or to pay for an alternative fertilizing scenario, and then, conditional on not keeping the *status quo*, chooses between the two single alternatives.
The study eventually leads to the elicitation of people's willingness to pay for each attribute. (Work still in progress).

Results
Basic statistics

Our sample proves to be representative of the population of the *Paris Basin* in terms of socio-demographic characteristics (same average age : 37 ; close share of women ; close educational level : 2/3 have a post-Bac degree).

Efforts to facilitate the questionnaire's comprehension and face-to-face interviews give a good quality in the answers. On the basis of control questions, we believe that the respondents had a good comprehension of the survey material and choice tasks. 75 % of the respondents found the questionnaire « understandable » or « very understandable ». And if 66 % claimed the issue to be of particular concern, more than 60 % found that the questionnaire allowed anyone to make one's opinion, without favoring either the *status quo* or the alternatives. The remaining 40 % did not share a consensus since more than one third of them found the alternatives favored.

WTP study
Work in progress

Conclusion and perspectives

This study is part of the PRO-EXTERN project (within Programme "Déchets et Société" from ADEME), wherein different economic methodologies are tested. Furthermore, together with the economic studies, some agronomic and environmental data will be provided, with a life cycle vision. The global conclusions of the project would provide decision support to assist decision makers (government, industry) in the development of the agricultural recycling of ROP.

References

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