CONSUMER PREFERENCE FOR ORANGE AND WHITE-FLESHED SWEET POTATO: RESULTS FROM A CHOICE EXPERIMENT CONDUCTED IN MAPUTO AND GAZA PROVINCES, MOZAMBIQUE

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CHAPTER I

INTRODUCTION

Over 95 percent of the global sweet potato (*Ipomoea batatas* (L.) Lam.) crop is produced in developing countries where it is the fifth most important food crop (CIP). In Mozambique, sweet potato is considered to be the third most important food crop after corn and cassava (INIA- IITA/SARRNET, 2003a). Due to its tolerance to drought, nutritional value (Vitamin A), and commercial potential, Mozambique has recently experienced dramatic increases in sweet potato research such as comprehensive breeding, production and the distribution of high quality plant material, and post harvesting programs.

There are two main types of sweet potato, the traditional or white-fleshed sweet potato (WFSP) and the orange-fleshed sweet potato (OFSP). The WFSP is widely produced among small farmers, but the OFSP was recently introduced and is being promoted by the agriculture authorities and their partners in Mozambique. Only the OFSP provides an inexpensive source of β-carotene, the precursor of Vitamin A (Van Jaarsveld et al., 2003; Tsou and Hong, 1992). OFSP was primarily introduced in Mozambique as part of an integrated approach to mitigate Vitamin A deficiency, which affects more than 70% of children under age 5, and 11% of women living in rural areas (Aguayo et al., 2004; MISAU, 2003).

It is well known that people with severe deficiency of Vitamin A are more susceptible to blindness and infections. OFSP has been used as part of food-based approach, recommended as an excellent source of Vitamin. Additionally, OFSP has been associated with improving the immune system of individuals living with HIV-AIDS (Low et al., 2007; Du Guerny, 2002).

These benefits have prompted both public and private sectors to promote OFSP. Despite the advantages of OFSP, most consumers apparently prefer eating traditional WFSP as evidenced by the fact that traders predominantly sell WFSP. In fact, Mazuze (2004) found that despite a comprehensive awareness campaign on the superior nutritional value of OFSP varieties, the price differences observed between white/cream-fleshed and orange-fleshed varieties have not been significantly affected; both types are typically sold at the same price in a market.

Given the health benefits of OFSP varieties, it is critical to understand how consumers value OFSP relative to traditional white varieties and to determine whether and under what conditions they are willing to pay more for the new OFSP in order to help small farmers and local traders to make reliable marketing decision. Furthermore, plant breeders and promoters need information to understand and define the type and characteristics of OFSP varieties that are more desired in order to include them in the breeding and promotion programs. The primary aim of this study is to generate information on consumer demand for OFSP versus traditional WFSP varieties to assist in developing marketing strategies to improve the level of production and commercialization of OFSP. This research also contributes to the methodological questions of whether stated/revealed preferences methods, which have become common-

place in the developed world, can be reliably used in a development context, and whether some of the biases observed in stated preferences methods in developed countries are exasperated or ameliorated in a developing country.

Objectives

The overall objective of this study is to determine consumer demand for sweet potato attributes in Mozambique.

The specific objectives are:

1. To determine consumers' willingness to pay (WTP) for OFSP and WFSP and estimate the market share between these two varieties.
2. To determine consumer's relative WTP for sweet potato attributes such as the color of the pulp (associated with nutritional value), dry matter content, and size of the roots.
3. To determine the effect of information about the healthfulness of OFSP on WTP and predicted market shares for orange and white fleshed sweet potato.
4. To determine whether and to what extent WTP is affected by visual presentation of the potatoes and hypothetical bias, i.e., determine whether WTP is influenced by whether the choice task involves real food and real money.
5. To determine the welfare gains associated with the introduction of orange fleshed sweet potato in Mozambique.

CHAPTER II

REVIEW OF LITERATURE

This chapter provides a brief background on sweet potato production and consumption in Mozambique, and succinctly describes the method of choice-based conjoint analysis, which is one of the most common methods used to elicit consumer preferences for food quality attributes. Also, this chapter reviews the limited amount of previous literature related to consumer WTP for sweet potatoes, the effect of information on WTP, and lastly, discusses the hypothetical bias in stated choice methods.

Sweet Potato in Mozambique

In Mozambique, sweet potato is one of the most important and traditional food crops, and in many regions of the country has ranked it as the third crop after maize and cassava based on use for food, area cultivated, and value for income generation (INIA-IITA/SARRNET, 2003a). Sweet potato is mainly produced by women from smallholder families in plots with areas varying between 0.01 to 0.1 hectares, and the average yield varies between 6-16 ton/hectare (Andrade et al. 2004a). According to the National Institute of Statistics (INE, 2001), in the 2000-2001 cropping season, nearly 1% (48,000 hectares) of the country's total cultivated area was devoted to sweet potato, and provinces like Gaza (29%), Zambézia (21%), Maputo (10%), and Manica (9%) accounted for the majority of the sweet potato production areas. These figures may have changed considerably from 2001 to the 2003 cropping season,

as more than 500,000 families from 65 out of the 128 districts of Mozambique received new improved planting material from the government and their partners (IITA-INIA-USAID, 2005 and INIA-IITA/SARRNET, 2003b).

Early in 2000, the government launched a massive program of production and distribution of stem and vines of cassava and sweet potato as part of an integrated approach to mitigate the effects of food and nutritional insecurity caused by a cycle of recurrent flooding and droughts in the country. At that time, nine new varieties of OFSP were introduced in the country after they had been scrutinized in a long and participative process of evaluation and selection carried out throughout the country (Andrade et. al, 1999).

In 2004, a survey was conducted in six of the ten Mozambique provinces, including, Gaza and Maputo, and included a total of 849 respondents. This study revealed that two-thirds of the subjects had heard about OFSP and more than half of this group was already cultivating OFSP. According to the survey, 62% of the respondents classified these varieties as good for consumption, 50% mentioned that they provide a reasonable yield (7-10 ton/hectare), and 30% referred then as very tolerant to pests and diseases (Andrade et al., 2004a; Andrade et al., 2004b).

The commercialization of sweet potatoes is mainly performed by small traders, particularly women coming from the outskirts of cities and municipalities. They buy the excess of production from farmers in the villages and resell it in the wholesale and retailer markets in urban areas. In the rural areas, the process of commercialization is carried out by local sweet potato producers who do not have opportunities to sell all their production to the traders coming from the cities. According to the 2004 survey, 17% of

the 849 respondents affirmed that they sell more than half of their sweet potatoes' production.

Methods Used to Estimate Consumer WTP

Measures of consumer WTP for a novel product or food quality attributes are increasingly being used as inputs in marketing and policy decisions, especially for the food industry (e.g., Alfnes et al. 2006; Lusk and Hudson 2004; Umberger and Feuz 2004). In general, WTP is defined as the maximum amount of money that, when paid by an individual, makes him indifferent to improving the quality of the goods or service and maintaining the status quo quality (Lusk and Hudson 2004; Cameron and James, 1987).

To estimate consumer WTP for food quality attributes, previous studies have used contingent valuation (CV), choice-based conjoint analysis/choice experiment (CE), and experimental auctions (EA), or the combinations of each of the three methods (Lin et al. 2006; Lusk 2003; Moon and Balasubramanian 2003; McCluskey et al. 2001). However, there appears to be a growing trend in the agricultural economics literature toward the use of CEs to elicit WTP for food product attributes.

One of the main drawbacks with the CV method is that it fails to elicit and estimate WTP for multiple goods or attributes and thus, identifying cross-price effects is difficult (Lusk and Hudson, 2004). Even more problematic, an extensive literature has arisen showing that the WTP values elicited in hypothetical CV environments are prone to hypothetical bias (List and Gallet, 2001). Often, WTP from a hypothetical CV study is two to three times higher than that obtained from a non-hypothetical study involving the exchange of real products and real money. Because of the weaknesses associated with CV method, CE has been gaining more recognition as method of measuring consumers'

WTP for food quality attributes, as it can easily handle multiple product attributes and can incorporate real economic incentives generating WTP estimates very close to revealed preferences (Adamowicz et al. 1997; Lusk and Hudson 2004).

CE, which is in essence an extension of the CV, but with more than two choice options with specific attributes, was developed in the psychology and marketing literatures in the 1970s, and evolved in economics because of the development of random utility theory. Also, the method has been regularly used in transportation and environmental valuation literature (Adamowicz et al. 1998; Hanley et al. 1998; Louviere and Woodworth, 1983).

In a CE, people made a series of choices between different products defined by multiple attributes. Such choices force consumers to make tradeoffs among the product attributes. In each question, consumers are asked to choose their most preferred choice option from an array of alternatives. In our case, respondents were offered two choices of sweet potatoes (say OFSP and WFSP) each possessing different levels of other attributes such as price and dry matter, and the option to choose neither. The choices permit the estimation of an indirect, attribute-based utility function, which is consistent with random utility theory and Lancaster's theory of utility maximization, which assumes that utility-maximizing consumers derive utility from product attributes (Lusk and Hudson, 2004; Louviere and Woodworth, 1983).

Apart from providing information on total and marginal WTP, this method allows researchers to determine the importance and ranking of each of the individual product attributes, and more importantly, determine which attributes significantly influence the

choice (Hanley et al. 1998). The approach also permits a straightforward way to estimate market shares of competing products and the welfare effects of new product introduction.

Previous Studies on WTP for Sweet Potatoes

To our knowledge, very few studies have used CE to evaluate consumer WTP for food quality attributes involving root and tuber crops such as OFSP. However, there are relevant studies on consumer WTP relating to some of the important attributes and information intended to evaluate in this study, such as Nalley et al. (2005), where, using EA, evaluated the consistency of consumer valuation under different information sets with sweet potato, and Jaeger and Harker (2005), using a modified sensory analysis, measured the monetary value consumers place on novel yellow-fleshed kiwifruit fruit with a new flavor and health profile, which are also attributes related to the new OFSP.

Nalley et al. (2005) used a controlled, uniform 5^{th}-price auction to elicit values for sweet potatoes among college students in Mississippi when location of origin is known and unknown, and before and after testing and providing health information. Results from this study indicated that both the effect of location of origin and heath information were significant. Despite the significant differences, in general, results from this study suggest a modest consistency in bid values among information sets, recommending that attempting to obtain values of attributes in isolation may lead to biased results.

Jaeger and Harker (2005) used a modified sensory test that incorporated monetary bids to evaluate New Zealand consumers WTP for a novel yellow-fleshed Kiwifruit. Results from this study demonstrated that consumers were willing to pay a significant price for the new kiwifruit, as result of improvements in the flavor, health content and knowledge that the variety is not genetically modified. In this case, the premium offered

by consumers for the new variety of kiwifruit was equivalent to a 176% of the retail price, revealing high commercial potential of this new product.

In Tanzania, Tomlins et al. (2007) used sensory evaluation to determine the flavor profile and consumer acceptability of four sweet potato cultivars with different levels of orange color or β-carotene content. Results from this study indicated that traditional WFSP and OFSP cultivars were different in their sensory profile. In general, the mean consumer responses demonstrated that OFSP were more acceptable than WFSP. In contrast to aforementioned papers, where WTP values were estimated, this study did not include real money to elicit consumer preferences for sweet potatoes, rather, placed more emphasis in the traditional sensory and consumer acceptability tests. However, the paper revealed important features related to the evaluation of both WFSP and OFSP, confirming results obtained by Andrade and Ricardo (1999) that varieties of OFSP have reasonable acceptability among consumers in Mozambique; and this is particularly true, since, Tanzania and significant fraction of Mozambique are very similar in terms of food choices, culture and habits. Although the sensory and consumer acceptability tests do not determine the market or monetary value of OFSP, these two studies provided a strong indication that this variety can also succeed in terms commercial.

Effects of Information on Consumer WTP

Several studies have investigated the impact of information, in particular, potential health benefits on consumer WTP for foods. Accounting for this aspect becomes important, as consistency of consumer valuation under different information conditions suggests different welfare values across information sets (Alfnes et al., 2006; Nalley et al., 2005; Lusk et al., 2004). OFSP has an important credence attribute, the

nutritional value, and consumers' previous knowledge or information about this attribute may significantly influence their valuation.

As previously mentioned, Nalley et al. (2005) evaluated consistency of consumer valuation under different information sets using sweet potatoes, and in general, results of their study indicated that participants provided with health information had a significant positive influence on mean WTP bids.

Alfnes et al. (2006) used CE and evaluated consumer WTP for color of salmon with different degrees of redness in Norway. Most of salmon farmers use a variant or synthetically produced colorants in salmon feed. Results from this study showed that the participants chose the reddest salmon when they where uninformed about the origin of the color, but when the information on the color of salmon was supplied, they started to change they preferences to the paler salmon.

In general, previous knowledge and information on the issue in valuation leads to a rational choose of the product, and sometimes, it may also leads to increasing demand for the product in question. For example, most studies on growth hormones or GM foods showed that normally consumers' perception of growth hormones is negative, and they tend to pay less for those products (Lusk et al., 2004). However, in some cases, as more information about the benefits of these products is displayed to consumers, the level of their rejection tends to decline (Huffman, 2003).

Hypothetical Bias and WTP

The phenomenon of hypothetical bias has been frequently associated with CV, as this method of elicitation generally involves asking people hypothetical questions where no money changes hands. Most empirical evidence suggests that WTP values in

hypothetical settings are higher than when real money is involved (List and Shogren, 1998; List and Gallet, 2001; Murphy et al., 2005).

Understanding whether people overstate their WTP values in hypothetical settings continues to be an important issue when stated preferences methods are used. CE has been referred to as one of the most efficient methods in handle the hypothetical bias. For example, Carlsson and Martinsson (2001) using a within CE design and found no difference between responses from hypothetical and non-hypothetical settings. Lusk and Schroeder (2004) used CE and compared responses elicited in a hypothetical and non-hypothetical setting. In general, results from this study indicated that non-visual/hypothetical response predicted higher total WTP (i.e., WTP to have a good versus not having the good) for non-hypothetical responses. However, marginal WTP (i.e., WTP to have good A vs. good B) was, in general, not statistically significant across non-visual/hypothetical and the visual/incentivized choice scenarios. Other studies have provided a more mixed picture (List et al., 2006).

Most of these studies were conducted in United States and Europe; however, Ehmeke et al. (2008), conducted a CV, and tested hypothetical bias using a dichotomous choices referendum in China, France, Indiana, Kansas, and Niger. Results from this study indicate that hypothetical bias is dependent on location. That is, they found significant differences in hypothetical bias across locations, and conversely to what is normally found in the literature, participants in Niger significantly overstated their WTP values in non-hypothetical setting. This surprising finding suggests that cultural factors could partially explain the hypothetical bias problem and suggest the need for more research on the issue in African countries.

We conducted this study in Mozambique, using CE and also tested for a form of hypothetical/visual bias. Usually, in non-hypothetical scenarios people faces choices between real products and real money is involved in all transactions. That is, people are invited to make their choice, knowing that at the end of the experiment one scenario will be drawn randomly as the real choice set and they will pay an amount of money according to the price in the alternative chosen in the randomly drawn particular choice set. In general, our results indicated that non-visual/hypothetical results are significantly different from non-hypothetical or visual/incentivized responses. However, in urban areas, values of non-visual/hypothetical scenarios tended to be higher than non-hypothetical responses, and in rural areas the opposite was more likely to occur.

CHAPTER III

CONCEPTUAL FRAMEWORK

Lancaster (1966) and McFadden (1974) have both argued that consumer demand for products can be written as demands for the underlying product attributes. In this context, it implies that the utility consumers derive from consuming sweet potato is a function of the potato attributes. Mathematically, this relation is described as follow:

Consumer's Utility for Sweet Potatoes = f (Product attributes, Price of product, Socio-economics Characteristics, Information)

Product attributes include those intrinsic characteristics that are frequently used by consumers to value the quality of sweet potatoes in the marketplace. Among them, this research considers the color of the pulp, dry matter content, and the size of the roots. Because color is associated with nutritional value of the variety, that is, the presence or absence of β-carotene, it's expected that consumer will value more OFSP than the white varieties. Hence, the first hypothesis to test is: Consumers' derive more utility for OFSP than WFSP. *Dry matter content* is an important proxy for the eating quality of the sweet potato varieties, and is intrinsically associated with taste. In general, good varieties present high level of dry matter content, usually varying from 25% to 30% of fresh weight (Woolfe, 1992). Overall, we expect a positive relationship between dry matter content and consumers' utility.

Therefore, the second hypothesis to test is: Consumers' utility for sweet potatoes is increasing in dry matter content. In Mozambique, consumers associate the size of sweet potato's roots with quality. Usually, roots with relatively large size take a long time to cook. Further, relatively large sweet potatoes exhibit less consistency after cooking, and are therefore less attractive to consumers. Hypothesis 3: Consumer's utility is decreasing in the size of the root. Of course, there are other attributes that may be important to consumers when purchasing sweet potatoes. However, most of these other quality attributes such as appearance, smell/aroma, or fiber are intrinsically related to the aforementioned attributes of flesh color, dry matter content, and size (Woolfe, 1992). Thus, this study focuses on what are the key attributes affecting consumer demand for sweet potatoes, while holding all other factors constant.

A final product attribute is price, which is expected to negatively affect demand for products. As the price of one type of sweet potatoes increases, it is expected that consumers will buy less of this variety and will buy more of other substitutable alternatives.

It was also posited that socio-economics characteristics, such as age, gender, the level of education and income, influence the utility derived from sweet potatoes. One particular socio-economic characteristic is whether consumers live in rural or urban areas. Different cultures within societies may have different preferences for sweet potato attributes. Rural consumers may be more tied to traditional means of production and consumption and may, therefore be less accepting of the newer OFSP. Thus, one hypothesis is that WTP for OFSP is higher in urban than in rural areas.

Many consumers are likely unaware of the nutritional benefits of OFSP, and as such, it is of interest to determine the extent to which informational statements influence demand for the new variety. If information on the nutritional value of the varieties is provided, we expect to find consumers demand for OFSP to rise relative to demand for white varieties. That is, a positive relationship between consumers' utility for OFSP and information is predicted. Providing information on the benefits of orange-fleshed sweet potatoes is expected to increase consumers' utility for orange versus white-fleshed sweet potatoes.

Also, many consumers normally state differently their preferences for public and private goods when they are under hypothetical and non-hypothetical settings. It is important to determine to what extent this difference will affects WTP values for OFSP. We expect that consumers from urban areas will tend to overstate their preferences in hypothetical scenarios while in rural areas this difference will be very small.

CHAPTER IV

METHODOLOGY

This chapter outlines the methods and procedures used to determine consumer preferences for orange versus white-fleshed sweet potato in Mozambique. Specifically, this section focuses on the data collection method, the experimental procedures, and data analysis approach used to elicit consumer welfare measures for orange versus white-fleshed sweet potato.

Data Collection Method

A choice experiment (CE) administered through an in person survey was used to collect the data in this study. Apart from being consistent with random utility theory and Lancaster's theory of utility maximization, a CE was used because it permits a straightforward way to elicit demand for multiple quality attributes. Furthermore, administering a CE in a developing country like Mozambique, where the majority of the targeted consumers have low levels of education is relatively easy compared to some other elicitation methods. In addition to the CE, each participant was given a questionnaire to collect information related to socio-economics characteristics of participants such as age, gender, education, household, income, level of nutritional knowledge, and the frequency of purchase and consumption of orange and white sweet potato

Design of Choice Experiment

In the CE, sweet potatoes were described by four attributes: pulp color, dry matter content, size, and price. As previously discussed in the conceptual section, these attributes were used in this study because they reflect the main characteristics consumers look for when purchasing or trading sweet potato (Woolfe, 1992). Each of these attributes were varied at different levels reflecting the range of what was observed in the principal marketplaces at the time of data collection.

Table 1 shows the attributes and attribute levels used in this study. The price attribute was varied among three levels: 7.5, 10 and 15 Meticais (24MT=1USD) per kilogram. Dry matter content and the size of the roots were both varied among the three levels, high, medium and low, and large, medium and small respectively. Each of these descriptors was precisely described for the participants (see Appendix 1). Finally, the attribute of pulp color was varied at two levels: orange or white

Table 1. Attributes and Attributes Levels Used in Choice Experiment

Attribute	Attribute Levels		
	Level 1	Level 2	Level 3
Price	MT7.5	MT10	MT15
Dry Matter Content	High	Medium	Low
Size of Roots	Large	Medium	Small
Color of Pulp*	Orange	White	-

*This attribute was used as fixed alternatives in each choice set

To construct the choice sets, we followed standard practices in the CE literature. Because one of the key issues in this study was the pulp color, every choice set had three purchase options: white flesh, orange flesh, or “none”. Thus, the two types of sweet potato (orange and white potato) represented fixed choice options or alternatives, but the

levels of price, dry matter content, and root size varied across options and choice questions.

Because there are two options (orange or white) each with three attributes varying at three levels, there are $3^3x3^3=729$ possible choice scenarios that could have been presented to respondents. From this full factorial of 729 possible choices, we selected 9 choice questions in which the prices of OFSP and WFSP were completely uncorrelated across the 9 choice options. All correlations between attributes within a variety (OFSP or WFSP) were zero. Further, the attributes were completely balanced within each variety, that is, each attribute level appeared exactly three times across the 9 choices in the OFSP and WFSP variety. The D-efficiency of the design was 74.38, which can be compared to a perfectly orthogonal design that can yields a D-efficiency score of 111.57.

Although these points in favor to the design, some drawbacks are important to mention. There are some non-zero correlations between attributes of dry matter and size of roots. For example, every time OFSP dry matter is high, them WFSP root size is small. As mentioned in the conceptual framework, in regard to dry matter, usually people prefer varieties of sweet potato with high dry matter content, and in regard to size, the small ones are the most preferred. To a certain extent, these corrections can be considered negligible; as both attribute-levels are the most preferred, and they can in some way offset each other between choice-alternatives. Even though some of these correlations are counterbalanced, to determine separately the effects of each attribute on each variety, we have to assume that preferences for price, dry matter content, and size of the roots are independent of variety (i.e., WTP for high vs. low dry matter content is the same for OFSP and WFSP).

An example of a choice experiment question used in this study is presented in figure 1. The final set-up of the 9 scenarios used in the choice experiment is presented in the Appendix 3.

Which Option Would you Prefer to Purchase, Orange, White or None?			
Sweet Potato attribute	**Orange Sweet Potato**	**White Sweet Potato**	**None**
Price/pound	MT 7.5	MT 15	If these were the only two options I wouldn't buy Sweet potato
Size of Potato	Small	Large	
Dry Matter Content	Medium	High	
I would choose . . .	□	□	□

Figure 1. Example of Choice Experiment Question

Prior to full implementation of the CE, two trial studies were conducted in the Department of Agricultural Economics in Oklahoma State University in US, and in the Fajardo and Bobole marketplaces, in Mozambique. The primary objective of this pre-test was to learn how consumers react to the questions and the process of data collection. Observations from the pre-test were used to refine the choice questions, instructions, and the recruitment strategies.

Experimental Procedure

To determine whether differences exist between rural and urban consumers, the study was conducted in both areas. Within a location subjects were recruited from the local marketplace to ensure the study was representative of the general sweet potato consumers' population. The study was conducted in Maputo, which is the main city in Mozambique, and is considered to be representative of urban areas, and Bobole, Manhiça and Macia, which are representative of rural areas.

After a detailed process of explaining the objectives of the survey and the rights of the subjects to participate or decline the interview, the CE was administered. To facilitate the process, the local marketplace committee and market managers were previously contacted, and a request was made to interact with participants. Plastic bags with three different quality roots of orange and white sweet potato were prepared in advance to help subjects to easily distinguish among different sweet potato sizes and color categories. The only attribute that was moved or changed from one to another plastic bag was the price. Thus, each choice set was physically represented in the experiment. This procedure was used for subjects participating in the visual/incentivized or non-hypothetical treatment, as the physically roots was not presented to those in non-visual/hypothetical scenarios.

Each subject was randomly assigned to one of the four treatments show in table 2. There were two treatment variables each varied at two levels: information given about the nutritional value of OFSP (yes or no) and the nature of the decision task (real or hypothetical). By comparing the choice patterns across each of the four treatments, the effect of information and the visual/incentivized vs. non-visual/hypothetical choices, and the interaction between the two, can be identified.

Table 2. The Experimental Treatments

		Information Given about OFSP	
		Yes	No
Decision Task	Visual/incentivized	Treatment 1	Treatment 2
	Non-visual/hypothetical	Treatment 3	Treatment 4

After being assigned to a particular treatment, the experiment procedure consisted of 6 steps:

Step 1: The subjects were asked to participate in the study. Prior to start the interview, the participants were informed that the objective of the study was to learn about preferences for sweet potatoes. Participants were also informed about their rights to accept or decline the interview, and it was made known that no one would face consequences for his or her unavailability or unwillingness to participate. It was clearly stated that any answers given in the study were completely confidential, anonymous, and would be used only for academic purposes.

Step 2: After accepting the invitation to participate, the subjects were informed about the content and structure of the questionnaire. They were informed that the questionnaire has two parts: the first part comprising 9 choice questions and the second part consisting of a few of questions related to socio-economics characteristics.

Step 3: For those participating in the visual/incentivized treatment (non-hypothetical), the two different types of sweet potato were displayed to them, grouped and arranged in three different levels of size (small, medium, and large) and dry matter content (low, medium, and high), and described as in the Appendix 1. Also, in the actual scenarios, participants were informed that after finishing with their choices, one of the choice sets would be drawn randomly as the real choice scenario, and they will be paid the amount of money corresponding to the alternative chosen, but at this time converted into real sweet potatoes. We decided to convert the real money payments into sweet potatoes because preliminary sessions of data collection showed that most of the participants when informed about the involvement of payment in cash tended to choose

the alternative with high monetary value, introducing instead high level of bias and allowing the experiment to be more artificial fashioned as opposed to the real word intended with the experiment. The inevitable need for money and some cultural aspects could be associated with this particular behavior.

The subjects assigned to non-visual/hypothetical treatments did not go through this process, the real money and presence of sweet potato was not involved in these scenarios. However, the non-visual/hypothetical experiment took place in the marketplace, and participants were informed about the differences in the attributes and attribute-levels as we did in the visual/incentivized treatments as displayed in Appendix 1. Although the experiment was hypothetical, the subjects were encouraged to answer truthfully as if the real money was involved.

Step 4: Those who participated in the treatments with information about sweet potatoes, were given information about nutritional value of orange and white-fleshed sweet potatoes shown in the Appendix 2.

Step 5: Participants were then instructed to indicate which of the three alternatives (OFSP, WFSP, or “none”) they most preferred for each of the 9 choice experiment questions.

Step 6: Finally, using open-ended questions, the participants were asked to provide demographics and other relevant information about themselves.

To ensure a random sample, a systematic sampling method was used to recruit participants. After the initial recruitment, every second buyer who appeared in the area where sweet potato was being sold was asked to participate in the interview. If the subject

was unavailable, the next person who appears was taken as target. Each person participated only once and was assigned on only one particular treatment.

Data Analysis

A discrete-choice model is used to analyze the CE data. In particular, a conditional logit model, which assumes choices are driven by the characteristics of the choice alternatives (the attributes of price, dry matter content, and size of the roots). In this CE, subjects were asked to choose between orange and white sweet potato and none options. Making use of random utility theory, individual *i*'s utility of choosing option or alternative *j* (either orange, white, or none), is represented by a deterministic component (V_{ij}) and a random component (ε_{ij}):

(1) $$U_{ij} = V_{ij} + \varepsilon_{ij}$$

where V_{ij} is the systematic portion of the utility function determined by the attributes of alternative *j*, and ε_{ij} is a stochastic term unobservable to the econometrician. The probability that a subject chooses alternative *j* is given by:

(2) $$\text{Prob}\left\{V_{ij} + \varepsilon_{ij} \geq V_{ij} + \varepsilon_{ij};\ for\ all\ k \neq j\right\}$$

For conditional logit models, ε_{ij} is assumed to be independently and identically distributed across the *j* alternatives and N individuals with an extreme value distribution. Under these assumptions, the probability of choosing alternative *j* is:

(3) $$P_{ij}=\text{Prob}\left\{j\ is\ chosen\right\}=\frac{e^{V_{ij}}}{\sum_{k=1}^{J} e^{Vik}}$$

where *J* is the number of alternatives, and the log-likelihood function is given by:

(4) $$Log\ L = \sum_{i=1}^{N}\sum_{j=1}^{J} z_{ij} \log(P_{ij})$$

where z_{ij} is a dummy variable and takes values of 1 for a specific option that was chosen.

Assuming a linear attribute-based utility function, the utility for option or alternative *j* can be specified as:

$$(5) \qquad V_{ij} = \beta_j + \alpha P_{ij} + \sum_{k=1}^{T} \beta_{ik} . X_{ijk}$$

where β_j is an alternative-specific constant, which in this context indicates the relative utilities of the orange and white flesh relative to the none of these option (the utility of which is normalized to zero for identification), α is a coefficient representing the effect of sweet potato price on utility for sweet potato, X_{ijk} is the kth attribute of alternative *j*, B_{ik} is the marginal utility of the alternative *j*'s kth attribute, in this case the coefficients of the attributes size of the roots and dry matter content.

Expanding (5) we obtain:

$$(6) \qquad V_{ij} = \beta_1 OFSP + \beta_2 WFSP + \alpha P_{ij} + \beta_3 HDM_j + \beta_4 MDM_j + \beta_5 LSR_j + \beta_6 MSR_j$$

where β_1 and β_2 are alternative-specific constant for orange and white-fleshed sweet potato relative to "none" option respectively, HDM_j is a dummy variable that equals 1 if alternative *j* has high dry matter content, MDM_j is a dummy variable that equals 1 if alternative *j* has medium dry matter content, LSR_j is a dummy variable that equals 1 if alternative *j* has large sized roots, and MSR_j is a dummy variable that equals 1 if alternative *j* has medium sized roots and 0 otherwise, respectively.

The parameters in equation (5 and 6) are obtained by maximizing the log-likelihood function shown in equation (4). Consumers' WTP for kth attribute is the price difference that would make the indifferent to change in the kth attribute from one level to another level. For example, WTP for OFSP relative to "none" option is given by:

(7) $$WTP_{Orange} = -\frac{\beta_1}{\alpha}$$

And WTP for WFSP relative to "none" is calculated by:

(8) $$WTP_{White} = -\frac{\beta_2}{\alpha}$$

The marginal WTP (MWTP) for alternative OFSP versus WFSP relative to "none" option is given by:

(9) $$MWTP_{O-W} = \frac{\beta_1 - \beta_2}{\alpha}$$

The utility of the levels "low" for dry matter content and "small" for size of the roots were normalized to zero for identification. Thus, WTP for alternative *j* and kth attribute (medium or high dry matter content and medium or large size of roots) can be calculated; for example, from (6), WTP for the attribute orange and white high dry matter (HDM) relative "none" is respectively:

(10) $$WTP_{Orange-HDM} = \frac{\beta_1 + \beta_3}{\alpha}$$

(11) $$WTP_{White-HDM} = \frac{\beta_2 + \beta_3}{\alpha}$$

The differences between estimations on equations (7) and (10), (8) and (11) were used to generate MWTP for alternative *j* and kth attribute. In this case, for example, MWTP for both orange and white HDM relative to "low" is the same and is given by:

(12) $$MWTP_{HDM-Low} = \frac{\beta_3}{\alpha}$$

Market share estimates can be obtained simply by plugging the estimated parameters from (6), along with assumptions about the choice alternatives and their prices into equation (3).

Standard errors of the estimated WTP and market share were estimated using the parametric bootstrapping method developed by Krinsky-Robb, in which 1,000 draws from the estimated parameter distribution (using the estimates and the Cholesky decomposition of the variance-covariance matrix). For each draw, WTP (or market share) was calculated, and the standard deviation over the draws represents the standard error of the estimate (Lusk and Schroeder, 2004; Alpizar, Carlsson, and Martinsson, 2001).

Welfare Effects of New Product Introduction

Methods to estimate the welfare effects from discrete choice models have been discussed in many studies (e.g., Hanemann, 1999; and Morey, 1999). Compensating variation (CV) is calculated using the formula:

$$(13) \qquad CV = -\frac{1}{\alpha}\left[\ln\sum_{j=1}^{2}\exp(V_{0j}) - \ln\sum_{j=1}^{3}\exp(V_{1j})\right]$$

where α denotes the constant marginal utility of income, in a linear utility model is the estimated coefficient of price or income, V_{0j} represents the deterministic utility at initial state or condition, in our case when we have only the traditional white-fleshed sweet potatoes, and V_{1j} is the deterministic utility at the final state, when we have both orange and white-fleshed sweet potatoes. Thus, the welfare change occurs when moving from the old conditions, where you have only the traditional white varieties to a new situation where you have both orange and white varieties. A positive expected *CV* is related with

WTP for improvement and a negative expected *CV* represents the willingness-to-accept (WTA) compensation for deterioration from the old to a new situation (Arianto et al., 2007).

Calculation of Scale Parameters

To determine whether the treatment-variables shown in table 1 affected choices, one must compare the conditional logit estimates across treatments. In such cases, it is important to control for possible differences in error variance, which are confounded with the parameter estimates in discrete choice models. To compare the model estimates, scale parameters for the joint models representing the data set from the Rural vs. Urban areas, Hypothetical vs. Non-hypothetical, and models with vs. without information were calculated. As previously indicated, this is an important process that allows one to determine whether differences in parameters estimates across data set are because of differences in variance (i.e. variances or scale factor differences) or differences in preferences stated of the subjects (Swait and Louviere, 1993).

In this study the scale parameters were determined by following the procedures described by Swait and Louviere (1993). First, the data was separated into treatments (e.g., real and hypothetical) and the standard conditional logit was estimated for each treatment. Refer to the likelihood functions from these two estimates as L_1 and L_2. Then, all data from one treatment was multiplied by a constant (i.e., the scale) and the data was pooled. The parameters from a conditional logit were estimated on this pooled data and the likelihood function value was recorded. The process was repeated for many different constants (i.e., scale values) until it was determined which scale value generated the highest likelihood function value from the pooled estimates – refer to this statistic as L_μ.

To test the hypothesis that preference parameters vectors (β) are identical across treatment, while controlling for differences in scale, the following likelihood ratio value can be calculated:

(12) $-2[L_{\mu} - (L_1 + L_2)]$

where L_{μ} is the log likelihood value for the joint model after controlling for scale, L_1 and L_2 are the log likelihood corresponding to a separate model (1) and (2) respectively. This statistic is distributed χ^2 $K\,(M - 1)$ degrees of freedom, where K is the number of parameters in each model, and M is the number of the models. If the value in equation (12) exceeds the critical χ^2, then the null hypothesis that the parameters are the same across treatment is rejected implying that the treatment did not influence preference parameters and we cannot pool the data across the two treatments. The alternative hypothesis is that the treatment influenced preference parameters. Likewise, a test for whether the scale parameter is different than one can be carried with a likelihood ratio test by comparing the L_{μ}, the log likelihood value for the joint model after controlling for scale, to the log likelihood function value for the joint model in which scales of both treatments is set to one.

CHAPTER V

RESULTS AND DISCUSSION

A choice experiment was carried out in Mozambique, in the southern provinces of Maputo and Gaza, between June-July 2008. Overall, 308 subjects from urban (190) and rural (118) areas participated in the study. Table 3 reports the characteristics of the participants who took part in this research. According to Mozambique National Census (INE, 1999), the Mozambique population is predominantly comprised of young people (54% are <20 years old; 40%, 20–64 years old; and 5%, >65 years old), with more adult women than men. Results from our study is similar to the population, as more than 60% of participants in both urban and rural areas were women, with an average age of 30 years. Demographic composition of the sample was generally similar across treatments. The null hypothesis of equality of the gender frequencies and mean age across urban and rural area cannot be rejected at 5% significance level. In sub-Saharan African countries, the level of education and income is quite different for people who live in urban and rural areas, and this is true in this study. The null hypothesis of equality of education and income for subjects from urban and rural areas was rejected at 5% significance level (table 3).

Table 3. Characteristics of Participants by Urban and Rural Areas

Variable	Definition	Region		
		Urban	Rural	*p*-value[a]
Gender	% of Male	40.00	36.44	0.5328
	% of Female	60.00	63.55	
Age	Mean Age in years	31.36 (9.44)[b]	29.91 (7.29)	0.1273
Education	% of participants with No school	2.64	8.47	<0.0001
	% of participants with Primary level	25.26	44.07	
	% of participants with High school	69.47	47.46	
	% of Undergraduate	2.63	0.00	
	% of Graduate	0.00	0.00	
Income	% of participants with less than $500 a year	18.95	69.49	<0.0001
	% of participants between $500 to 749	12.63	18.64	
	% of participants between $750 to 999	10.00	5.93	
	% of participants between $1,000 to 1,245	13.16	3.39	
	% of participants with more than $1,250 a year	45.26	2.54	
How often do you eat sweet potato per month?	Frequently (%)	30.26	40.68	<0.0001
	Periodically (%)	37.89	54.24	
	Rarely (%)	26.84	5.08	
	Never (%)	5.01	0.00	
Most important sweet potato attribute	Origin (%)	1.58	1.36	0.4042
	Price (%)	26.63	34.92	
	Appearance (%)	23.79	11.86	
	Color of Pulp (%)	48.00	51.86	
Number of participants		190	118	

[a] *p*-value for the null hypothesis of equality of mean and frequencies along the regions, calculated from Mantel-Haenszel Chi-Square test.
[b]Numbers in parenthesis are standard deviations.

The general characteristics of the participants from the table 3 reveal that the majority of the subjects eat sweet potato at least once a month, and individuals in rural areas tend to consume sweet potato often. Another important aspect considered in the study was subjects' perceptions about the most important attribute of sweet potato. Apart from dry matter content, the most important attributes to consumers is the color of the

pulp. This was true in both urban and rural areas, as the null hypothesis of equality of the frequency in stated attribute importance across the two regions cannot be rejected at 5% significance level.

Results from the CE

Summary statistics associated with the 9 choices each subject made between orange, white, and the "none" options by treatment are presented in table 4. In general, participants from urban and rural areas chose the orange option much more often than the white option. However, subjects from rural areas chose the "none" option much more than participants from urban areas.

Table 4. Choices between Orange and White Fleshed Sweet Potatoes by Treatment

Choice Option	Urban				Rural			
	With Information		Without Information		With Information		Without Information	
	Non-hyp[a]	Hyp[b]	Non-hyp	Hyp	Non-hyp	Hyp	Non-hyp	Hyp
Orange	53.0%	62.1%	43.7%	41.1%	57.3%	37.8%	41.7%	37.7%
White	22.4%	20.8%	30.6%	39.2%	14.9%	26.8%	30.5%	31.3%
None	24.6%	17.1%	25.7%	19.7%	27.8%	35.4%	27.8%	31.0%
Number of participants	52	46	45	47	32	30	28	28

[a] Visual/incentivized or Non-hypothetical Scenario
[b] Hypothetical or non-visual Scenario

As expected, participants in the treatments with information about the nutritional value of sweet potato chose the orange option more frequently than participants in the treatments without information and this is also true for both urban and rural areas. Conversely, the white option was chosen more in situations where information about nutritional value of sweet potato was not provided. These outcomes suggest that people with information are more likely to choose the orange varieties and those who do not have information are more prone to choose white varieties in detriment to the orange varieties.

Although in treatments with information the difference between the percentage of responses in visual/incentivized and non-visual/hypothetical scenarios is relatively greater than in situations without information, there is no a clear trend with regard to the effect of hypothetical vs. visual/incentivized or non-hypothetical conditions. However, in urban areas, the percentage of participants who chose the "none" option was greater in the vsual/incentivized treatments than in the hypothetical, and in the rural area, the opposite happened, as the percentage of participants choosing the "none" option was grater in the hypothetical scenarios than in the non-hypothetical.

Conditional Logit Estimates

The results of the general conditional logit model (CLM) estimation fitted to the pooled data set are presented in table 5. For sake of comparison and discussion, disaggregated estimates from segmented urban and rural samples are reported as well. Likelihood ratio tests indicated that there were no significant differences in scale across the Urban and Rural models, and as such a relative scale value is not reported in table 5.

Table 5. Conditional Logit Estimates by Area

Independent Variable	Region		
	Joint	Urban	Rural
Variables			
Price	-0.09*	-0.10*	-0.08*
	(0.01)[a]	(0.02)	(0.02)
Large sized roots (LSR) vs. Small	-0.07	0.33*	-0.68*
	(0.07)	(0.10)	(0.13)
Medium sized roots (MSR) vs. Small	0.34*	0.42*	0.27
	(0.10)	(0.13)	(0.17)
Roots with high dry matter content (HDM) vs. Low	3.79*	3.46*	4.66*
	(0.13)	(0.15)	(0.26)
Roots with medium dry matter content (MDM) vs. Low	2.22*	2.12*	2.75*
	(0.13)	(0.14)	(0.26)
Orange fleshed sweet potato (OFSP) vs. None	-0.75*	-0.39	-1.56*
	(0.17)	(0.20)	(0.32)
White fleshed sweet potato (WFSP) vs. None	-1.54*	-1.18*	-2.39*
	(0.19)	(0.23)	(0.35)
Summary statistics			
Number of observations	2772	1710	1062
Number of participants	308	190	118
Log Likelihood (LL)	-2026.00	-1249.00	-727.85
Pseudo R^2	0.33	0.34	0.38

*Statistical significant at 0.05 level.
[a]Numbers in parentheses are standard errors.

In general, the model performance, as measured by the pseudo R^2 of 0.33 for the pooled sample, 0.34 for the urban, and 0.38 for the rural sample, indicate a good fit[1]. According to Louviere et al. (2000), a pseudo R^2 ranged between 0.2 and 0.4 is correspondent to an R^2 of 0.7 to 0.9 in ordinary least squares (OLS) models. As expected, the coefficients of price were found to be negative and significant in all models, meaning that options with higher prices were less likely to be chosen as compared to options with lower prices. Although this result is intuitive and perhaps unsurprising, it is

[1] We also estimated a Multinomial Probit Model (MNP), which relaxes the IIA assumption (the LL for the pooled data was equal to -1997). Despite the difference in LL values between MNP and CLM, the parameters estimates from these two models are very similar, and as a result we proceed with the more parsimonious CLM.

important to note that this finding suggests the results pass at least one test of internal validity. Further, given the education and literacy level of many of the participants, it was not a foregone conclusion that rational responses would be obtained.

Table 5 shows that the coefficients associated with large sized roots (LSR) vs. small root sizes are negative and significant for the rural area. For LSR, this result is an indication that the roots with small size are, in general, more preferred than the LSR. Another result is readily evident: the positive, significant and relative high coefficients of high dry matter (HDM) indicates that of dry matter content is the most important attribute to the subjects' utility of consuming sweet potatoes. The coefficients for OFSP and WFSP relative to the "none" options are both negative, in part, as a result of the importance of dry matter. That is, for options with low levels of dry matter content, people frequently selected the "none" options, resulting in a negative coefficients of the orange and white alternatives in the model. More important is the relative comparison of the coefficients for OFSP and WFSP, which suggest that, holding constant other factors, OFSP is more highly preferred than WFSP.

Table 6 reports the results of likelihood ratio tests conducted to determine whether model parameters were significantly influenced by (i) the area of data collection (urban versus rural), (ii) incentivized and presentation of roots (non-visual/hypothetical versus visual/incentivized or non-hypothetical), and (iii) the effect of health information (with versus without information). To carry out the tests, we estimated six separate models equivalent corresponding to the two-levels for three treatment variable and compared the respective log-likelihood functions to the pooled data set controlling for potential

differences scale. Table 6 shows that we are able to reject the hypothesis of the equality of parameters across each of paired treatments levels at the *p*-value=0.05 or lower.

Table 6. Likelihood Ratio Tests for Effect of information, Real-Money Payments, and Area

Test	Scale	LL[a] for Model (1)	LL for Model (2)	LL for Joint Model	χ^2 statistic	df	*p*-value[b]
Urban (1) vs. Rural (2)[c]	0.94	-1249.00	-727.85	-2026.00	98.30	8	<0.0001
Hyp (1)[c] vs. Non-Hyp (2)	1.03	-1000.00	-1014.00	-2026.00	22.00	8	0.0049
With Info (1) vs. No Info (2)[c]	1.23	-964.06	-997.83	-2021.00	118.20	8	<0.0001

[a]LL= Log-likelihood
[b]*p*-value for the null hypothesis of equality of the true parameters ($\beta_1 = \beta_2$) and scale factors or error variances ($\mu_1 = \mu_2$) in the model 1 and 2.
[c]Model which the date set is assumed to have a scale parameter equal to 1 unit.

These results suggest that we cannot pool the data from different treatments, as the null hypothesis of equality of parameter across treatments is strongly rejected at any standard level of significance. Specifically, these outcomes indicate that the area or region (rural or urban), information (with or without) and the visual/incentivized or hypothetical scenarios each significantly affected on choices among sweet potato options. As expected, consumers with deficiencies in knowledge about the nutritional value of sweet potatoes exhibited different choices or preferences in relation to those that were exposed to information. Also, consumers exposed to the visual/incentivized scenarios, that is, those who were confronted with the treatments which involved the use of real roots as sample, articulated differently their preferences compared to those who were only shown hypothetical scenarios. Having established that choices were affected by all treatment variables, table 7 report results separately for each treatment combination. As mentioned earlier, it is evident that the dry matter content is the most important attribute observed in all treatments as indicated by the fact that the parameter coefficients for this

attribute were positive, statistically significant and relatively higher than other attributes in the choice experiment.

For example, in case of the urban-with information-visual/incentivized treatment, chooses potato with high dry matter yields 4.14 more utility than a potato with low dry matter content. By contrast, medium root size only increases utility by 0.52 as compared to roots with small size. Similar comparisons with other attributes indicate that dry matter content has a larger effect on utility than that of other attributes, and this is true for all treatments.

Table 7. Conditional Logit Model Estimates by Treatment

Independent Variable	Urban				Rural			
	With Information		Without Information		With Information		Without Information	
	Incent.[a]	Hypothetical	Incent.	Hypothetical	Incent.	Hypothetical	Incent.	Hypothetical
Price	-0.11*	-0.09*	-0.12*	-0.09*	-0.11*	-0.15*	-0.02	-0.08
	(0.03)[b]	(0.04)	(0.03)	(0.03)	(0.06)	(0.06)	(0.06)	(0.05)
Large size	-0.25	0.46	0.26	0.94*	-0.86*	-1.10*	-1.08*	-0.08
	(0.21)	(0.26)	(0.20)	(0.21)	(0.30)	(0.27)	(0.29)	(0.28)
Medium size	0.52*	0.63*	0.18	0.58*	0.61	0.68*	-0.60	0.51
	(0.26)	(0.33)	(0.25)	(0.25)	(0.37)	(0.33)	(0.45)	(0.37)
High dry matter content	4.14*	4.04*	3.32*	3.19*	3.82*	5.96*	6.12*	5.36*
	(0.35)	(0.36)	(0.30)	(0.28)	(0.41)	(1.03)	(0.72)	(0.65)
Medium dry matter content	2.81*	2.39*	1.91*	1.87*	2.08*	4.14*	3.80*	3.05*
	(0.35)	(0.36)	(0.27)	(0.25)	(0.41)	(1.03)	(0.71)	(0.63)
Orange sweet potato	-0.8	-0.1	-0.41	-0.80*	-0.10	-2.80*	-2.47*	-2.58*
	(0.46)	(0.45)	(0.39)	(0.40)	(0.59)	(1.11)	(0.79)	(0.75)
White sweet potato	-2.09*	-2.01*	-0.79	-0.79	-2.37*	-3.19*	-3.13	-2.80
	(0.51)	(0.54)	(0.43)	(0.43)	(0.63)	(1.13)	(0.87)	(0.78)
Summary statistics								
Number of observations	468	414	405	423	288	270	252	252
Number of participants	52	46	45	47	32	30	28	28
Log Likelihood	-304.60	-239.09	-320.59	-313.35	-181.23	-175.03	-151.69	-164.61

*Statistical significant at 0.05 level
[a] Incent.=Visual/incentivized treatment
[b] Numbers in parentheses are standard errors

Another way to compare magnitude of the coefficients is to calculate WTP estimates. Total and marginal WTP for all seven attributes were computed for each of the eight models shown in table 7. The mean WTP and 95 percent confidence interval are presented in table 8. The findings indicate that the total WTP for orange varieties relative to none option is greater than the total WTP for white varieties in all real treatments in study. This result can be easily confirmed by the positive marginal WTP for orange relative to white-fleshed sweet potatoes in seven out of eight models.

Recall that the first objective of this study was to determine WTP for OFSP vs. WFSP. As hypothesized, holding constant other attributes constant, the date indicate consumers are willing to pay much more for orange than white-fleshed sweet potatoes varieties. These findings suggest that the equality of the prices for OFSP and WFSP observed in the marketplace is not directly linked to the color of the pulp *per se*, but is due to other factors associated with the crop.

Table 8. Willingness-to-Pay by Treatment

Variables	Urban				Rural			
	With Information		Without Information		With Information		Without Information	
	Visual/Incent.[a]	Hypothetical	Visual/Incent.	Hypothetical	Visual/Incent.	Hypothetical	Visual/Incent.	Hypothetical
Total WTP								
Orange vs. none	-7.43[b] [-15.72, 1.13][c]	-1.11 [-11.16, 9.35]	-3.39 [-9.72, 3.11]	-9.34 [-18.25, 0.07]	-0.97 [-11.22, 10.03]	-18.90 [-33.22, -4.66]	-141.15 [-225.68, -51.19]	-32.32 [-50.33, -13.77]
White vs. none	-19.45 [-28.63, -10.08]	-22.81 [-35.62, -10.63]	-6.61 [-13.59, 0.51]	-9.12 [-19.21, 0.72]	-21.99 [-33.61, 10.65]	-21.55 [-36.36, -7.17]	-178.57 [-269.87, -79.63]	-35.21 [-54.15, -16.24]
Marginal WTP								
Orange vs. white	12.02 [9.06, 15.30]	21.69 [17.17, 26.30]	3.22 [0.74, 5.75]	-0.22 [-3.56, 3.21]	21.02 [15.90, 25.77]	2.64 [-0.33, 5.80]	37.42 [10.73, 64.33]	2.89 [-2.40, 8.55]
Large vs. small size	-2.30 [-6.05, 1.29]	5.19 [-0.55, 10.78]	2.13 [-1.11, 5.23]	10.92 [6.16, 15.47]	-8.03 [-13.30, -2.67]	-7.47 [-10.97, -4.00]	-61.43 [-92.65, -29.26]	-1.03 [-7.71, 5.38]
Medium vs. small size	4.79 [0.09, 9.75]	7.17 [0.03, 14.99]	1.49 [-2.45, 5.78]	6.73 [1.22, 12.61]	5.68 [1.05, 12.67]	4.58 [0.18, 9.12]	-34.54 [-81.11, 17.92]	6.41 [-2.16, 15.92]
High vs. low dry matter	38.43 [32.36, 45.08]	45.92 [37.99, 53.62]	27.65 [22.54, 32.56]	37.01 [30.49, 43.30]	35.49 [28.42, 42.92]	40.41 [26.88, 53.92]	349.69 [269.48, 422.24]	67.19 [51.10, 82.64]
Medium vs. low dry matter	26.10 [19.57, 32.50]	27.11 [19.12, 34.36]	15.85 [11.19, 20.13]	21.69 [15.79, 27.14]	19.31 [11.26, 26.11]	27.97 [14.14, 41.79]	216.80 [131.94, 290.72]	38.19 [22.40, 53.24]

[a]Visual/Incent.= Visual/incentivized treatment.

[b]WTP values are calculated from the coefficients in the models in table 6, and the values are measured in MT per Kilogram (1$=24MT).

[c]Numbers in brackets are 95% confidence interval calculated using the Krinsky-Robb bootstrapping method.

One of the objectives of this study was to determine the effects of the specific crop attributes such as dry matter content and the size of the roots on consumers' WTP for sweet potatoes. As previously mentioned, dry matter content is the most important sweet potatoes' attribute. This finding is reinforced by WTP statistics reported in table 8, which indicates that the marginal WTP for high versus low levels of dry matter content is very high in all treatments in study. The highest price in the choice scenarios was 15 MT, and the subjects demonstrated that they are WTP twice as much as this price to obtain varieties with high level of dry matter content. Further, marginal WTP for high dry matter content relative to low dry matter content is almost twice compared to marginal WTP for the color of the pulp, and this is true whether the participants were provide with information about the quality of the roots or not. For example, in the treatment rural-with information-visual/incentivized, marginal WTP for orange versus white is about 21 MT per kilogram of sweet potato and marginal WTP for high versus low dry matter content is about 35 MT, differing by a factor of 1.7. The same situation is true in the treatment urban-with information-visual/incentivized, where the difference between the values of WTP for dry matter content and the pulp color is by a factor of about 3.

Thus, the hypothesis that consumers are WTP more for higher levels of dry matter content is strongly supported by the data. These results suggest that dry matter content is a key factor that contributes for the price equality between the orange and white-fleshed sweet potatoes. If the traditional white varieties have high dry matter content, and being sold at similar price as the new orange varieties with high nutritional value, then, means that dry matter differences between white and orange potatoes is more important than

differences in nutritional value. That is, orange varieties do not compete well with the traditional white varieties in terns of dry matter content. Hence, policy makers and plant breeders should realize that the nutritional benefits of OFSP will only be realized, when one first meets consumers' demands for dry matter content. To illustrate, table 9 shows predicted market shares between OFSP and WFSO under several different scenarios where dry matter content varies. Results from table 9 show that the probability the individual would choose orange (0.49) or white (0.51) varieties is about the same when the prices of both orange and white are the same, and when orange varieties have medium dry matter content, but white varieties have high DM content (Scenario 1). This scenario in some way represents current conditions in the marketplaces in Maputo and Gaza. When the level of dry matter content is improved from medium to high, the probability of choosing orange (0.78) and white (0.22) increases dramatically different (Scenario 2).

Table 9. Sensitivity Analysis on changes in Dry Matter Content and Prices of OFSP and WFSP, using Estimates from Urban Areas, with Information and Visual/incentivized Scenario

Variable	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	Orange	White	Orange	White	Orange	White	Orange	White
Price	12*	12	12	12	20	12	20	12
Root Size	Med	Med	Med	Med	Med	Med	Med	Med
High Dry Matter	-	High	**High**	High	-	High	**High**	High
Medium Dry Matter	**Med**	-	-	-	**Med**	-	-	-
OFSP	Orange	-	Orange	-	Orange	-	Orange	-
WFSP	-	White	-	White	-	White	-	White
Predicted Market Shares (%)	0.49	0.51	0.78	0.22	0.29	0.71	0.61	0.39

*Prices in MT/Kg, ($1=24MT)

In scenario 3, the price of OFSP was increased from 12 to 20 MT/Kg, with medium level of dry matter content for orange and high for white, the probability the individual choose orange is 0.29 and is 0.71 for white. A higher price with lower levels of DM content is clearly disadvantageous for OFSP, even if people have information on nutritional value of OFSP. Scenario 4, shows, however, that even if OFSP are priced higher, that if DM content was improved to high, the probability the individual would choose orange (0.61) is greater than that of choosing white (0.39). These scenarios further demonstrate the importance of improving the DM content of OFSP is the variety is to be successful.

In relation to the size of the roots, marginal WTP for medium sized roots relative to the small is generally greater than marginal WTP for the large versus small sized roots (table 8). In fact, we found some negative values of marginal WTP for large versus small sized roots. For instance, subjects from urban area, submitted to the treatments with information and visual/incentivized, revealed that they were willing to pay more 2.30 and 8.03 MT per kilogram for small sized roots instead of large roots. Accordingly, in terms commercials, varieties that yield medium sized roots are more preferred and likely than large sized roots.

Effect of Information

Another objective of this study was to assess the effect of information about the nutritional value of OFSP on WTP estimates and predicted market shares. Since 2000, the year of the effective introduction of these new varieties of sweet potatoes in Mozambique, the government and their partners have promoted the variety by disseminating information on their nutritional value and the consequent impact on the

public health. Thus, it is important to determine whether such information actually affected behavior. To accomplish this objective, subjects were randomly assigned to one of two treatments - either with or without information on nutritional value of sweet potatoes.

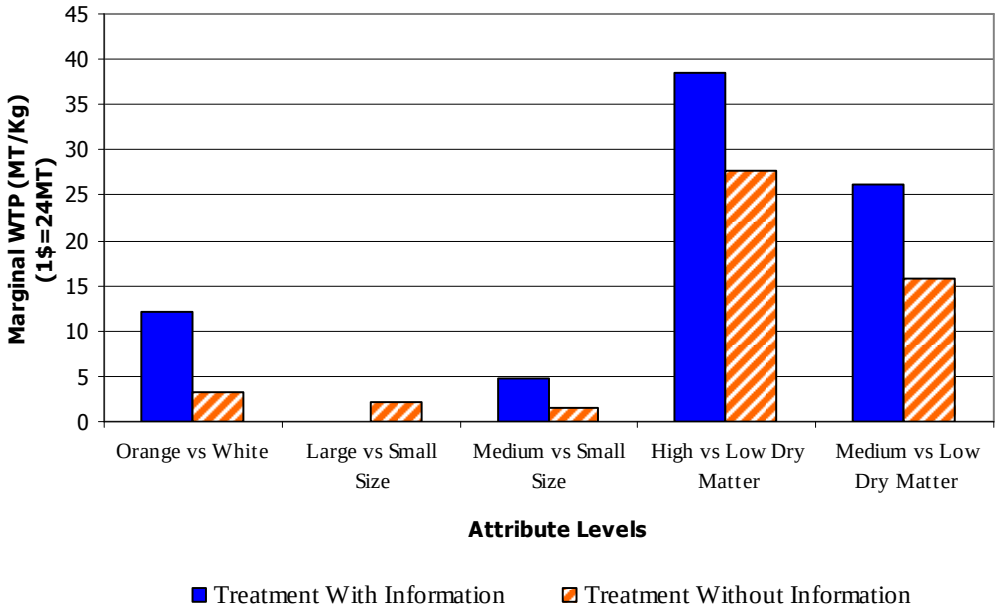

Figure 2. Marginal WTP (MT/Kg) for Treatments with and without Information, Calculated from the Visual/incentivized Scenarios in the Urban Area, (1USD=24MT)

The results indicate that providing information on the health benefits of OFSP did, in fact, increase consumers' WTP for OFSP relative to WFSP. In fact, as confirmed by the likelihood ratio test (χ^2=118.2; p<0.05) in table 6, in general, treatments with and without information provided different outcomes (figure 2). In relation to the color of the pulp, both results in table 8 and 10 reveal that consumers value orange more than white varieties when information is provided. For example, results in table 10 show that in urban areas, if consumers are provided with information on nutritional value of OFSP,

most would choose orange (78%) as compared to white (22%) varieties. When health information is not provided, the share choosing OFSP falls from 78% to 60%. In rural areas, the need for health information is even more relevant as compared to urban areas, as most would choose orange (91%) as compared to white (9%), and when health is not advertised, the share choosing OFSP decreases from 91% to 66%.

These results indicate a greater need to continue working on the promotion of new varieties of orange-fleshed sweet potatoes, as many individuals appear unaware of the health benefits. However, it is important to recognize that one must consider the cost of additional education. In this regard, the effect of information on marginal WTP for OFSP, as shown in tables 8, while positive, is small. This could be a result of the fact that some people are already informed of health benefits as a result of the promotional campaigns carried out by the government and partners. As such, there may be a positive, but diminishing value to additional information.

Table 10. Predicted Market Shares (%) for Orange and White-Fleshed Sweet Potatoes

Variables	Urban				Rural			
	With Information		Without Information		With Information		Without Information	
	Visual/Incent.[a]	Hypothetical	Visual/Incent.	Hypothetical	Visual/Incent.	Hypothetical	Visual/Incent.	Hypothetical
OFSP	0.78[b] [0.73, 0.84][c]	0.87 [0.82, 0.91]	0.60 [0.52, 0.67]	0.50 [0.42, 0.57]	0.91 [0.85, 0.94]	0.60 [0.49, 0.70]	0.66 [0.55, 0.76]	0.56 [0.45, 0.66]
WFSP	0.22 [0.16, 0.27]	0.13 [0.09, 0.18]	0.40 [0.33, 0.48]	0.50 [0.43, 0.58]	0.09 [0.06, 0.15]	0.40 [0.30, 0.51]	0.34 [0.25, 0.45]	0.44 [0.34, 0.56]

[a]Visual/Incent.= Visual/incentivized treatment.

[b]The market shares are calculated under the assumption that the average price of sweet potato is 12 MT/kg (1USD=24MT), the roots have medium size, and the dry matter content is high.

[c]Numbers in brackets are 95% confidence interval calculated using the Krinsky-Robb bootstrapping method.

Differences between Visual/incentivized and Non-visual/Hypothetical Settings

To test for the hypothetical bias, different subjects responded to the treatments under non-visual/hypothetical and non-hypothetical scenarios are considered as visual/incentivized treatments. The likelihood ratio test (χ^2=22.0, p<0.05) presented in table 6 indicates that we can reject the hypothesis that the coefficients from the treatments under non-visual/hypothetical and visual/incentivized scenarios are equal, and this result is consistent with the majority of empirical studies using private goods (Lusk and Schroeder, 2004; List and Shogren, 1998). However, despite the difference, the magnitude is not as large as that observed in other studies (figure 3). For instance, Lusk and Schroeder (2004) found that on average, subjects from hypothetical treatments overstated their total WTP by a factor of about 1.2, and also List and Gallet (2001), in a summary of twenty-nine experimental studies revealed that average participants overstated their WTP in hypothetical scenarios by a factor of 3.

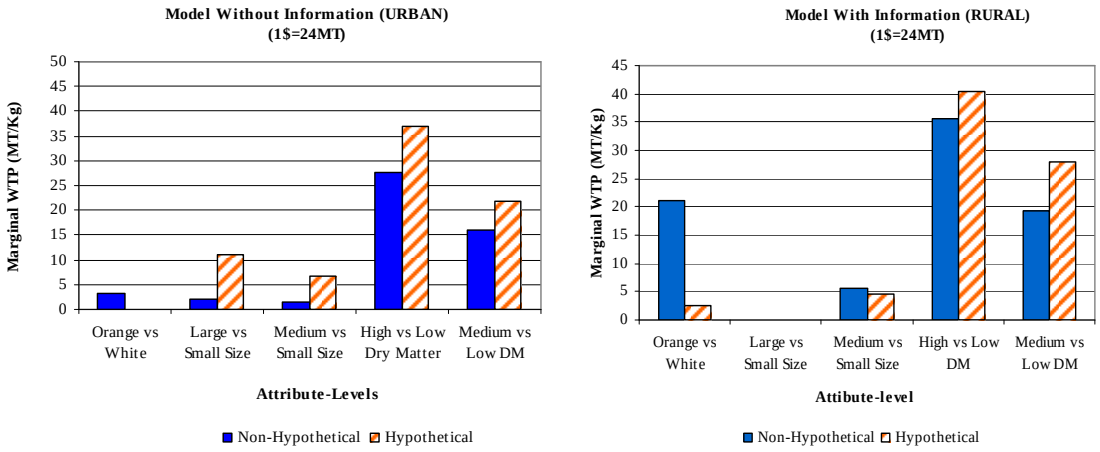

Figure 3. Marginal WTP for Non-visual/hypothetical and Visual/incentivized or Non-hypothetical Treatments in Situations with and without Information Respectively

Results from this study (table 8) indicate that on average, subjects from urban areas overstate their total and marginal WTP by a factor of about 1.4, hence, relative small as compared to the average obtained from other studies. However, it is difficult to draw any generalizable results about this treatment effect; sometimes WTP is higher in the non-visual/hypothetical treatment and sometimes it is lower. Indeed, for each of the paired columns shown in table 5, if we take the ratio of WTP from the non-visual/hypothetical treatment to the WTP from the visual/incentivized treatment, we find the average value across all attributes and locations is about 1.01.

At this point, it is important to mention that in some situations, we found relative higher values of welfare measures in visual/incentivized scenarios as compared to the hypothetical ones, something against to the ordinary results in these situations. This situation is more common in the treatments in rural areas. In fact, as pointed out by Ehmke, Lusk, and List (2008) in one study conducted in Niger, cultural effects might be behind these kinds of outcomes, as they found that unlike other locations in the US and Europe, the direction of hypothetical bias actually flipped in Africa. Furthermore, as mentioned earlier, despite the significance on the average values, the difference between the values of total and marginal WTP (table 8) under actual and hypothetical scenarios is not economically large. And this situation is also reflected on the values of the predicted market shares in table 10. For example, in table 8, under the scenario rural-with information, the average value of marginal WTP for high versus low dry matter content, under the visual/incentivized treatment is 35.49, CI (28.42, 42.92) and for the hypothetical is 40.41, CI (26.88, 53.93), and each of the average values can match either

the confidence interval for visual/incentivized or hypothetical scenarios, such is the proximity between the average values.

Although this study do not allow formal conclusions about the precise magnitude of hypothetical bias, in the way that previous studies did by using real-money to pay for the randomly drawn choice set, it at least give some information about the hypothetical bias which may be associated with an experimental methodology.

In summary, the results from the visual/incentivized and hypothetical scenarios were found to be significantly different, however, the difference is not as big as expected, and also there is no a clear pattern between this two types of situations, that is, we found some scenarios with visual/incentivized values greater than hypothetical and vice versa, suggesting that the employment of either visual/incentivized or hypothetical is context-specific.

Welfare Effects of Introduction of Orange-Fleshed Sweet Potatoes

This section calculates the consumer surplus effects resulting from the introduction of OFSP. In particular, we compare consumer surplus in the traditional scenario with only white varieties to the new situation where we have both white and orange-fleshed sweet potatoes, and identify WTP to move from the new to the old scenario. In particular, the welfare change from the old to a new situation for each subject was obtained by calculating the compensating variation, illustrated in equation 11 in the methodology chapter.

Table 11. Estimated welfare change from the traditional white to a new situation with orange and white varieties (MT/Choice Occasion)

Scenarios/Region	Urban		Rural	
	With Information	Without Information	With Information	Without Information
Visual/Incentivized	12.51[a]	6.36	18.81	57.37
Hypothetical	21.28	7.19	5.47	9.43

[a]Welfare are calculated under the assumption that the average price of sweet potato is 12 MT/kg (1USD=24MT), the roots have medium size, and the dry matter content is high

Overall, results in table 10 indicate that there are gains in welfare from introduction of orange-fleshed sweet potatoes in the food system. Assuming the non-hypothetical treatments with-information as base of comparison, results indicate that consumers from the rural areas (MT 18.81 per choice occasion) derive higher benefits from the introduction of orange-fleshed sweet potatoes than those from the urban area (MT 12.51 per choice occasion), and this situation was expected as people from rural areas are more likely to consume sweet potatoes (table 3), particularly because of the relative shortage of alternative products and income constraints as compared to consumers from urban areas.

Then, the hypothesis that the proportion of welfare gains in urban areas will be relatively higher than the gains from consumers in the rural areas is not totally supported by the data of study, and this is an indication that the fact of living in rural areas does not pull back people to pay more for sweet potato attributes.

We rely on the outcomes of this study and determine the aggregate welfare change as described by Lusk, Norwood, and Pruitt (2006). To arrive at aggregate welfare changes, we must identify the number of choice occasions sweet potatoes consumers face

in a year. To do so, we have to find the potential amount of sweet potato consumed and the percentage of consumers who certainly would buy sweet potatoes. The per-capita consumption of sweet potatoes is assumed to be about 16 kg/person/year (Steyn, 2003), and that the projections of national population for 2007 is about 19 million individuals, 40% of them living in urban areas (INE, 1999). So, the projected total amount of sweet potato consumed is 304 million kilograms (19*16), 121.6 of that consumed in urban areas and 182.4 in rural areas. We know from table 3 that nearly 40% of consumers in rural areas purchase or consume sweet potatoes once a week. In urban area this is about 30%. Then, 422 million choices (i.e., 121.6/0.3) in urban areas and 456 million choices (i.e., 182.4/0.4) in rural areas could be made in 2007. Thus, when consumers are informed about the nutritional values of sweet potatoes the welfare from introduction of OFSP can be translated to MT 5,529.42 million (12.51*422) in aggregate benefits in urban areas. The same is true for rural areas, as informed consumers will face welfare gains per choice occasion of about MT 18.81, yielding an aggregate benefit of MT 8,577.36 million (18.81*456).

It is important to note that these predictions are based on national figures, and one might want to desegregate this outcomes to a provincial or district levels. Also, these figures can alter if the per-capita consumption is adjusted to the provincial or district context. We used the welfare gains per choice occasion generated from Maputo and Gaza to estimate the aggregate welfares because these two provinces resembles a bit of what normally happens throughout the country in terms of sweet potatoes' production, consumption and commercialization. Independently of the assumptions one could made,

the introduction of orange-fleshed sweet potatoes increases the welfare gains to the society.

Implications of the Study

The results of this study provide space to draw some implications, particularly from the valuation method and agribusiness point of view in Mozambique.

First of all, the information elicited in CE can be effectively used to determine consumers' perceptions of value in the context of developing countries, and this is true whether OFSP or other new crop product features are involved. In general, the findings of this study indicate that OFSP are more valued than WFSP, and this is consistent with those results found in traditional sensory evaluation and consumer acceptability of OFSP conducted in Tanzania (Tomlins et al., 2007), and in Mozambique (Andrade and Ricardo, 1999).

Secondly, although the visual/incentivized or non-hypothetical treatments were not designed to be strictly comparable in the way that they would be in an normal context were money was physically involved, results from this study suggest a careful treatment of hypothetical bias in developing countries, as in some cases, values from hypothetical settings were positive and higher than visual/incentivized or non-hypothetical scenarios, and this situation is in light of the findings from Ehmke, Lusk, and List (2008).

Thirdly, results of this study strongly suggest a perfect and direct association between high dry matter content, medium sized roots and consumers' preference for OFSP. Thus, from agribusiness standpoint in Mozambique, it is important for plant breeders to focus on improving and selecting particularly varieties with high level of dry matter content, as consumers are willing to pay only significant premium for OFSP if this

attribute is satisfied. The WTP information, the predicted market shares and the compensating welfare information suggest that OFSP should move to a commercial production. However, such a decision will be pending in accurate knowledge of costs, and most important, whether the investments costs will be recovered.

Lastly, the effort made by stakeholders in investing in research and development of OFSP needs to be continued, as welfare gains from having these varieties are extremely optimistic. Indeed, such is a great potential of these varieties, that investments in crop breeding and awareness programs should be continuously supported in Mozambique.

Limitations and Future Research

The limitations of this study should be observed in conjunction with the implications of the research.

First of all, the CE was conducted in Maputo and Gaza, provinces we consider represent most of the sweet potato consumers. Maputo was chosen because of its diversity in culture and food habits, and Gaza as one of the most important provinces in terms of production and consumption of sweet potatoes. However, prudence is required in dealing with results from this study, as Mozambique is vast and multicultural and we are not sure that all ten provinces are strictly represented in our sample.

Secondly, perhaps one of the most important limitation of the study is that the visual/incentivized and hypothetical settings were not strictly comparable in the way that they would be in a normal framework were money is physically exchanged. As pointed earlier, this situation was imposed because of when money was involved, most of the participant started to direct their choices thinking about gains or winning from the

choices they were making, thereof introducing a lot of noise in the collected data. To minimize this situation, the money involved in the real scenarios was exchanged by the equivalent of sweet potato roots. Therefore, a future research, special in Africa, addressing this issue, will be helpful in determining to what extent this behavior affects the values elicited in CE.

Thirdly, although the correlations between some attributes did not seriously affect the results of this study, to determine separately the effects of each attribute on each variety, we assumed that preferences for price, dry matter content, and size are independent of variety. As normal in this context, future studies should properly address this assumption by using a design that provides complete orthogonal attributes between and within choice alternatives.

Fourthly, as pointed out in the section on welfare implications, the predicted welfare gains were calculated taking into account indicators and assumptions about sweet potato, as for example the per-capita consumption. As we know, in general, the system of data collection in Mozambique still need some readjustments to reflect a more realistic idea of the events occurring in the agricultural sector. Thus, all reasonable precautions must be taken in discussing this issue.

Finally, the study shows that consumers are willing to give a premium to OFSP as result of their nutritional value. However, this will effectively take place if varieties with high dry matter content are available. It is important to change the current image and perceptions about OFSP, that is, the customers' heritage and history associated with low dry matter content. Generally speaking, even if people are aware of something nutritious, they sometimes prefer to buy items based on the taste or some traditional attributes, and

the findings of this study support this point of view. Therefore, there is space for future studies, particularly in examining the perceptions Mozambicans have of the image and awareness of the OFSP, by using in this case scenarios where the taste or palatability test is considered as base of comparisons.

CHAPTER VI

CONCLUSIONS

This study investigated how consumers value the incoming OFSP relative to the traditional white varieties in Mozambique. The study compares discrete choices from conditional logit model, using data generated by a choice experiment with eight treatments representing scenarios under rural and urban areas, with and without information on sweet potatoes' nutritional values, and visual/incentivized and hypothetical framework. Welfare measures for sweet potatoes' specific attributes were estimated, and a number of inferences can be made.

Firstly, the values of total WTP for orange varieties relative to none option were found to be greater than the total WTP for white varieties in seven out of eight treatments in study. Accordingly, the marginal WTP for OFSP versus WFSP were positive in those treatments. Under information-visual/incentivized scenarios, the marginal WTP for orange versus white varieties in rural area (MT 21.02) was nearly twice the marginal WTP in urban area (MT 12.02), indicating a relative importance of OFSP in rural areas, and at the same time suggesting a more vigorous attention and promotion of these varieties in urban areas.

Secondly, among the attributes in study, the dry matter content was the most valued, accounting for about 75% of consumers' utility for sweet potatoes. And this situation is almost the same in all eight treatments in study. Under information-visual/incentivized scenarios, the marginal WTP for high versus low dry matter content (MT 35.49) in rural area was nearly similar to the marginal WTP in urban area (MT 38.43), indicating a relative stability of this attribute in both rural and urban areas. However, on average, the values of marginal WTP for high dry matter content were almost twice compared to marginal WTP for the color of the pulp in both treatments with and without information. Therefore, price differences between orange and white varieties are more likely to take place if the requirements for dry matter content are fulfilled as compared to the color of pulp.

Thirdly, if the level of dry matter content in both orange and white varieties is set to be high, them varieties of OFSP will generate high values of market shares. In conditions of high dry matter content, nearly 70% of the predicted market shares will be more likely to be allocated to OFSP. Again, the value of the orange color will be reflected in terms of price differential if the varieties have satisfactory levels of dry matter content.

Fourthly, the size of roots was also considered as an important qualitative attribute. Results from this study suggest that, roots with small to medium size are far preferred to roots with large size. This is also a valuable result for the crop breeders, suggesting that the process of evaluation and selection of varieties must also start to look at the aspects related with the morphology of the roots

Fifthly, values of welfare estimates under sets with health information of sweet potatoes were, in general, significantly different from those generate under scenarios without health information. Thus, results from this study strongly suggest that consumers without proper information on the benefits of OFSP will be willing to pay relative fewer values for these varieties, and as result, considerable segment of sweet potatoes' consumers would choose white varieties in detriment of OFSP.

Sixthly, responses from treatments under visual/incentivized and hypothetical scenarios were significantly different, and this is consistent with majority of empirical studies using private goods. In general, results from this study indicate that consumers from urban areas overstate their total and marginal WTP by a factor of about 1.4; however, this factor is relative small as compared to a factor of about 3, found in the majority of studies involving private goods. In rural areas, some values of welfare measures were high in visual/incentivized than hypothetical scenarios, reviving the hypothesis the employment of either visual/incentivized or non-hypothetical and hypothetical settings is context-specific. Though, overall, actual scenarios generate more consistent and stable information.

Finally, results from the compensating variation strongly indicate that there is a welfare gain from changing from the old or traditional situation with only white varieties to a new situation with both orange and white varieties. Again, these results are extremely dependent on the levels of dry matter content. Thus, data from this study show that when consumers are informed about the nutritional values of sweet potatoes the welfare gains per choice occasion in urban increases by MT12.51, representing about MT 5,529.42 million in aggregate benefits. Also, in rural areas, informed consumers will face

welfare gains per choice occasion of about MT18.81, yielding an aggregate benefit of about MT 8,577.36 million.

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APPENDICES

Appendix 1. Information given to the Participants prior to respond the Questionnaire

In this interview, you are asked about your preferences for 9 different scenarios involving orange and white-fleshed sweet potato. Each of the 9 scenarios is described by three attributes: a) price (Mt per kilogram), with three levels, 7.5MT, 10MT, and 15MT, b) dry matter content, also with three levels, high, medium and low, and c) size of the roots, comprising large, medium and small levels.

Dry Matter Content:

- **Potatoes** with ***low dry matter content***, result in ***high moisture content*** (which are moist flesh when cooked)
- **Potatoes** with ***medium dry matter content*** are those in between low and high dry matter
- **Potatoes** with ***high dry matter content***, result in ***low moisture content*** (which have dry, starchy, firm flesh when cooked)

Size of Potato:

Size	*Weight (g)*	*Diameter of the root*
Small(S)	Less than 150g (0.33lb)	Less than 4.5cm or 1.8in
Medium(M)	Between 150g and 300g (0.33lb<M<0.67lb)	Between 4.5cm (1.8in) and 8cm (3.1in)
Large(B)	Greater than 300g (B>0.67lb)	Greater than 8cm (3.1in)

Source: USDA SR20 on NutritionData.com

Appendix 2. Nutrition Message on Orange versus White Sweet Potato

Orange fleshed sweet potato is a good source of Vitamin A, C, natural sugars and carbohydrates. Because of that, regular consumption of these varieties can help improve your health. People with Vitamin A deficiency are more susceptible to develop infection because their immunologic system becomes very weak as result of lack of Vitamin A. Other can develop blindness, and occasionally some can see the development of their body affected, and this situation is especially catastrophic in children. Vitamin A is indispensable in particular for children, because there are in the process of growing. Also pregnant and women in lactation, are in especial need of Vitamin A to help the development of the babies. There are other excellent sources of vitamin A, including vegetables, fruits, and fish with deep orange or dark green color. Despite its high level of carbohydrate (sugars), white sweet potato is poor source of Vitamin A.

Nutritional Facts on 100g, of cooked, baked in skin, without salt

Orange Sweet Potato (Serving Size 100g)		**White Sweet Potato(Serving Size 100g**	
Amount per serving		Amount per serving	
Calorie 90	Calories from fat 1	**Calorie** 93	Calories from fat 1
	% of Daily value		**% of Daily value**
Total fat 0g	0%	**Total fat** 0g	0%
Saturated fat 0g	0%	Saturated fat 0g	0%
Trans fat		Trans fat	
Cholesterol 0mg	0%	**Cholesterol** 0mg	0%
Sodium 36mg	1%	**Sodium** 10mg	0%
Total carbohydrate 21g	7%	**Total carbohydrate** 21g	7%
Dietary fiber 3g	13%	Dietary fiber 2g	9%
Sugars 6g		Sugars 1g	
Protein 2g		**Protein** 3g	
Vitamin A	***384%***	***Vitamin A***	***0%***
Vitamin C	33%	Vitamin C	16%
Calcium	4%	Calcium	1%
Iron	4%	Iron	6%
% Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calories needs			

Source: USDA SR20 on NutritionData.com

Appendix 3. Choice Experiment Scenarios

Scenarios	Orange Sweet Potato			White Sweet Potato		
	Price	Size of Roots	Dry Matter Content	Price	Size of Roots	Dry Matter Content
1	7.5	Small	Medium	15	Large	High
2	7.5	Medium	High	7.5	Small	Low
3	7.5	Large	Low	10	Medium	Medium
4	10	Small	Low	15	Medium	Low
5	10	Medium	Medium	7.5	Large	Medium
6	10	Large	High	10	Small	High
7	15	Small	High	15	Small	Medium
8	15	Medium	low	7.5	Medium	High
9	15	Large	Medium	10	Large	Low

VITA

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Scope and Method of Study: We conducted a Choice Experiment (CE) to evaluate consumers' preferences for the new orange-fleshed sweet potato (OFSP) and the traditional white varieties (WFSP), by comparing information generated in eight treatments representing scenarios under urban and rural areas, with and without information about nutritional value of potatoes, and under visual/incentivized and non-visual/hypothetical framework.

Findings and Conclusions: Total WTP for OFSPs were greater than the total WTP for white varieties in seven out of eight treatments in study. Accordingly, the marginal WTP for OFSP versus WFSP were positive in those treatments. Under information-visual/incentivized scenarios, the marginal WTP for orange versus white varieties in rural area was nearly twice the marginal WTP in urban area, indicating a relative importance of OFSP in rural areas. Among the attributes in study, the dry matter content was the most valued. On average, the values of marginal WTP for high dry matter content were almost twice compared to marginal WTP for the color of the pulp, in both treatments with and without information. Therefore, price differences between orange and white varieties are more likely to take place if the requirements for dry matter content are fulfilled as compared to the color of pulp. Finally, results from the compensating variation strongly indicate that there is a welfare gain from changing from the traditional situation with only white varieties to a new situation with both orange and white varieties. In urban areas, aggregate welfare gains of having these two varieties in the production system can be nearly MT 5,529.42 million and in rural areas these benefits are about MT 8,577.36 million.

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