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Adoption of biodegradable mulching films in agricultural: is there a negative prejudice towards materials derived from organic wastes?

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Abstract

In recent decades, one of the problems affecting the environment has been the increased use of plastics in agriculture, often illegally performed by open burning in the fields. The adoption of biodegradable products may represent an important opportunity to increase the environmental sustainability of agricultural sector. The goal of this study is to estimate the farmers' willingness to pay for innovative biodegradable mulching films. A sample of 120 horticultural farms in the Province of Foggia (Apulia Region, Italy) has been surveyed by a questionnaire. The survey results demonstrate a substantial interest by farmers towards products made with innovative materials.

keywords: Biodegradable mulching film, willingness to pay, innovations, farmers stated preferences

Introduction

In recent decades, the pressing need to reduce the consumption of non-renewable resources and the emission of greenhouse gases into the environment, has led to the wide development of bio-based plastics made from renewable sources. At the same time, the environmental impact of urban and agricultural wastes has encouraged the research of new methods of treatment and disposal to obtain soluble bio-based substances (SBO), which in turn can be used for several applications in the fields of agriculture, such as materials to create biodegradable plastic polymers (Montoneri *et al.*, 2011). Considering that the disposal of plastics in agriculture is often illegally performed by open burning in the fields, leading to greenhouse gases, air pollution, and fire accidents, the adoption of biodegradable products may represent an important opportunity to increase the environmental sustainability of agricultural sector. Therefore, the advantage of producing bio-plastics is twofold: the disposal of urban wastes, and the reduction of agricultural environmental impacts. Plastic materials containing SBO are particularly suitable for the manufacture of mulching films.

The allocation of SBO in the agricultural market has a rather high and attractive potential but the exact extent to which biodegradable plastics will replace “traditional” one is still not well known. The goal of this study is to estimate the extent of farm adoption of bio-based mulching films converted by urban and agricultural wastes. To do this, farmer's willingness to pay for the substitution of conventional film with innovative one is assessed by applying a contingent valuation method. In this work we present the case study of the Province of Foggia (Apulia Region, Italy), which is one of five areas in Italy with higher rate of pollution resulting from mulching plastic waste incineration.

Method

A sample of 120 horticultural farms that may take advantage of mulching technique has been surveyed by means of a questionnaire. Farmers are asked for their preferences towards the adoption of a bio-degradable mulching films made of SBO. In addition to the traditional determinants of farmers' willingness to pay for the introduction of an innovation (e.g. gender, age, income, education), the analysis considers the role of their attitude towards the origin of the mulching film. In other words, we want to verify the existence of a negative prejudice towards materials derived from organic waste. The sample survey involves mainly the

municipalities of the province of Foggia, one of five areas in Italy where there is the higher rate of pollution caused by the incineration of waste (including plastic waste), and that has a significant amount of solid waste. The contingent valuation (CV) study involved about 120 farmers operating in the Province of Foggia (Apulia Region, Italy). The interview is aimed at farms that adopt (and/or potential adopters) the technique of mulch to horticultural crops. The questionnaire consists of four parts. The first part is structured to analyze the correlation between socio-economic characteristics of the interviewees with their willingness to use and pay for the product under investigation (corporate characteristics, environmental ethics and attitude, risk tolerance, social networks and information channels). The second part aims to inform respondents about potential economic and environmental benefits of biodegradable film mulch and to find information on farmers' attitude with respect to their use (in the Table 1 are presented the expected sign for each socio-economic variables).

Table 1: Socio-economic variables

Variables	
Socio-demographic characteristics	Gender Age Education Extra_activity Soil_fertility
Farm characteristics	Corporate Corporate form Managment type Farming experience Labor Land size Type crops
Environmental attitudes	Type change in the last 5 years Area cultivated with organic methods Energy production from renewable sources Protection of the territory (Prevention of hydrogeological)
Risk Propensity	Fertilizers use Insurance policies Agricultural credit
Social network and informative channels	Agricultural loans Industry associations Other associations computer use Web and internet E-commerce Reviews

Qualitative analysis of socio-economic character and adoption (consumer behaviour and attitudes towards the product) follows the contingent ranking analysis. Farmers are asked to sort the characteristics of agricultural film. Analysis of farmers' choices is based on the breakdown of products in their characteristics, in order to estimate the relative importance of individual assessments themselves. Operationally, the collection of data is based on individual assessments of mulching film described by values or levels assumed by their attributes. To this end, respondents are presented two alternatives, which differ for attributes and their levels. Farmers express their preferences by ordering a series of alternatives according to the contingent (Table 2).

Among these attributes, through interviews with retailers and representatives of associations, are selected three key aspects, considered crucial to the decision to purchase and use,

identified in strength, durability and price. In the third part of the questionnaire is prepared by the auction to estimate the willingness of farmers to purchase the goods even in the face of a higher price, offering several alternatives for the same price. Finally, some personal conclude the interview information.

Results

According to the first results, the adoption of a mulching film is not contingent to the compounds whose is made (Table 2). Indeed, the 94 % of respondents do not care of SBO origin. On the other hand, the most relevant technical item for choosing it is having enough operational time frame (3-6 months) followed by the strength of materials and compatibility with harvesting machinery.

Table 2: Number of potential adopters

Willingness to adopt	Number of potential adopters
Mulching technique	18 (48,5%)
Biodegradable films	35 (61,4)
Biodegradable films from organic waste	64(94%)

Table 3: Ranking of most important attribute

Most important attribute	Number of respondents
Integrity	28
Strength	14
Mechanical _harvesting	12
Disposal	6
Transparency	3

Table 4: Statistics for willingness respondents to adopt mulching films from organic waste

Variable	Obs	Mean	Std. Dev.	Min	Max
WTP	62	464.11	101.30	200	750
mean_cost_conventional (€/ha)	30	415.17	110.36	220	600
mean_cost_biodegradable(€/ha)	29	414.83	120.05	220	700
quantity_film conventional (kg/ha)	33	188.03	53.73	100	300
quantity_film biodegradable (kg/ha)	28	116.43	17.79	100	170

Regarding the willingness to pay, prices range from 200 to 750 €/ha, being the average 464 (Table 4). Considering the current applied rate of 116 kg/ha of bio-plastic, the average price amounts to 415 €/ha. According to the surveyed farmers, current expenditure for biodegradable cellulose cornstarch (Mater Bi) is 3.52 €/kg while for conventional one amounts to 2.20 €/kg.

We also calculate the number of respondents who are willing to pay for each bid we raise in the questionnaire. As Table 5 shows, the maximum number of farmers who are willingness to pay for biodegradable films from organic waste is for the first bid and corresponding with the adopters of biodegradable films.

Table 5: Statistics for number of respondents saying "Yes" for each bid

WTP (€/ha) mulching films from organic waste	Potential adopters' mulching technique	Adopters' mulching technique	Adopters' conventional films	Adopters' biodegradable films	Total respondents	Ratio (%)
<360	2	5	1	4	7	11
360	1	3	1	2	4	6
405	1	1		1	2	3
450 (first bid)	3	17	5	12	20	32
495	4	13	6	7	17	27
540		4	1	3	4	6
>540	1	7	6	1	8	13

Discussion

These survey results seem quite encouraging in that they demonstrate a substantial interest by farmers against products made with innovative materials. This implies that there is a market potential of these materials, which, however, must take account of the decisive steps necessary to facilitate the complete replacement of traditional plastics including initiatives of communication and information to farmers, such as field testing, in order to demonstrate the effective action of soil degradation and the absence of pollutants in subsequent periods. In this sense, it is therefore a clear need for significant investments in research and experimentation that, at present, is only possible through public support motivated by the opportunity to develop renewable resources such as municipal waste and to promote innovation in the field of plastics.

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