Are small Sub-Sahara African farmers willing to pay for vegetative propagated orange fleshed sweetpotato planting material? Evidence from Central Mozambique

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Abstract

This paper evaluates farmers' willingness to pay (WTP) for the vegetative propagated orange fleshed sweetpotato (OFSP) planting material that is many times considered as a public good. Famers' WTP for OFSP vines was elicited by conducting a real choice experiment (RCE) among 121 small sweetpotato growers in central Mozambique with prior experience growing OFSP but with no participation in OFSP vine distributions in the previous 3 years of the experiment. Results reveals a higher farmers' willingness to pay for OFSP varieties (US$0.07-0.12) compared to the non-orange planting material (US$ 0.03) and compared to the traditional subsidized price of clean sweetpotato vines (US$ 0.06) used in Mozambique. These results may encourage formation of a network of private vine multipliers that would supply permanently OFSP planting material in wider areas.

JEL classification code: Q16

Keywords: Seed systems, Sweetpotato, Willingness to pay, Mozambique

I. Introduction

Seed systems in Sub Saharan Africa are characterized by the dominance of an informal sector that supplies between 85% and 90% of the required crops seed (Venkateson 1994), the low availability of clean and healthy planting material (Staver et al 2007), and by a reduced formal sector that has focused on a narrow band of crops, particularly grains, and that has concentrated much of the available multiplication technology (Scowcroft & Polak-Scowcroft 2002).

In the case of roots and tubers in this African region, the development of sustainable seed systems has posed many challenges to many countries. On one side, root and tuber planting material is considered a public good given its vegetative propagation, which creates little incentives for a wide appearance of private seed suppliers, but on the other side, seed systems in Sub Sahara Africa constantly face natural and man-made disasters that undermine the sustainability of seed production in the region (Staver et al 2007).

Mozambique is a poor country in SSA that has experience severe consequences after a prolonged period of war and that is permanently vulnerable to natural disasters like drought and floods. Under these conditions seed supply has largely depended on imported seed, has heavily relied on emergency programs of free seed distribution and has faced a limited market infrastructure and high transportation costs that has limited the distribution of crops seed nationwide (Rohrbach & Kiale 2007). In the case of sweetpotatoes, the multiplication and distribution of planting material has been limited and associated mainly to post-war and an emergency distribution programs which has

resulted in projects of short duration and no engagement on long run programs for seed production.

Recently in Mozambique, the dissemination of orange fleshed sweetpotato (OFSP), a vitamin A rich food, through different extension programs (Low et al 2005, REU 2008) has brought attempts to establish a network of decentralized vine multipliers that can produce high quality OFSP vines that would enhance the production of OFSP roots and that potentially could create a new income generating enterprise for small farmers. Although the awareness of OFSP is growing and more farmers are increasingly demanding OFSP vines for root production, it is not clear whether these farmers requiring OFSP would pay for the sweetpotato vines and keep a sustained demand for this planting material that would consolidate the private multiplication of OFSP vines

This paper evaluates the potential demand of OFSP planting material among small sweetpotato growers in central Mozambique by eliciting their willingness to pay for this planting material and discusses potential incentives for a private multiplication of OFSP in the country. Famers' willingness to pay (WTP) for clean OFSP vines was elicited by conducting a real choice experiment (RCE) among 121 small sweetpotato growers in central Mozambique with prior experience growing OFSP but with no participation in OFSP vine distributions in the previous 3 years of the experiment. This experiment was done in January 2008 right before the beginning of the sweetpotato planting season. Then the information is analyzed using a mixed logit model and the marginal WTP for the different vines of OFSP varieties derived from this econometric analysis.

The paper follows by introducing the context of the sweetpotato seed systems in Mozambique and recent attempts to produce and distribute OFSP planting material in the Zambezia province. Section III describes the real choice experiment used while section IV provides details of the mixed logit model used in the analysis. Section V presents and discusses the results of the analysis and presents farmers WTP for OFSP vines. Finally, in section VI the paper draws some conclusions.

II. Production and distribution of sweetpotato planting material in Mozambique

Sub Saharan Africa (SSA) food security heavily relies on the security of their seed systems, but unfortunately these seed systems have faced permanent natural and man-made disasters that have limited their capacity of supplying sufficient and adequate planting material in different countries of this region (Cromwell et al 1993, Srivastava & Jafee 1993). In addition, the formal sector composed by national agricultural programs and a group of large non-governmental organizations (NGO) that usually concentrates the best seed multiplication technologies have remained reduced in most countries and had let the informal sector to supply most of the required plating material (85%-90%) but with the drawback of uneven quality of the planting material supplied (Venkatesen 1994, Lanteri & Quagliotti 1997). The bias towards the production of grain seed on Sub Saharan Africa seed systems have resulted in more difficult conditions for the production of seed for vegetative propagated crops like cassava, yam and sweetpotato and therefore less healthy planting material available in the seed systems (Staver et al 2007, Scowcroft & Polak-Scowcroft 2002).

In Mozambique, one of the poorest countries in sub Saharan Africa with high illiteracy levels and low life expectancy (Wils 2002), sweet potato is considered a secondary crop, with less than 3% of the total cultivated land in this country. However, around 35% of the farmers in this country grow sweetpotatoes (more than 1 million farmers). Zambézia is the second most important province to grow sweet potato after Tete. In 2005, the total production of sweet potato in Zambézia was calculated in 193,117.6 MT (MINAG 2006).

The production of sweetpotato planting material in Mozambique has heavily relied on the informal sector that is responsible for about 90% of the sweetpotato vines produced in the country but with a major drawback: the uneven quality of the available vines which has resulted in low yields of roots (Rohrbach & Kiala 2007) The formal sector composed by the national program of root and tubers and a limited number of NGOs have remain limited and usually active only when there were emergency programs funded by the government and international cooperation that has required large amounts of vines for free distribution.

In recent years, there have been some attempts in Mozambique to disseminate the nutritious orange fleshed sweetpotato (OFSP) which is targeted to combat vitamin A deficiency among children under 5 years old and women (Low et al 2005). In most of these cases a wide availability of clean planting material has been a common constraint and the distribution of OFSP vines has used mixed schemes that included free distributions and vine sales at a subsidized and fixed price (Low et al 2005, OVATA 2006, CIP 2008).

In 2007, the Reaching End Users (REU) project in Mozambique distributed free of charge 70% of the total OFSP planting material targeted to small farmers in the Zambezia province while managed to sell the other 30%. However, the sale price was set arbitrarily, with uncertainty about farmers' reaction to this sale experience and below the production cost of the planting material. The price was fixed in 1.5 Mozambican Meticais (Mtn) per kg (6 US$ cents/kg) which is slightly lower than the actual cost of multiplication at Umbeluzi, the main agricultural station near Maputo (1.6 Mtn/kg), but much lower than the REU project vine multiplication costs for Zambézia (1.7-9.7 Mtn/kg) under different settings (CIP 2008).

Under these facts, the feasibility of the appearance of private and sustainable vine multipliers remains dubious. In a country such as Mozambique with high transportation costs, reduced formal sector, unknown sweetpotato vine demand and unstable agro-ecological conditions, building a sustainable seed system with high quality seed becomes very challenging. However, recent research findings have revealed that small private farmers are able to produce OFSP vines at a reduced production cost. Farmers using conventional multiplication techniques and irrigating their multiplication plots with watering cans were able to produce OFSP vines at 0.50 Mtn/kg. Now it is important also to determine whether the selling price of OFSP vines would be higher than the subsidized price used so far in the distribution of OFSP planting material.

III Experimental procedure: a real choice experiment (RCE)

The valuation of public goods has received large attention in the economic literature. Given the lack of reveled preferences and developed markets for these goods, valuation methods have used a number of elicitation methods that try to estimate the true respondent's willingness to pay for the public good. Most of these methods have been based on stated preferences and have used hypothetical scenarios where respondents receive hypothetical information about the public good and the benefits associated with buying the public good (Mitchel & Carson 1989, Green & Srinivasan 1990).

Unfortunately most of these methods have failed to incorporate the incentive compatibility (IC) (Becker et al 1964) that makes the respondents to provide their true WTP for a good being valued under hypothetical scenarios (Hoffman et al 1993). Many studies have demonstrated that elicitation of WTP under hypothetical scenarios and based on stated preferences tend to overestimate the real WTP and usually provides higher WTP than methods based on market based approaches (Wertenbroch & Skiera 2002)

Recently, the elicitation of WTP of public goods have used market research techniques that try to create incentives to the respondents to reveal their WTP by providing them real market conditions, making them to face budget constraints and to finally buy a product at the price expressed during the WTP elicitation (Alfnes et al 2006, Lusk & Schroeder 2004, Johansson-Stenman & Svedsates 2003). Based on the seminal work of Lancaster (1966), these methods try to value non-monetary attributes of public goods from respondents' selection of different bundles of these attributes rather than the public goods

themselves. Thus, individual preferences determine the relative weights given to various attributes when a choice is made (Baidu-Forsen 1997). The choice of preferred alternative bundles is made following an experimental market prices design (non-hypothetical choices) and facing posted prices. To induce real economic incentives, respondents have to commit to drawn a unique binding scenario that she/he will have to buy at the end of the experiment participation (Lusk & Schroeder, Alfnes et al 2006).

Although elicitation of farmers WTP for seeds have been studied, most of these studies have used methods based on stated preferences and hypothetical experiments (Horna et al 2005, Dalton 2004, De Groote & Kinenju 2008) very few studies have used market based experiments to elicit the WTP for crop seeds (Wikstrom 2003). We adapted the methodology develop by Alfnes (2006) for eliciting consumers WTP for different color salmon fillets in Norway and built a similar real choice experiment (RCE) for eliciting farmers WTP for different varieties of OFSP planting material. We built this experiment considering the peculiar rural Mozambique setting.

Our experiment consisted in ten different choice scenarios where each participant farmer chose between vines of two different sweetpotato varieties that displayed their correspondent selling prices. The main difference with the Alfnes et al work is that while they only varied the color of salmon fillet in addition to the randomly assigned prices in each choice scenario, for the valuation of different OFSP varieties we allowed in each choice scenario the variation of more than one vine attribute including variety yields, drought resistance, other pest resistance, taste and level of vitamin A. However the

bundle of vine characteristics was kept associated with specific sweetpotato varieties used. We included in this experiment the four most preferred OFSP variety (Resisto, MGCL01, Jonathan and Lo323) and always the most used local variety (traditionally white and mainly Admark, Comparule, Forty one, Canasumana and Muanagamela)

In addition to the two sweetpotato options for buying, the respondent was always able to choose the "none of these" option if they did not liked any of the two varieties displayed or if they found the price assigned to each variety unaffordable. However it was always reminded that at the end of the experiment participation a binding scenario was going to be chosen randomly and the farmer would have to buy the selected variety at the assigned price or keep the money if having selected the "none of these" option. When this last was the case we offer the participant to pick another binding scenario if she/he wanted to proceed with the vine purchase.

Following previous studies we used a fractional factorial design for varying the 10 different scenarios faced by each respondent. Each scenario displayed two unique sweetpotato varieties and the assigned prices. To increase the price variability of the experiment, we actually designed an experiment with 20 scenarios divided in two groups. Each group had exactly the same paired sweetpotato variety scenarios but we designed two set of prices, each of which was applied to half of the respondent sample. Prices varied between 1 Mtn per kg to 3 Mtn per Kg of vines and included the selling price of OFSP vines used by the REU project to sell the OFSP vines in the first year of implementation (1.5 Mtn) and experiences of other NGOs buying OFSP vines from the

REU project to later distribute them among targeted farmers for free. Table 1 describes the 10 scenarios faced by respondents and shows one set of prices.

Table 1. Scenarios of The Real Choice Experiment Used in Mozambique

	Variety 1	Variety 2	None of the two
Scenario 1	MGCL 3.0 Mtn	LO323 1.5 Mtn	None
Scenario 2	Local 1.5 Mtn	LO323 2.0 Mtn	None
Scenario 3	Resisto 2.5 Mtn	Jonathan 2.0 Mtn	None
Scenario 4	Resisto 1.0 Mtn	MGCL 2.5 Mtn	None
Scenario 5	Jonathan 1.5 Mtn	MGCL 1.0 Mtn	None
Scenario 6	Local 1.0 Mtn	Jonathan 3.0 Mtn	None
Scenario 7	Jonathan 3.0 Mtn	LO323 2.5 Mtn	None
Scenario 8	Local 1.5 Mtn	Resisto 2.0 Mtn	None
Scenario 9	Resisto 3.0 Mtn	LO323 3.0 Mtn	None
Scenario 10	Local 2.0 Mtn	MGCL 1.0 Mtn	None

For selecting the sample of respondents, the study restricted the population to communities with previous experience with OFSP in order to capture the WTP for planting material they really are familiar with. In addition, households in the universe of selected communities had not received vines for the last two years. We randomly selected 6 villages among organizations that participated in TSNI and Eat Orange projects. The interviews took place in the communities of Suluwe, Suliua, Lialia, Liberdade, Sitao and Nicurrucuma, all of them located in the Zambezia province during

the last week of January 2008. As indicated previously, we invited 20 households to participate in the study from each selected community. One of the six communities had 21 participants; hence the final sample size was 121 households, encompassing a total of 1210 observations or choice scenarios.

The process started with an overall explanation of the objectives of the study to the six communities that were selected. We carefully explained what the experiment entailed at community level meetings, and then to each individual candidate, emphasizing that participation on the study was completely voluntary and that each participant would receive 6 MTn[1] (0.25 US$) for their participation and that they could use this money for buying OFSP vines or remain with the cash to purchase anything else. Then we asked for the participation of twenty volunteers in the six communities visited.

To conduct the study, we organized around 50 kg of each of four popular OFSP varieties (Resisto, Jonathan, MGCL01 and LO323) and the local variety dominant in the community and split the material into small packages of 1 kg of each variety. Each enumerator had the five packages of sweetpotato vines and the set of prices for each scenario that were previously determined. In each of the ten scenarios it was possible to pair each of the five varieties with the other 4 remaining varieties. Thus, in each scenario, the respondent farmer had to express which, if any, of the two varieties they would buy at the displayed prices. Prior to starting the experiment, we explained that at the end of the experiment the respondent would randomly draw one of the ten scenarios and they would

[1] In the Milange district farmers received the equivalent in Malawian Kwacha (30 MWK) as this is the most used currency in this part of Mozambique. All the experiment for this group was conducted in this currency.

have to buy the variety s/he chose in that scenario at the price s/he indicated (binding scenario). This was an incentive to really express whether the respondent would buy the OFSP variety at the displayed price or chose to keep the cash. The respondent was then free to buy any quantity of the binding scenario that per se asked for their WTP to buy one Kg of planting material (the minimum bought was 1 Kg).

The choice experiment was accompanied by a survey questionnaire and part of this questionnaire was applied before the experiment and another part right after the choice experiment. Before the choice experiment we registered the characteristics of the farmers' household, some information about crop production and sales and the name of the most common local sweetpotato. Although most of the respondents had previous experience with OFSP, we provided them a summary of the main characteristics of each of the varieties included in the experiment related to yields, drought resistance, disease resistance, taste, level of vitamin A and maturation period. This information was provided right before the real choice experiment.

Each choice experiment administered by an enumerator for each individual was carefully supervised during implementation so that any doubts were resolved promptly. Each participant received her/his 6 Mtn before starting the choice experiment and paid for the OFSP vine selected as soon as the binding scenario was determined. The respondent received the vines bought at the end of the interview. All of the participants indicated their intention plant the material purchased given that the trial was conducted during the beginning of the rainy season.

IV. A mixed logit model

Mixed logit models consider one random component, keeping the basic model as a logit, but allowing to represent correlation and/or heteroskedasticity (Munizaga & Alvarez-Doziano 2003). The most interesting property of the model is that under certain regularity conditions, any random utility model has choice probabilities that can be approximated as close as wished by a mixed logit (McFadden & Train 1997). This model allows correlation and heteroskedasticity between alternatives and is capable to release the assumption of independence of irrelevant alternatives, making the substitution patterns between alternatives flexible (Revelt & Train 1998)

We used a mixed logit model in order to estimate farmers' marginal willingness to pay for OFSP vines and to evaluate the determinants of these farmers' WTP for vines. We can assume a sample of N respondents with the choice of J alternatives on T choice occasions. The utility that individual n derives from choosing alternative j on the choice occasion t is given by:

$$U_{njt} = \beta_n X_{ntj} + \xi_{njt}$$

Where β_n is a vector of individual specific coefficients, X_{ntj} is a vector of observed attributes related to individual n and alternative j on choice occasion t and ξ_{njt} is a random term that is assumed to be distributed IID extreme value.

Conditional on knowing β_n the probability of the respondent n choosing alternative i on choice occasion t is given by:

$L_{nit}(\beta_n) = \exp(\beta'_n X_{nit}) / \sum \exp(\beta'_n X_{njt})$

which is the conditional logit formula (McFadden 1974). The unconditional probability of the observed sequence of choices is the conditional probability integrated over the distribution of β:

$P_n(0) = Sn(\beta)f(\beta /0)d \beta$

The unconditional probability is thus a weighted average of a product of logit formulas evaluated at different values of β, with the weights given by the density f. The integral cannot be solved analytically and is approximated through simulation (Brownstone & Train 1999).

For the RCE of the OFSP vines, each participant was asked to make choices over 10 different scenarios that had assigned randomly different prices. The choice data of the 1210 scenarios was analyzed with the following mixed logit

$U_{nis} = \beta_{resisto} + \beta_{Jonathan} + \beta_{Mgcl01} + \beta_{Lo323} + \beta_{nonthese} + \beta_{Pr}\text{Price}_{nis} + \beta_{exp}\text{Expselect}_{nis} + \xi_{nis}$

Where the first four β are the alternative specific constants for each alternative sweetpotato variety and $\beta_{nonethse}$ is the specific constant for the "none of these" responses.

Price $_{nis}$ is the price in Mozambican meticais Mtn of one kg of vines of sweetpotato variety *i* and β_{exp}Expselect $_{nis}$ is a dummy variable taking the value of zero if the respondent has not had prior experience with the variety chosen in each scenario. This variable target to control biases in the responses associated with lack of knowledge of the OFSP variety being evaluated. Finally, ξ_{nis} is an error term that is independent and identically distributed and represents the stochastic influences not observed by the analyst. For identification purposes, the alternative specific parameter for the local variety is normalized to zero.

The mean WTP per kilogram of sweetpotato variety *i* can be calculated by dividing the utility difference between 1 kg of variety *i* and the "none of these" alternative, with the negative of the price sensitivity parameter.

$$WTPis = (\beta_{var\_} - \beta_{nonthese}) / \beta_{pr}$$

where WTP_{is} is the estimated mean WTP per kilogram of sweetpotato variety *i* in scenario *s*; and all other variables and parameters are as described in the previous equation.

V. Results and Discussion

All of the 121 participants had had experience in the past with at least one of the varieties used in the experiment. Moreover, although most did not have experience with *all* of the varieties, a significant proportion of farmers had observed some of the other OFSP

among their neighbors. The most know variety among farmers was Resisto (84% of the respondents) and the least known Lo323 (68% of the respondents).

Among those who had experience with OFSP varieties, we asked for farmer variety attributes preferences and the rank across sweetpotato varieties for each attribute. As summarized by table 2, different varieties are recognized differently for their attributes.

Table 2. Farmers' evaluation of attributes of OFSP varieties (N=121)

	Resisto	Jonathan	MGCL01	LO323	Local
Which variety is best for:					
Yield	60%	31%	50%	33%	59%
Drought resistance	15%	23%	46%	21%	66%
Better taste	68%	56%	58%	52%	17%
Which variety would you never plant	17%	38%	17%	24%	39%

Farmers reported as the most used local varieties Admarc (14.9%), Comparule (16.5%), Forty one (14.9%), Canasumana (16.1%) and Muanagamela (33.9%). Resisto was recognized as the highest yielding variety that can compete with the local variety in terms of yield performance. A large majority also reported that the local variety is the most resistant to drought -- a much desired characteristic in drought-prone areas like the Zambézia province. MGCL01 is the OFSP variety that received the highest recognition as drought resistance, which is in accordance with findings from the formal research

program. Between 56% and 78% of the farmers with experience cultivating Resisto, Jonathan and LO323 stated that it was difficult to conserve the vines of these varieties while only 27% of the MGCL growers and only 7% of the local sweetpotato growers expressed difficulties in keeping the vines of these varieties. The attribute where all OFSP varieties are superior to the local variety is taste and was largely recognized by farmers participating in the study. Finally, Jonathan, together with the local variety, are varieties that farmers would choose not to plant if they have access to vines of other sweetpotato varieties for planting. The main reason cited for not desiring to plant Jonathan was low yields (21%) and for the local variety the main reason was its lack of vitamin A (30%).

Respondents had some experiences in buying sweetpotato vines prior to this study (44% of the respondents), but most the farmers with purchase experience (89%) bought it from OFSP dissemination programs and at fixed and subsidized price. On the other side only 12% of the respondents recognized having sold sweetpotato vines (mainly OFSP). In this context, the RCE results are quite revealing. Table 3 summarizes the quantity of vines bought per respondent and the quantity of money invested in buying the vines.

Seven farmers (6%) selected none of the two alternatives in the 10 scenarios of the experiment and did not purchase any OFSP vines. Although farmers were required to buy at least one kg of the variety selected in the binding scenario, only 31 farmers bought the minimum quantity and about 68% of the participants bought between 2 and 6 kg of

Table 3. Quantity of Vines Bought and Money Invested by Respondent Farmers (N=121)

Quantity of vines purchased (Kg)	Number of farmers	Quantity of money invested (Mtn)	Number of farmers
0	7	0	7
1	31	1	5
2	53	1.5 - 3	50
3	18	4 - 5	33
4	8	6	21
5	2	>6	5
6	2		

vines. On average, farmers invested 2.1 Mtn[2] per kg of OFSP bought but there was a group of 5 farmers that invested more money than the amount received for their participation in the experiment. Seventeen percent of participants decided to invest the total 6 Mtn and 49% invested at least half of the money they received for their participation. These results are encouraging given that the trend was to buy and invest more than the minimum required. In addition, many farmers expressed their willingness to buy more OFSP vines but at the time of the experiment they did not have money available. Zambézia is a very resource poor province, known for the limited purchasing power of its residents.

In terms of responses to the choice experiment, 295 out of the total 1210 scenarios received a neither of the two alternatives response (24%). MGCL01 and Resisto were the

[2] The exchange rate for 2008 is 1 US$=24.8 Mtn

two most preferred varieties in the willingness-to-pay scenarios and were selected for purchase 56% and 55% of the times they were paired with other sweetpotato varieties. The local variety was selected only in the 8% of the scenarios. The perception is that this local variety was broadly available in each community and this may have influenced famers WTP for this variety.

In terms of the price influence for the decision made in each scenario, about 31% of the respondents selected a variety that was more expensive than the alternative variety in the same scenario and in these cases the price difference was about 0.75 MTn. In contrast, in 28% of the scenarios respondents selected the cheaper alternative but in these cases the average difference between the selected variety and the alternative was higher: 1.21 Mtn. This suggests that although prices are important to make a decision in buying sweetpotato vines, there must be other factors that influence this decision and many farmers are willing to pay more for varieties with characteristics they prefer. The average price difference provides an idea of the sensitivity of the purchase decision related to the price. Consistent with economic theory, the higher the difference between alternative prices, the more likely the farmer is to purchase the cheaper product.

For the econometric analysis, we exclude the 6 cases were respondents answered the none of these alternative to the 10 scenarios proposed. The socioeconomic characteristics and other descriptive statistics of the sample used for this study are summarized above in table 4.

Table 4. Descriptive Statistics of Variables Used in the Econometric Analysis

Variable	Mean	Standard deviation
Respondent was female	0.29	0.15
Respondent age	37.1	15.3
Years of education	3.5	6.2
Has lowlands (dummy)	0.95	0.22
Number of plots	3.1	1.2
Hire workers	0.33	0.28
Have irrigation	0.12	0.32

The mixed logit results are summarized in Table 5. Given that we designed the experiment in order to not having correlation between the characteristics of sweetpotato varieties and the prices in the scenarios and between the two prices in each scenario the choice probability for an alternative increased as the price decreased. In terms of choosing the vines of OFSP varieties, buying OFSP any of the OFSP vines increased the utility of this purchase decision in comparison with the decision to buy the local varieties. This means that the average sweetpotato grower prefers to plant OFSP varieties However, the marginal utility provided by each OFSP variety differs according to the variety chosen. Buying MGCL01 first and Resisto second produces the highest utility for the farmers buying sweetpotato vines, followed by Lo323 and finally Jonathan that provides less than have of the marginal utility provided by MGCL01. Finally, the fact that farmers have had prior experience with the chosen variety in each scenario has a strong and significant effect over the choice probability. This is consistent with the objectives of the

experiment where we expected higher WTP among farmers with direct experience of OFSP vines.

Table 5. Estimated parameters of the mixed logit model

Variables	Parameters	Standard errors	p-value
Generic variables			
Price	-0.8400	0.0584	0.0000
Expecselect	6.6112	1.0057	0.0000
Alternative specific constants			
Resisto	1.3059	0.1660	0.0000
Jonathan	0.7315	0.1743	0.0000
Mgcl01	1.7608	0.1492	0.0000
Lo323	1.1560	0.1605	0.0000
Nonthese	-0.6890	0.1424	0.0000
Summary statistics			
Number of observations	1210		
Number of participants	121		
Log likelihood	-1099.82		

- Estimated with STATA 9.2 (Hole 2007)

From the econometric results it is straight forward to calculate farmers' willingness to pay for sweetpotato vines and table 6 presents the WTP per kilogram of each of the 4 OFSP vines alternatives.

Table 9. Willingness to pay per kilogram of vines of sweetpotato varieties

OFSP variety	WTP (Mtn*)	Standard error
Local variety	0.62	0.15
Resisto	2.37	0.32
Jonathan	1.69	0.23
MGCL01	2.92	0.35
Lo323	2.20	0.31

*1 US$ = 24.8 Mtn

As expected, the higher the utility provided by buying specific sweetpotato varieties, the higher the WTP for this planting material. Thus all WTP for OFSP planting material are significantly higher than the planting material for the local variety (Wald test, p-value 0.0000). Among the OFSP varieties the WTP for MGCL01 and the WTP for Jonathan are significantly the highest (Wald test, p-value 0.0000) and the lowest (Wald test, p-value 0.0000) respectively. We found no significant differences between the WTP for Resisto and Lo323 (Wald test, p-value 0.1567). These results are suggesting that farmers in Mozambique are willing to pay more for a variety like MGCL01 with the best drought

resistance among the OFSP varieties and the lowest for the variety with the lowest yields and the less preferred taste. The other two high yielding varieties and with good taste, Resisto and Lo323 are well preferred among sweetpotato growers that would buy their planting material at prices between 2.20 Mtn and 2.37 Mtn.

The elicited WTP for OFSP planting material was always higher than the prior subsidized price of 1.5 Mtn that was used by prior projects distributing OFSP vines. Even the planting material for the variety Jonathan would be bought at a higher price than this subsidized price (1.67 Mtn). On the other hand and as expected, the vines for the local variety received had a low WTP (0.62) that is lower that any selling price of sweetpotato vines used before. However it is important to highlight that planting material of these local varieties is well spread among sweetpotato growers and few of them would require buying new planting material. Given the large supply of vines of these varieties in local communities it is consistent to expect such a low price.

Conclusions

In areas where farmers face significant dry seasons and limited access to valley bottoms with residual water supply during the dry season, the availability of adequate quantities of vines at the beginning of the rains is a major constraint. In our sample only 37% of the farmers had retained their OFSP vines from previous season for the 2008 planting season This experiment was conducted in six villages where the 121 participant households had received OFSP vines over two years ago. Thus, understanding whether farmers are willing to pay for vines and their varietal preferences is critical for evaluating whether it

will be possible to encourage the appearance of private vine producers with a commercial orientation. The latter is envisioned as a more sustainable strategy than continued reliance on free or heavily subsidized public sector and NGO distribution systems.

The real choice experiment with 4 OFSP varieties currently being promoted in Zambézia and the dominant local variety revealed that willingness to pay is higher for any OFSP variety than for local varieties; the latter are considered to be readily available. The variety clearly preferred by farmers is MGCL01 (Persistente), for its yield, taste, and most importantly, it being the most drought resistant of the OFSP varieties. Farmers are willing to pay up to 2.92 Mtn for this OFSP variety. Resisto and Lo323 are also well preferred OFSP varieties and farmers are willing to pay higher prices for the planting material of these two varieties (2.37 and 2.20 Mtn per kg respectively) which are high yielding and have good taste. All OFSP varieties were considered to be superior to the local variety in terms of taste.

On average, farmers invested 2.1 Mtn per kg of OFSP bought but there was a group of 5 farmers that invested more money than the 6 Mtn received for their participation in the experiment. Seventeen percent of participants decided to invest the total 6 MTn in vine purchase and 49% invested at least half of the money they received. These results are encouraging given that the trend was to buy and invest more than the minimum required.

Consistent with economic theory, the higher the difference between alternative prices for varieties, the more likely the farmer is to purchase the cheaper product. Among the third

of respondents selecting more expensive varieties in a given scenario, the price difference was about 0.75 Mtn. In contrast, in 28% of the scenarios respondents selected the cheaper alternative, with the average difference between varieties being higher: 1.21 Mtn.

The implications of this study are very promising if it is also considered that the production of OFSP vines under small farmers conditions seems to be profitable. Using conventional multiplication methods and watering cans for irrigating the vines during dry periods, small farmers in Zambezia can produce OFSP vines as cheap as 0.50 Mtn per kilogram (CIP 2008). Comparing this cost with the WTP for OFSP planting material we can anticipate profit margins between 1.19 and 2.42 Mtn per kg of produced vines with clear advantages for producing MGCL01 planting material. Hence, the prospect for viable de-centralized private vine producers of OFSP are encouraging, especially for varieties under demand such as MGCL01 (Persistente), Resisto and Lo323. As long as the cost of production of these vines is within the range that Zambézian farmers are able to pay, the demand for OFSP vines will likely be driven by the demand for roots in accessible markets.

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