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Are consumers willing to pay for beef that has been produced without the use of uncontrolled burning methods? A contingent valuation study in North-West Spain

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ABSTRACT

Land burning has long been used as an effective means of land management. Used in a controlled manner, the burning of vegetation to clear land can have minimal effects on the natural environment. However, uncontrolled land burning, where fires are allowed to spread beyond the intended area, can have severe and detrimental effects on ecosystem functioning. This paper examines the premium residents of the Cantabria region of Spain are willing to pay for beef that has been reared without the use of uncontrolled land burning. Using the single bounded contingent valuation method, the result indicates that the average respondent is willing to pay an 84% price premium (€11.31 more per kilogram) for beef that has been farmed using a more environmentally means of land management. Willingness to pay is influenced by several factors including; price, age of the consumer, level of education, number of dependants in the respondents household and historical beef consumption preferences. Further to this, the results of the bivariate probit model suggest that not all factors influencing the decision to enter the hypothetical market, influence willingness to pay. This demand-side analysis suggests that there is a viable market for Pasiego beef in the Cantabria region with more environmentally favourable production credentials.

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1. Introduction

The practice of land burning can be traced back to early hunter-gather populations (Scherjon et al., 2015) and has been suggested to be a major contributor to many of the world's great grasslands (Smith, 1993). Today, land burning continues to be used globally as an effective tool in the management of farmland, mainly in marginal areas traditionally subjected to subsistence agricultural practices. Controlled land burning (also known as prescribed burning) is a technique in which fire is used, under supervision, on specified areas of land under specific climatic conditions to achieve a set of objectives. These objectives can include removal of shrubs to increase grass pastures, wildlife habitat management, control of weeds and insects, biodiversity maintenance and, most commonly, the reduction of fire hazards through the elimination of fuel sources (Fernandes and Botelho, 2003). When controlled burning is used as a land management tool,

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fires are, by definition, controlled, minimise damage to the environment and can be much smaller in size in comparison to uncontrolled land burning.

Uncontrolled land burning, on the other hand, is a disorganised method of land management where an individual sets fire to vegetation with no regard to suitable climatic or soil conditions, or to how the fire will spread. As uncontrolled burnings are left unmonitored, they may lead to wildfires, which, due to their scale, are associated with an extensive array of negative impacts on the local and global environment that are not associated with controlled fires. Wildfires¹ have been linked to soil loss (Pausas et al., 2008), increases in runoff and sediment yield (Mayor et al., 2007), a reduction in the abundance of organic material (Rovira et al., 2012) and degradation of water quality (Smith et al., 2011). Despite this array of negative impacts, the use of uncontrolled land burning remains common in some regions. A number of stated preference studies have examined willingness to pay (WTP) for wildfire prevention programmes. For example, in a recent Spanish discrete choice experiment study (Alló and Loureiro, 2020) found that Spanish households are willing to support forest fire prevention programmes to reduce the frequency of occurrence of aggressive wildfires. Studies on WTP a price premium for farm produce, produced without uncontrolled burning practices, are absent from the literature.

Cantabria, in the North of Spain, has a long history of agricultural burning as a land management tool (Moreno et al., 2014). However, as areas are becoming increasingly arid due to more frequent and longer dry spells, these uncontrolled burns become wildfires much more frequently. Mainly due to human activity, the northwest region of Spain also has the highest number of winter fires in the country (Jiménez-Ruano et al., 2017), making issues related to uncontrolled burns a year-round problem in the study area. It has been suggested by the head of the Spanish Forestry Association that “cattle farming interest” may be to blame for the use of uncontrolled burning which has led to the increase in wildfires (BBC, 2015). Others have also suggested that fires in the northwest region of Spain (Galicia, Asturias, Cantabria, the Basque Country, and the provinces of León and Zamora) are associated with extensive agriculture (Moreno et al., 2011). In addition to beef farmers, a portion of these land burning events may be attributable to conflicts between landowners and forest administration (Leone et al., 2009)².

In part, the use of uncontrolled land burning stems from traditions and culture but other socio-economic and climatic elements also contribute. With greater residential development, higher biomass and the loss of native tree species which would have formed natural firebreaks, the potential for uncontrolled burns to become wildfires is far greater. As a result of a decrease in the number of sheep and cow herds that graze the land, shrubby biomass has increased. This translates to a much higher risk of wildfire propagation when fire is used to control pasture lands (Carracedo et al., 2018). Additionally, under the EU Common Agricultural Policy subsidy payments are made based on the principle that farmers keep their land in what is known as ‘Good Agricultural and Environmental Condition’. As farmers receive greater subsidies for cleared pastureland as opposed to scrubland, a farmer may decide that clearing the land using uncontrolled burns is the most efficient method of receiving these subsidies (Castellnou et al., 2010; Valkó et al., 2014).

The increasing danger of wildfires has been recognised, with unsanctioned burns in Spain becoming illegal. However, these laws have had a perverse effect (Castellnou et al., 2010). Due to the illegality of unsanctioned burns in Spain, individuals perform “hit and run” fires where the fires are set and the perpetrator immediately leaves the scene to avoid prosecution. These unattended burns may then become wildfires.

As highlighted above, legislative attempts to stop uncontrolled burning have proven unfruitful (Castellnou et al., 2010). Financial incentives offered to farmers to discontinue the use of uncontrolled burning of land provides an alternative means of dealing with this issue. This study proposes the use of a labelling system as a means of generating financial benefits for farmers of beef to reduce the use of uncontrolled burns. Within a labelling system, environmental information about the production of the product is placed on the product’s packaging. This information is then used by the consumer to decide whether they would be willing to buy the product. Importantly, if the consumer values the environmental services maintained or created by the product or its production, they may be willing to pay a price premium. If a consumer is willing to pay a price premium, a mechanism can be developed whereby producers can be receive payment for the maintenance of ecosystem services.

In this paper, we estimate the premium residents of Cantabria in Northern Spain are willing to pay for beef that has not been raised on farmland that employs uncontrolled burning practices. To assess the potential for this environmentally friendly product, the single bounded contingent valuation (CV) method was employed. The study adds to the existing literature by being the first to examine consumers’ WTP for agri-products that have not been produced using uncontrolled burning for land management. Additionally, from a policy perspective, evidence for an economically viable environmentally-friendly beef market may induce producers to create such a scheme and in doing so foster a switch to less damaging land management tools.

¹ Issues related to wildfires are predominantly, but not solely, caused by scale and intensity. In some cases, an uncontrolled burn will not become larger than a controlled burn. In these cases, an uncontrolled burn will have no greater impact on the environment. However, due to the manner that uncontrolled burns are set, these types of fires have a much higher probability of causing large-scale environmental damage.

² Leone et al. (2009) report that 53.5% of fires in Spain are due to intentional actions, 25% are of unknown origin. However, the authors also report that it could be the case that if wildfires with unknown origins were properly categorised agricultural fires may account for between 45% and 50% of all fires. A comparable statistic for maliciously caused fires is not given.

2. Labelling and CVM

This study suggests a price premium on local agricultural goods to assess whether respondents value wildfire prevention. This approach has been used extensively within the literature on food products, using the stated preference methods of contingent valuation (CV) and choice experiments (CE). In the former, respondents are offered a complete good and asked their WTP. In the latter, respondents make choices between bundles of goods which vary in their attributes, one of which is price.

A popular method of conveying information about a potential new food product in a CV study is through labelling. In these cases, respondents are informed that the good will have a label that signifies some quality/qualities about the product or its production. CV studies using food product labels include wine (Brugarolas et al., 2010; Loureiro, 2003; Sellers, 2016), apples (Cerdeira et al., 2012; Loureiro et al., 2001; Rousseau and Vranken, 2013), fruits and vegetables (Nandi et al., 2017), seafood (Hynes et al., 2019; Salladarré et al., 2016), rice (Zhou et al., 2017) and beef products (e.g. Corsi and Novelli, 2011; Saraithong, 2016; Tonsor and Shupp, 2009).

Labelling applied to beef products has been used to convey a wide range of qualities such as where the beef originates from (Li et al., 2017), the safety of the product (Saraithong, 2016), the use of growth hormones (Lusk et al., 2003), and whether the product is sold directly to the consumer (Sanjuán et al., 2012). Within the literature terms such as “organic” (Lin and Kim, 2017; Corsi and Novelli, 2007, 2011; Heo and Sung, 2004), “raised carbon-friendly” (Li et al., 2016), “eco-friendly” (Charry et al., 2019) and “sustainably produced label” (Tonsor and Shupp, 2009) have been used to provide information to the respondent.

Focusing on the studies relating to environmental management of the beef stock, the results of Corsi and Novelli³ (2007, 2011) suggest that there is a market for “organic” labelled beef in Italy. However, in both studies, labelled beef is described solely as being “organic”. Likewise, both Heo and Sung (2004) and Lin and Kim (2017)’s study of South Korean respondents found that consumers were willing to pay a premium for organic beef products. As the organic label used in the study has both health and environmental connotations it is often difficult to parse the reason for the acceptance or otherwise of the presented price premium, in the absence of exploratory questions being asked of respondents. Further analysis by Lin and Kim (2017) gives some insight into why an individual may pay more for “organic” beef. Their results suggest that an “organic” label is valued higher than either a label that signifies environmentally friendly practice or food safety practices. This is likely due to the authors using pre-existing labels, defined by the South Korean government, where the organic label incorporates elements of food safety and environmentally conscientiousness. Lin and Kim (2017) also compared a pre-existing environmentally friendly label to a food safety label. The authors found that there was a statistically significant premium for the environmentally friendly label in comparison to the food safety label.

With respect to the use of a “sustainably produced label”, Tonsor and Shupp (2009) asked approximately 500 respondents in a national survey of U.S. consumers if they would be willing to pay more for tomato, apple and beef products. The authors did not find a statistically significant willingness to pay a price premium for any of the listed products with a “sustainably produced label”. However, for beef alone, their analysis suggests that a subset of individuals would be willing to pay a premium. As no clearly defined criteria exist for “sustainably produced” products, Tonsor and Shupp (2009) gave each respondent a list of terms and asked them if they felt the term could be applied to the “sustainably produced” label. The term most often associated (78% for beef) with the “sustainably produced” label was “environmentally friendly”.

Li et al. (2016) investigated whether a representative sample of U.S. consumers would be willing to pay more for beef that was certified as “raised carbon-friendly”. As described to the respondents, the “raised carbon-friendly” certificate would be given to producers who used a prescribed grazing system that reduced carbon emissions in comparison to traditional practices. The authors did not find, for the sample as a whole, a statistically significant willingness to pay for beef that was certified as “raised carbon-friendly”. Much like in Tonsor and Shupp (2009), only a subset of individuals were willing to pay a premium for the certified beef. Li et al. (2016) found that individuals on higher incomes, who are environmentally conscious and believe in the efficacy of government regulation were most willing to pay for the proposed programme.

Elsewhere, Charry et al. (2019) examined consumer behaviour in relation to beef production in Colombia. Respondents were asked if they would be willing to pay more for beef that was produced with 35% less greenhouse gas emissions compared to regular beef production. The results again suggest that only a certain segment of the sample was willing to pay a price premium for eco-friendly beef. In the case of Charry et al. (2019) the only significant determinants for purchasing the eco-friendly beef were education and income. This coincides, to some degree, with the results of Tonsor and Shupp (2009) and Li et al. (2016) and may imply that, in general, eco-friendly beef is a luxury good that lower-income groups may not be able to afford. However, as noted elsewhere (De Boer et al., 2013), individuals that are most concerned with the environment may choose to substitute away from beef products instead of a more environmentally friendly product. This may be truer for low-income groups if they have a more elastic demand for beef with respect to price.

³ Corsi and Novelli’s 2011 study compared the results from data used from their 2007 study to data collected two years later to test if the BSE disease, prevalent in cows at the time, affected organic beef consumption.

Within the CV studies that looked at the effects on consumer demand of environmental conscience practices for beef production only those who used the “organic” label term found statistically significant WTP (Heo and Sung, 2004; Corsi and Novelli, 2007, 2011; Lin and Kim, 2017). The other studies found no significant WTP for the average consumer (Tonsor and Shupp, 2009; Li et al., 2016; Charry et al., 2019). No study presented a negative WTP for environmentally friendly beef.

In addition to the CV method a number of choice experiments have examined the willingness to pay for labelled beef products literature. For example, Zanolini et al. (2013) found that for Italian beef consumers an organic label was preferred to conventional or genetically modified beef. However, Ortega et al. (2016) estimated that for Chinese consumers a “green” label was preferred to an “organic” label. Grebitus et al. (2013) observed, for Canadian consumers, that as carbon emission and/or water usage rose due to beef production propensity to purchase ground beef fell. Although Li et al. (2018) found that U.S. consumers were willing to pay more for “raised carbon-friendly” ground beef and steak, respondents rated ‘reducing the environmental footprint’ relatively low in importance in comparison to other attributes including price. Additionally, research by Alló and Loureiro (2020) indicates a WTP, through a one-time tax, for megafire prevention programmes in Spain, that include planting of more resistant tree species, social programmes and forest cleaning to reduce the number of hectares at risk of being burned, lending credence to the perceived importance of fire prevention in the study area. The authors note that those unwilling to pay for fire prevention programmes are those who feel they are already paying too many taxes. Interestingly, the authors found no greater WTP in high-risk areas.

3. Methodology

The CV method is a stated preference technique used to estimate the value a person places on a hypothetical good or service; in this case the value of beef that has been produced without any associated uncontrolled burning practices on the farm where the animals are raised (hereafter referred to as no burn Pasiego beef). Within the CV method, a respondent is presented with a hypothetical good and asked to state their willingness to pay for that item through a specified payment vehicle e.g. tax, charitable donation or in this case a price premium on local beef. There are several different elicitation designs for the CV method. The approach chosen for this study is the single bound dichotomous choice (SBDC) (Bishop and Heberlein, 1979).

In the SBDC design, a statement is presented to the respondent about the hypothetical good the researcher wishes to value. The respondent is then asked if they are willing to pay the bid price, which has been previously set by the researcher, for the good described. The respondent can either respond “yes” meaning they are willing to pay the bid price or “no” they are not willing to pay the bid price. If the respondent replies “no” to the initial question, they may be asked why they would not be willing to pay any additional amount no matter how small. This is often done to eliminate protest bids.

In the present study, respondents were first asked if they would be willing to pay any extra amount for the no burn beef before they were presented with the bid price. This allows a better understanding of which respondents were not willing to enter the hypothetical market and which respondents were not willing to enter at the bid price they were presented with.

The bid price, or price premium in this case, is a single randomly assigned value for each respondent. The acceptance of the bid price by the respondent in the SBDC method reflects the respondent’s willingness to pay at least the bid value. This elicitation method was chosen over an open ended design as while it does not reveal their maximum willingness to pay, it reduces the cognitive demand on respondents, particularly for products or scenarios that the respondent may be unfamiliar with Oerlemans et al. (2016). In addition, it reduces the potential for strategical responses where respondents overstate their value of the good to increase the likelihood of the good in question being produced (Carson and Groves, 2007).

Using a SBDC question format, the WTP function for individual i can be described as:

$$WTP_i = x_i\beta + \varepsilon_i \quad (1)$$

where x is a vector of explanatory variables, β is a vector of parameters to be estimated and ε is the error term. In this case

$$\begin{aligned} WTP_i &\geq bid_i \text{ if the offered bid amount for the no burn Pasiego beef is accepted and} \\ WTP_i &\leq bid_i \text{ if the offered bid amount for the no burn Pasiego beef is not accepted} \end{aligned} \quad (2)$$

Designating $y_i = 1$ if bid_i is accepted and $y_i = 0$ if bid_i is not accepted, the probability of $y_i = 1$ is a function of the explanatory variables x and can be described as:

$$\begin{aligned} Pr(y_i = 1|x_i) &= Pr(x_i\beta + \varepsilon_i > bid_i) \text{ or} \\ Pr(y_i = 1|x_i) &= Pr(\varepsilon_i > bid_i - x_i\beta) \end{aligned} \quad (3)$$

Assuming that the ε_i has a normal distribution $N(0, \sigma^2)$, the standard probit specification can be written as:

$$Pr(y_i = 1|x_i) = \Phi\left(\frac{x_i\beta}{\sigma} - \frac{bid_i}{\sigma}\right) \quad (4)$$

where $\Phi(\cdot)$ denotes the standard cumulative normal density function. In the standard probit model x_i and bid_i are estimated as explanatory variables. The estimates of β/σ , the vector of coefficient estimates associated with each of the explanatory variables, and $-\frac{1}{\sigma}$, the coefficient estimate on bid_i are obtained.

In this analysis, consideration also has to be given to respondents' willingness to participate in the hypothetical market. Respondents who are unwilling to pay a price premium can take one of two forms. The first can be classified as a true zero bidder. This is someone who places no value on the good being offered and, consequently, is not willing to pay a premium for the no burn beef. The second set can be described as a protest bidder. These individuals value the good but are unwilling to pay for it. This may reflect a mistrust in some component of the hypothetical market (e.g. the payment vehicle) rather than a lack of benefit derived from the specified environmental service/services. When not controlled for, protest bids can lead to biased WTP estimates. Several approaches have been taken within the literature to deal with protest bids, which include exclusion from analysis, two step-models and a sample selection method; this latter approach is undertaken within this analysis.

Using a sample selection method, it is assumed that the decision to participate in the hypothetical market and the decision to pay the bid price are not independent of one another. Consequently, participation and willingness to pay should be jointly estimated. A well-established method of alleviating sample selection bias through joint estimation is the Heckman model (Heckman, 1979). Originally introduced to deal with events where the first choice was binary and the second was continuous, the model has since been adapted for two binary outcome variables (Van de Ven and Van Praag, 1981).

The resulting bivariate probit model can be described as:

$$Pr(y_{1i} = 1 | x_{1i}) = Pr(\varepsilon_{1i} > bid_i - x_{1i}\beta_2)$$

$$Pr(y_{2i} = 1 | x_{2i}) = Pr(\varepsilon_{2i} > x_{2i}\beta_2)$$

$$\rho = corr(\varepsilon_{1i}, \varepsilon_{2i}) \quad (5)$$

where subscript 1 denotes that these elements related to the decision to accept the bid price and subscript 2 indicates the relationship to the decision to enter the hypothetical market. The errors in the bivariate probit are assumed to be independently and identically distributed as a standard bivariate normal (Φ_2) with correlation ρ ; that is

$$\varepsilon_{1i}, \varepsilon_{2i} \sim \Phi_2(0, 0, 1, 1, \rho) \quad (6)$$

If $\rho = 0$, then the errors are independent and Φ_2 reduces to two separate standard normal distributions. If $\rho \neq 0$, then the errors are correlated and the probability of one error is dependent on the probability of the other. The ρ coefficient therefore captures some of the unobservable characteristics that correlates probability of entering the hypothetical market and the decision to state a WTP the bid price.

Of particular interest are the predicted joint probabilities of y_{1i} and y_{2i} as these give an indication of the interrelationship between the two choices presented to the respondent, entering the hypothetical market and WTP the bid price.

$$\begin{aligned} Pr(y_{1i} = 1, y_{2i} = 1) &= \Phi_2(x_{1i}\hat{\beta}_1, x_{1i}\hat{\beta}_1; \hat{\rho}) \\ Pr(y_{1i} = 1, y_{2i} = 0) &= \Phi(x_{1i}\hat{\beta}_1) - \Phi_2(x_{1i}\hat{\beta}_1, x_{1i}\hat{\beta}_1; \hat{\rho}) \\ Pr(y_{1i} = 0, y_{2i} = 1) &= \Phi(x_{2i}\hat{\beta}_2) - \Phi_2(x_{1i}\hat{\beta}_1, x_{1i}\hat{\beta}_1; \hat{\rho}) \\ Pr(y_{1i} = 0, y_{2i} = 0) &= 1 - \Phi(x_{1i}\hat{\beta}_1) - \Phi(x_{2i}\hat{\beta}_2) + \Phi_2(x_{1i}\hat{\beta}_1, x_{1i}\hat{\beta}_1; \hat{\rho}) \end{aligned} \quad (7)$$

To avoid endogeneity related bias in the heckman probit model a valid exclusion restriction method is required (Wolffolds and Siegel, 2019). This is achieved through the inclusion of a variable that, in this case, impacts the decision to enter the hypothetical market but not WTP. Careful consideration was given to this matter as most available variables will either affect both dependent variables or neither. The variable "Burning Land threatens the environment" was created to deal with this matter. Further information on this variable is presented in Section 5.

4. Study area and survey

4.1. The Pasiego mountain area

The Pasiego mountain area encompasses three river catchments; Pas, Miera and Asón, located in Cantabria in Northern Spain. They are Atlantic catchments, draining into the Cantabrian Sea with a total drainage surface of 1737 km². The dominant climate is temperate hyper-oceanic. The average annual precipitation is approximately 1200 mm, although in the upper part of the Pas and Miera catchments the precipitation may reach 2600 mm. Three different zones can be differentiated across the study area, a coastal area in the lower parts of the catchments, internal valleys in the middle

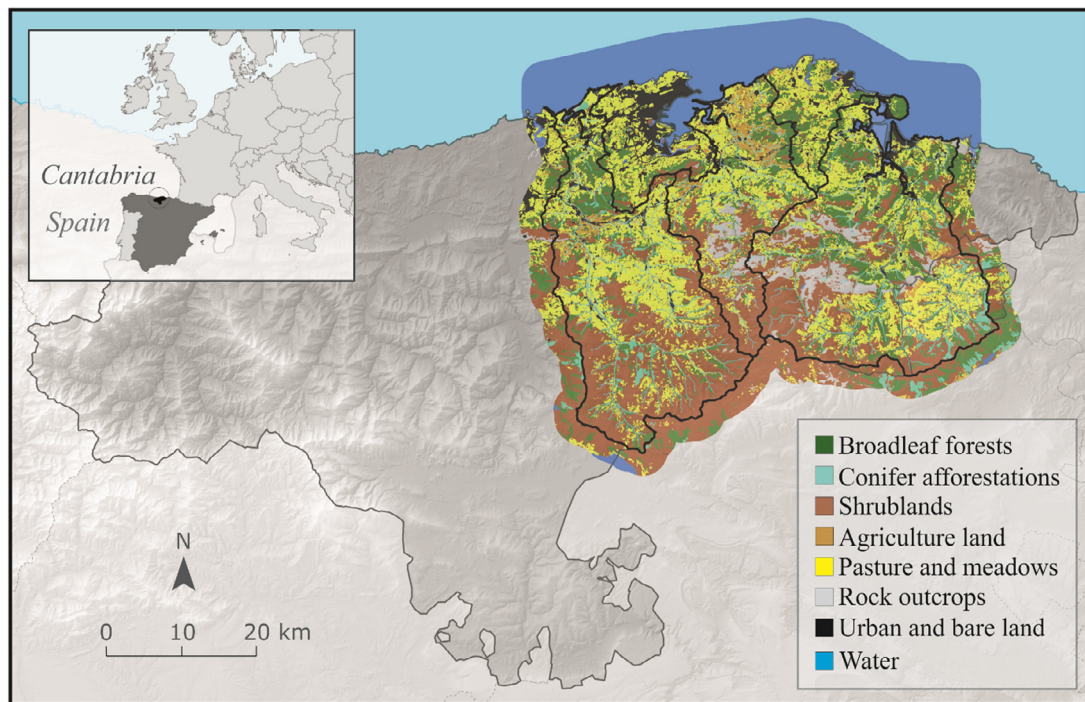


Fig. 1. Image of the Three river catchments of Pas, Miera and Asón in Cantabria.

region and a mountain range in the higher reaches of the catchments. The highest mountains have an average altitude ranging between 1300–1700 m.

Landscape structure and vegetation patterns portray the legacy of intensive land management practices over the last 400 years. After the foundation of the “Royal Artillery Factory” in La Cavada in 1616, the native forests in the eastern extreme of the region of Cantabria were intensively exploited for 160 years to obtain wood for naval construction. Deforestation in these areas has been maintained by fire and cattle grazing since then. Thus, a mixture of shrubs and extensive pastureland currently covers up to 75% of the catchments’ surfaces. Mature forest fragments (of oak and beech forests) are relegated to valley and marginal locations in steeper hillslopes (Fig. 1).

The number of fire outbreaks and the total area burnt in the region has increased in the last couple of decades. In part, this is due to an increase in shrubby biomass caused by a decrease in the number of sheep and cattle grazing the land. This has increased the risk of wildfires when uncontrolled burns are used to maintain pasture lands (Carracedo et al., 2018).

Over 70,000 people live in the study area. More than half of the population is concentrated near the river mouths, in the towns of Santoña, Laredo, Oruña and Arce. There are also important population areas at the bottom of most of the open valleys (Liérganes, Puente Viesgo, Ramales de la Victoria, etc.). The population density is 42 inhabitants (inh)/km², 54 inh/km² and 60 inh/km² in the Miera, Pas and Asón catchments, respectively. Most of the population growth has occurred in towns close to coastal areas while the population in the mountain villages has declined. Population decrease in the mountain areas reflects the reduction of cattle farming in the Cantabria region. The region has seen a 20%–30% reduction in the number of farms and cow heads in the last decade. The remaining farms have placed an increased emphasis on beef cattle. Indeed, in 1995, only 33% of total cows in the region were used for beef production but this figure increased to 57% by 2010 (Moros and Buscá, 2014). The condition of the land, coupled with climatic changes and socio-economic conditions (e.g. subsidy payments received for cleared pasture land) and the importance of beef farming to the region suggests that without intervention uncontrolled land burning will continue to have a serious impact on the study area.

4.2. Survey design and data collection

The initial draft of the survey was developed based on the current literature and past experiences of the research team. After this first stage of survey development, a focus group was conducted to inform the language and ability of the general public to answer all survey questions. Due to COVID-19 restrictions, the focus group stage was conducted on a one-to-one basis with 25 individuals of different demographic backgrounds. Following these interviews, the survey was modified to reflect the information provided by the participants. The amended survey was then tested using a pilot study. Following the recommendations of Haab and McConnell (2002), the CV question was asked in an open-ended format during the

pilot study, to guide the bid values used for the SBDC question in the main survey. The pilot study consisted of 31 people and was conducted via telephone.

The main survey was undertaken by trained professionals using computer-assisted telephone interviewing. Participation was voluntary and the survey took approximately 10 min to complete. Residents were surveyed across the entire Cantabria region. Respondents were screened to match local area level demographics for age, gender and whether or not they lived in a rural area. The respondents were also asked if they consumed meat. If the respondent did not consume meat the survey was discontinued.

In the survey, respondents were given a series of Likert style questions examining the factors that have influenced them in their historical beef purchases. The Likert scale was 1 to 5 with a 6th “do not know” option.⁴ The respondents were also asked questions in relation to their perception of the local environment, the ecosystem services provided within the Pasiego mountain region and what they believed are the biggest threats to the local environment. Then they were asked about their views on farming and its effects on the environment.

The CV question section of the survey began by asking if the respondent was familiar with the practice of land burning to get a better understanding of awareness of this practice before it was explained to the respondent. The context for eco-labelled beef was then explained to the respondents. Respondents were then read the effects that uncontrolled land burning can have on the natural environment. Five effects of uncontrolled burning were read to each of the respondents. These effects were informed by expert opinion and the literature. These included (1) the loss of natural spaces for wildlife, (2) a decrease in the number of animals such as birds, plants, trees and insects living in the Pasiego territory, (3) soil erosion and degradation, (4) reduction of water quality (this includes a decrease in water clarity, unfavourable changes in chemical composition and increasingly less suitable waters for human and wildlife use) and (5) a reduction in the ability of the natural environment to remove carbon from the atmosphere.

The respondents were then asked if they thought land burning impacts the Pasiego territory. This question created the dummy variable “Burning Land threatens the environment” highlighted in Section 3. Next, the respondents were asked to “consider two options when purchasing a Pasiego beef fillet, taking into account the family budget. The first option is the usual beef fillet that you can find at your local supermarket. It is beef produced in the Pasiego mountains and valleys. The cost of this steak is €13.50 per kg. An individual portion weighs about 225 g and can cost €3.04 euros. It may also have been produced on a farm that used uncontrolled burning techniques. The second option is the beef fillet of the mountains and valleys of Pasiego but which, in addition, is produced by ranchers who do not use uncontrolled burning. This product will be given the label “No burn Pasiego beef”. By producing beef without uncontrolled burning, the negative environmental impacts previously mentioned will be greatly reduced”.⁵

Following this, the respondent was asked if they were willing to pay more for the no burn Pasiego beef product in comparison to the traditional beef product. For those who responded “no” to this question, they were asked why they would not be willing to pay a price premium for no burn beef. For those who answered “yes” they were asked whether they would be willing to pay one of the following randomly assigned, per kg, bid prices: €14.50, €15.50, €16.50, €17.50, €19, €22. These prices were set based on the open-ended CV question used in the pilot study. The survey ended with a series of socio-demographic questions.

5. Results

Table 1 presents summary statistics for a select number of variables. The sample consists of 1070 observations. There is an equal split between females and males and the average person was 55 years old. Employment has been grouped, for analysis, into four categories. Those employed make up 46% of the sample. These are individuals who work full time, part-time or are self-employed. Approximately 11% of the sample are homemakers and 3% are students. Unemployed individuals (14%) include those not working due to illness or disability and retired people. Three-quarters of the respondent lived in an urban area.

Almost half of the sample (47%) have a primary or lower level of education, 29% attended secondary level education and 24% have third level education. Respondents were placed in one of three social classes based on their current or, in the case of those unemployed (including retired), their most recent job. The group referred to as social class 1 (49%) contains directors and managers, mid-level technicians, public service personnel and administrative staff. Social class 2 (40%) are skilled and semi-skilled manual workers and farmers. The final category, social class 3 (11%), are those that stated they have never been employed.

Only 21% of the sample identified themselves as the primary purchaser in their household. However, this does not indicate that the average respondent does not make some of the purchasing for the household or is not involved in decision making. The average number of children per household was 0.42. Recreational use of the region is infrequent with only one-third of the respondents using it once a month or more. About 18% used the region for recreation more than twice a month and 13% never used it.

⁴ In order to keep these variables on a consistent scale for analysis, observations that choose the ‘do not know’ option have been remapped to 3 “neither important nor unimportant”. Those who chose the “do not know” option ranged from 1% for the influence of taste on previous beef purchases to 3.2% for the influence of price.

⁵ This quotation is a translation of the Spanish wording used in the survey.

Table 1
Summary statistics of surveyed respondents.

Variable	Mean (SD)
Female	0.50 (0.50)
Age	54.46 (16.34)
Employed	0.46 (0.50)
Student	0.03 (0.18)
Homemaker	0.11 (0.32)
Unemployed	0.14 (0.34)
Social class 1	0.49 (0.50)
Social class 2	0.40 (0.49)
Social class 3	0.11 (0.31)
Lived in Pasiego region	0.55 (0.50)
Urban dweller	0.75 (0.44)
Education primary or lower	0.47 (0.50)
Education secondary	0.29 (0.45)
Education third level	0.24 (0.42)
Household primary purchase maker	0.21 (0.41)
Dependants in household	0.42 (0.80)
Uses the Pasiego region for recreation once a month or more	0.33 (0.47)
Burn land threatens the environment	0.73 (0.45)
Eat beef once or more per week	0.75 (0.43)
Historical beef purchase influenced by:	Likert scale 1 to 5
Product's price	3.80 (1.18)
Product being locally farmed	4.47 (0.95)
Product produced using environmentally friendly practice	4.36 (1.00)
Product's taste	4.72 (0.67)

Respondents' income is not included due to the high number of individuals who were unwilling to disclose their income.

Table 2
Acceptance rates for bid prices of no burn Pasiego beef.

Bid value	€14.50	€15.50	€16.50	€17.50	€19	€22
Acceptance rate	95%	93%	89%	87%	75%	74%

Approximately three-quarters of the respondents ate beef once a week or more while 18% ate beef more than three times a week. Respondents that said they never eat any meat were asked not to complete the survey. Respondents that eat meat but did not eat beef were allowed to complete the survey. The respondents that eat meat but not beef accounted for 4% of the sample.

In relation to the Likert style questions about the importance of factors driving historical beef purchases, product taste has the highest average score of 4.72 which is closest to 5, indicating “very important”. Price, on the other hand, was 3.8 between “neither important nor unimportant” and “somewhat important”. Approximately one quarter of the respondents stated that price was either “very unimportant” or “unimportant”. Whereas 63% of the respondents stated that price was either “important” or “very important”, suggesting a price sensitive sample.

Before the respondents were presented with the product or any discussion about land burning, they were asked a series of Likert style question about threats to the natural environment they live in. One of these questions asked whether the respondent felt that the burning of shrubs for land clearing was a threat to the natural environment they live in. From this question, the dummy variable *burning land threatens the environment* was created with 1 indicating a Likert score of a 4 or a 5 meaning respondents believe land burning does pose a threat to the environment. Just under three-quarters of the sample fell into this category. It is assumed that the response to this question influences the decision to be WTP some amount (i.e. enter the market) but after that should not influence the yes/no response to the bid amount presented. If one thinks land burning causes damage to the environment and they care about the environment, they should be willing to pay some amount for a product that reduces this harmful activity. If they do not think land burning impacts the natural environment then there is no need to pay for a product that, by their assessment, provides no benefits. However, one should not be able to predict the actual price premium the respondent is willing to pay from the variable ‘Burning Land threatens the environment’.

In the survey, 13% of the total sample said they would be unwilling to pay anything more for the no burn beef in comparison to the conventional beef product. Respondents were given a list of reason for not wanting to pay more for the no burn beef and asked whether or not each applied. The most common reason for saying “no” was not having enough information (6%), followed by not valuing the ecosystem services (5%) and not having any extra money (5%).

Table 2 presents the acceptance rate of bid values for those who entered the hypothetical market. As predicted by economic theory, as price increases the acceptance rate drops.

The bivariate probit jointly estimates the probability of accepting the bid value and participation in the hypothetical no burn Pasiego beef market. The Athrho coefficient seen near the bottom of Table 3 is the correlation coefficient between

Table 3
Bivariate probit model for no burn Pasiego beef.

Variable	Participation	WTP
Bid value	–	–0.097 (0.014)***
Burning land threatens the environment	0.168 (0.064)***	–
Female	–0.101 (0.111)	–0.071 (0.098)
Age	0.044 (0.018)**	0.039 (0.017)*
Age ²	–0.000 (0.000)***	–0.000 (0.000)**
Pasiego	0.124 (0.094)	0.049 (0.087)
Urban dweller	0.201 (0.108)*	0.147 (0.098)
Secondary level education	0.103 (0.123)	0.201 (0.110)*
Third level education	0.266 (0.155)	0.316 (0.131)**
Employed	0.106 (0.129)	–0.029 (0.115)
Student	0.813 (0.501)	1.113 (0.381)***
Homemaker	0.101 (0.179)	0.260 (0.174)
Social class 2	–0.087 (0.120)	0.029 (0.106)
Social class 3	0.210 (0.217)	–0.171 (0.189)
Primary purchase maker	–0.006 (0.129)	–0.123 (0.114)
Dependants in household	–0.161 (0.061)***	–0.137 (0.055)**
Uses Pasiego region for recreation once or more a month	–0.108 (0.103)	0.030 (0.093)
Consume beef once or more a week	–0.085 (0.120)	–0.091 (0.103)
<i>Factors influencing beef purchases:</i>		
Beef price	–0.078 (0.043)*	–0.080 (0.038)**
Environmentally friendly beef rearing practices	0.145 (0.049)***	0.132 (0.046)***
Locally farmed	0.087 (0.053)	0.119 (0.049)**
Beef taste	–0.101 (0.121)	–0.104 (0.113)
Constant	–0.534 (0.613)	0.749(0.615)
Athrho ^a	12.46 (6.48)*	
Log-likelihood	–727	
AIC	1543	
BIC	1767	
Observations	1070	

Results of the participation aspect of the bivariate probit are presented in column two. The results of the WTP portion are presented in column three.

*Indicates significant at 10%.

**Indicates significant at 5%.

***Indicates significant at 1%.

^aAthrho is the Fisher's Z transformation of the correlation coefficient. To obtain estimates of rho, the correlation coefficient, an inverse transformation can be applied.

the residuals of the two probit models. The significant Athrho statistic suggests that the bivariate probit model rather than two separate univariate models is more appropriate. Additionally, the results of a likelihood ratio test comparing the jointly estimated bivariate probit to standard probit models supports the use of the bivariate probit.

Each part of the bivariate probit contains one variable not found in the other. The bid value variable is only in the WTP portion of the model for obvious reasons and as discussed previously the variable *Burning land threatens the environment* is only present in the participation part of the model. As expected, the coefficient related to the bid value is negative and significant. This suggests that as the price of the “no burn” beef increases the probability that the respondent accepts the bid value decreases. The variable *burning land threatens the environment* is positive and significant, indicating that if the respondent reported their belief that burning shrubs for grass regeneration was damaging to the natural environment of the Pasiego mountains and valleys they were more willing to consider the purchase of no burn beef.

In the participation and WTP parts of the model, age had a quadratic effect on the dependent variables. As age increases, respondents were more likely to enter the hypothetical market and more likely to accept the bid price. However, there is a turning point at which the positive effect of age turns negative. In the participation part of the model, the turning point was 49.4 years and for the WTP portion, it was 51.6 years. Educational attainment only impacts the probability of a “yes” response to the CVM question. Whether the respondent lived in the Pasiego region had no statistically significant impact on either participation in the hypothetical market or willingness to pay for the no burn beef. A respondent living in an urban area was more likely to enter the hypothetical market but was not willing to pay more, on average. Respondents with a second level or university level education as opposed to primary level or lower were no more likely to enter the hypothetical market but were more likely to accept the bid price, suggesting a higher WTP.

There is no statistical difference between those who normally purchase the shopping in comparison to those who do not with respect to both entering the market and WTP. The number of dependants in the household impacted both outcome variables negatively. This is likely to be related to disposable income and/or the quantity of beef that would need to be purchased to satisfy the whole family. Being employed, as opposed to unemployed, unable to work or retired, had no statistically significant impact on entry to the hypothetical market or acceptance of bid values, nor did being a homemaker. Students, on the other hand, were significantly more likely to respond “yes” to the CVM question but not more likely to enter the market. However, given students typically lower levels of income it is difficult to determine if

Table 4
Estimated willingness to pay for no burn Pasiego beef per kilogram.

Measure	WTP	Lower bound	Upper bound
Mean	€24.88	€23.19	€27.55

this would result in real-world sales. Using the Pasiego region for recreation once or more a month had no impact on the dependent variables. Social class also appears to have no impact.

Several questions were included in the questionnaire in relation to historical beef consumption which can be used as a pseudo validity test. Based on the negative and significant coefficient for the variable “beef price”, the more importance a respondent placed on beef price, the less likely they were to enter the market and the less likely they were to accept the bid price. The more important environmentally-friendly beef rearing practices are to the respondent the more likely they are to consider purchasing the product and the more likely they are to accept the bid price. The more important it was to the respondent that the beef was locally produced the higher the implied WTP. The importance of beef taste had no impact on either dependent variables. These four variables follow an obvious logic and indicates that there is consistency between previous buying habits and the respondents’ answers to the CVM questions. If the respondent is price sensitive in previous beef purchases, they remain price sensitive in the hypothetical market. The respondent’s perception of environmentally friendly farming practices are important to the respondent when considering whether to enter the market and when assessing their WTP the stated bid value based on the significance of the positive coefficient in both parts of the model. These questions also indicate that some of the value of the no burn Pasiego beef to the respondents comes from the fact that it is locally farmed.

Table 4 presented the mean willingness to pay for the no burn Pasiego beef option. The mean welfare estimate suggests that the average respondent would be willing to pay €24.88 for the product, a price premium of €11.38. Upper and lower bounds were calculated using the Krinsky–Robb method (Krinsky and Robb, 1986) indicating the true population value lies somewhere within the 95% confidence interval of between €23.19 and €27.55. The mean willingness to pay indicates that this product could command an 84% mark up on conventional beef.

6. Discussion

Overall acceptance rates (presented in Table 2) of each bid value were quite high ranging from 95% at a bid value of €14.50, a one euro premium, to 74% at €22. As predicted by economic theory, as the price increased the acceptance rate dropped. However, it is also expected that the larger gap between the upper bid values would result in a larger percentage drop in acceptance rates. This is not the case here as the largest change in the bid price, going from €19 to €22, resulted in the smallest percentage change in acceptance rates of the bid price, falling by only 1%. There is no theoretical reason why such an outcome would occur. The acceptance rates overall are considerably higher than would have been expected from the pilot study in which an open ended maximum WTP question was employed rather than actual bid values. This may suggest that higher bid values should have been used. Additionally, given the bid values, it is worth considering that an alternative means of modelling the data may be more appropriate.

When WTP has a skewed distribution, as is the case here, a log-transformation is applied. As such, the model was re-run assuming a log-normal distribution to check for robustness of the findings. Although the results were similar between the two models, model fit was slightly better using the unaltered WTP bid values. The welfare estimate, the metric of primary concern, was also somewhat larger using the log-normal transformed bid values at €28.60 compared to the value €24.88 generated from the model presented previously.

The two portions of the bivariate probit (Table 3) indicate that there are some differences in relation to the factors that influence participation and the factors that influence WTP. Being from an urban area, as opposed to a rural area led to an increased probability of entering the hypothetical market. Having a secondary level or a university education and the importance of the product being locally farmed and the beef’s taste were all significant in the WTP portion of the model and not in the participation portion of the model.

The significance of the variable referring to whether an individual lived in an urban area, may be related to exposure to the uncontrolled beef burning practice. It may be the case that those living in rural areas are more likely to use uncontrolled burning techniques or know someone who does. These individuals, if they are farmers, may then be less willing to enter the hypothetical market as they may want to continue the practice themselves or they may not value the product as a consumer. Individuals who may know farmers using this practice may be less willing to give an implied condemnation to the actions of farmers using this practice. Consequently, urban dwellers are comparatively more likely to enter the market.

The results of the education variable follow on from previous literature (Charry et al., 2019). Higher education may suggest a better understanding of the impacts of land burning on the environment.⁶ However, given that education was

⁶ Those with higher levels of education were more likely to be aware of land burning before starting the survey and more likely to think burning grassland was detrimental to the environment.

only significant in the WTP portion of the model, it is more likely that as education is, in this sample, correlated with high earnings resulting in respondents who are less price sensitive.

It is interesting that there was no statistical difference between the primary purchaser (the person who normally shops for the household) in comparison to those who do not with respect to both entering the market and WTP. This is an important finding as if the primary purchase maker was significantly less likely to purchase the product it would raise questions as to the applicability of this study in a real market situation.

The WTP estimates presented here suggest that the average respondent would pay a relatively large price premium for the no burn Pasiego beef. In comparison to the previous CVM literature, only products using the term “organic” have estimated positive WTP for beef products (Heo and Sung, 2004; Corsi and Novelli, 2007, 2011; Lin and Kim, 2017). All other labels have only found positive WTP for some subsection of their sample (Tonsor and Shupp, 2009; Li et al., 2016; Charry et al., 2019). There may be several reasons for this difference. The survey was conducted during the Covid-19 pandemic. During this time, expenditure on goods that are consumed outside of the home, e.g. holidays or eating out were much lower than normal. This may result in a larger percentage of expenditure being spent on household items, and grocery shopping in particular. In turn, this may lead to a greater willingness to pay for environmentally friendly food products, i.e. there may be a lockdown related increase in WTP for food items with pro-environmental properties. There is also some evidence to suggest that the average shopper has been buying more higher-end grocery products during the pandemic (Baker et al., 2020).

From a policy perspective, considerable insight can be drawn from the results presented here by both marketers and producers of beef in the Cantabria region. Given that 87% of the sample were willing to pay more for the no burn beef, there seems to be an appetite for this type of product. The acceptance rate of the bid prices was greater than expected, based on pilot studies, particularly for the higher bid prices. In the pilot study, one respondent indicated they would be willing to pay €27 per kg in the open-ended CV question, the second highest value was €20. In the absence of higher bids in the study and looking at the slow decline in acceptance rates as the bid level rose, there may be some level of “yea-saying” occurring, inflating the price premium respondents stated they are willing to pay. Consideration was given to truncation of the higher bid values. However, following Parsons and Myers (2017), it was deemed inappropriate as it does not address any underlying issues.

It may be the case that an alternative elicitation method could yield a different result. A single-bound approach was taken in this survey as it was deemed, and is generally considered, the least cognitively demanding elicitation method and is most likely to ensure incentive compatibility. However, a double-bounded method in which a follow up bid is presented to respondents could have revealed a sharper downturn in WTP after the highest bid value than is suggested by the results presented. The literature also suggests that stated willingness to pay may be inflated by cognitive biases. One such example is referred to as hypothetical bias, in which a respondent states that they are willing to pay more for the hypothetical good in the hypothetical market than they would if they encountered the good in the real market (Ajzen et al., 2004). When such a bias exists, the reported WTP for the hypothetical good can be much larger than the price one would receive if the good was sold in the real market.

A further consideration comes from the work of Corsi (2007). The estimations presented here do not consider quantity adjustments as a reaction to quality changes. The introduction of a new product to a market, as presented here, creates a change in the bundle of goods the consumer chooses from. As such, consumers may employ more complex substitution patterns to maximise utility given some budget constraint than is implicit in this analysis. Here it is suggested that consumers will increase their budget, substitute from traditional beef to the no burn beef and consume the same (similar) amounts of beef over a given time period. This will result in the same amount of beef being consumed but at a higher price. However, it is more likely, given the new consumption bundle, consumers will employ a new substitution pattern amongst the goods they can choose from. As a result, beef consumption may fall, either due to a simple reduction in beef consumption to keep expenditure the same as it was before the introduction of the new product or, more likely, through a complex substitution pattern incorporating the new beef product, the old beef product, other meats and meat free options. As such, the results here, in particular the WTP estimates, should be viewed as the willingness to pay for a single unit of no burn beef and cannot be considered as a means of explicitly calculating the possible total value of the no burn beef market.

The presence of a positive WTP estimate does suggest that a no burn beef product can command a price premium. The concept of land burning being familiar to a large number of individuals in the Cantabria region (70% of the sample presented here stated they knew about land burning before they took part in the survey), provides a strong basis for the ability to create the no burn beef product. However, this analysis demonstrates demand for the product but suggest nothing about the supply of the product. Engagement with the farming community would also be necessary for the product to be a success.

A key determinant of the viability of the no burn beef market is the additional cost associated with using a means of land clearing that does not necessitate the use of uncontrolled land burning. It stands to reason that the current method used by each farmer is the one that benefits them the most; it is possibly cheapest or easiest. If the cost of clearing the land using an alternative means to uncontrolled burning outweighs the financial gains the producer would receive from entering the no burn beef market, then the producer will not enter this market. It is also likely that farmers who have the lowest costs associated with not using uncontrolled burns are the most likely to do so. This may result in those who are already producing in a manner consistent with the criteria for the no burn label, using the label and collecting the

premium. Likewise, the producers who are causing the most damage may not switch given their associated costs (Hynes and Garvey, 2009). Such an event may lead to consumers paying a price premium without gaining any environmental benefits.

To gain the largest environmental advantage the price premium needs to be sufficiently large so that most or all producers would switch to a no burn means of production. Alternatively, or in addition, policy makers could consider building in extra support for this type of land clearing into already existing agri-environmental schemes thus providing compensation for more environmentally friendly land clearing practices. To assess this, further research needs to be conducted to determine the cost of abatement of the currently widespread use of uncontrolled burning techniques in the region.

7. Conclusions

In this paper, the willingness to pay for an environmentally friendly beef product was explored. This beef product labelled “no burn Pasiego beef” would require that the producer does not use uncontrolled land burning practices for pasture maintenance. A single bounded dichotomous choice CV methodology was used in combination with a bivariate probit model. Variables relating to historical beef purchase suggest a coherence between the results of the analysis and past decision making. Age, education, number of dependants in the respondent's household and price all play a significant role in explaining the willingness to pay for the product. The results suggest that the average respondent was willing to pay €24.88 per kg, indicating a price premium of €11.38.

Although the results indicate that consumers would be willing to pay a price premium for a product that reduces the number of wildfires in the Pasiego region, there are several challenges still associated with producing such a product. For the product to be most beneficial, a large percentage of the farmers would have to take part. It is essential for the farmers undertaking uncontrolled burning to participate. It may be quite difficult to get a large number of farmers to join an unproven product scheme, particularly if they have relied on uncontrolled burning for their entire career as farmers. Further to this, education may be needed for the buyers. Although 70% of respondents were aware of land burning prior to an explanation, potential buyers may still need to be informed of the extent of the problem relating to uncontrolled burns, how much environmental damage they may cause and, of course, the benefits of the product. There may also be a significant stumbling block in relation to the perceived effectiveness of the no burn beef product. As highlighted in the introduction, an estimated 50% to 55% of wildfires are caused by actions outside of agriculture (Leone et al., 2009). So, even if every beef farmer produces using the no burn method wildfires will still occur. It may then be difficult to convince buyers that the product is worth the price premium if it does not eliminate wildfires. Although the analysis presented here shows a clear willingness to pay a large price premium for this product, implementation of this scheme or a similar one will require careful planning and design to achieve maximum buy in on both the supply and demand side.

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