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### **Factors Affecting Consumers' Willingness to Pay for Good Quality Sweetpotato in Papua New Guinea<sup>1</sup>**

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#### **Abstract**

In this paper, the influence of socio-economic and product quality attributes on consumers' willingness to pay for good quality sweetpotato in Papua New Guinea was examined. The quality of sweetpotato was assessed by consumers based on its physical appearance, taste and maturity. Using a two-step double hurdle model, the determinants of the discrete choice on willingness to pay, and the amount of premiums consumers were willing to pay for better quality sweetpotato, were estimated. Of the 356 respondents surveyed, 88% were found to be willing to pay an average of 2.22 kinas per kg more for better quality sweetpotatoes, with a minimum of 0.96 kinas per kg and a maximum of 3.47 kinas per kg. The premiums that consumers were willing to pay were influenced by socio-economic factors such as education, the place of origin (Highlands regions), the number of years the household has been living in Port Moresby, as well as product quality attributes such as the physical appearance of the roots (freshness, cleanliness, shape and size), the maturity of the roots, and the sweetness. These results provide useful information on consumer preferences and quality requirements for sweetpotato that will enable farmers and researchers to produce the appropriate qualities that better meet market demand.

**Key words:** willingness-to-pay, sweetpotato, smallholder farmers, Papua New Guinea

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## 1. Introduction

Sweetpotato (*Ipomoea batatas*) is among the world's most valuable food crops, but it is often under-utilized (Andrade et al., 2009). More than 95% of the global production is in developing countries where it is mostly grown as a starch staple (FAO, 2008). In Papua New Guinea (PNG), it is the most significant staple, and accounts for about 43% of all food energy consumed (Bourke and Vlassak, 2004). It is cultivated nationwide with about 3 million tonnes produced annually, with the Highlands accounting for about 75% of total production. In the Highlands, household consumption accounts for nearly 68% of production and the remaining quantity is used as feed for pigs (Bourke and Vlassak, 2004). The average national consumption was estimated to be 260 kg/person/year, with annual per capita consumption being 299 kg in rural areas and 42 kg in urban areas (Gibson, 2001).

Over the past few years, sweetpotato has become an essential cash crop for smallholders in PNG. For instance, in 2005 only 2% of production was marketed (Spriggs, 2005). However, this proportion has increased to about 5-10% in recent years (Chang et al., 2013) because of increasing urbanization and the mining boom. This presents an opportunity for smallholders to improve their livelihood by increasing market participation. In the light of increasing market participation, understanding consumer preferences and willingness to pay (WTP) for quality sweetpotato is essential.

In this study, a two-step estimation approach was employed to examine both whether WTP is present at all (the 'discrete decision'), indicating that consumers are sensitive to quality variation in sweetpotato and, for those who are, the extent of WTP. Determining factors were examined for both steps. This approach allowed us to avoid conflating determinants of WTP among consumers who have a positive WTP and those who are indifferent to quality differences (ie. have a zero total WTP). It also allowed information to be obtained about consumer preferences which are useful for farmers, policymakers and researchers in their efforts to produce the right products to meet market demand. In particular, this study will provide relevant information to producers with regard to quality requirements, thus enabling them to choose appropriate varieties, and to plan and implement post-harvest and marketing activities accordingly.

The next section presents a review of literature on the WTP for improved agricultural products. This is followed by a review of empirical studies on estimating the determinants of WTP in section 3. Section 4, presents the methodology, including a description of the data and the analytical framework used for analyses. Section 5 presents the empirical results. Discussions of the results are presented in section 6, followed by the conclusions in section 7.

## 2. Review of literature on WTP for agricultural products

Willingness to pay is the maximum amount a person is willing to pay for a good or commodity (Kalish and Nelson, 1991) while, willingness to accept refers to the maximum amount an individual is willing to receive in order to give up a good (Dimitri and Greene, 2002). WTP has also been explained as the economic value of a good to a person or a household under given conditions (Gunatilake et al., 2007). This concept has been used to examine the economic viability of product attributes and projects, set affordable tariffs, evaluate policy alternatives, and assess financial sustainability, as well as design socially equitable subsidies (Brookshire and Whittington, 1993).

The decision on whether or not to pay a premium, and by how much, can be considered either as a joint decision or addressed separately in two sequential processes. Most of the studies reviewed<sup>2</sup> employed either linear models such the Ordinary Least Squares

<sup>2</sup> See, inter alia, Adepoju & Oyewole (2013); Bhatta, Doppler, & Bahadur (2009); Boccaletti & Moro (2000); Bonti-Ankomah & Yiridoe (2006); Chowdhury, Meenakshi, Tomlins, & Owori (2011); Gil, Gracia, & Sanchez (2000); Makatouni (2002); Omot, Spriggs, & Chang (2010); Oviahon, Yusuf, Akinlade, & Balogun (2011); Peterson, Hustvedt, & Chen (2008); and Watson & Ryan (2007).

(OLS) or the dichotomous choice models such as the probit, logit and Tobit models, and their extensions in ordered (e.g. Boccaletti & Moro, 2000), multinomial or conditional form (Sampson, 2014). The choice of the appropriate model to estimate determinants of WTP depends upon the nature of the dependent variable. For example, if the dependent variable is binary, in which case the decision on WTP is being considered as a discrete choice (yes or no), the use of a dichotomous choice model is appropriate. Alternatively, an OLS regression-based model can be used if the dependent variable is the actual amount that is willing to be paid.

Several approaches have been employed to estimate WTP, depending on whether a hypothetical or an actual WTP is being measured and also whether it is measured directly or indirectly. In terms of direct methods, also known as stated preference, the most popular approaches used in empirical studies include choice experiments (conjoint analysis and choice modelling) and contingent valuation methods (CVM) (Asafu-Adjaye, 2000; Voelckner, 2006). The most common indirect methods, also referred to as revealed preference methods, comprise the hedonic pricing, travel cost model, dose response approaches and averting expenditure/avoided cost approaches (Asafu-Adjaye, 2000; Hanky, Shogren, & White, 1997).

The most popular stated preference methods that are applied in WTP studies are conjoint analysis (see for example, Krystallis, et al, 2006; Merino-Castello, 2003) and choice experiments (Carlsson et al., 2007; Chowdhury et al., 2011). A conjoint analysis allows the quantification and prediction of the individual's overall judgment of a product based on its most significant attributes (Monteiro and Lucas, 2001). However, conjoint analysis does not provide the respondent with an opportunity to say 'no' to the good and, thus, is considered to produce unconditional and relative measures of WTP (Asafu-Adjaye, 2000). On the other hand, choice modelling can be used to provide conditional and absolute measures of WTP by providing values of multiple alternatives for respondents to choose among (Asafu-Adjaye, 2000; Bennet and Blamey, 2001). However, besides its requirement of a complex survey design, choice modelling also presents contrasting views in terms of what is perceived as key attributes by the respondents and policy makers when describing the choice alternatives (Bennet and Blamey, 2001). In this study, given that consumers' WTPs were elicited without showing the respondents the physical sweetpotato roots, CVM becomes more appropriate for capturing consumers' WTPs for good quality sweetpotato in this study. This method has also been applied in many empirical studies for eliciting preferences (Adepoju & Oyewole, 2013; Aguilar & Kohlmann, 2006; Boccaletti & Moro, 2000; Watson & Ryan, 2007). Evidence from Cameron et al. (2002), Choe et al. (1996) and Vossler and Kerkvliet (2003) suggests that predictions from "hypothetical" CVM scenarios are consistent with actual behaviour. Similar assertions are also made by Adamowicz (2004) and Whitehead and Blomquist (2006).

### **3. Empirical studies on estimating the determinants of WTP**

Previous studies underline the increasing interest attached by consumers to criteria in the choice and the premiums they are willing to pay for products. In most of these studies a number of factors have been found to influence WTP among consumers in both rural and urban settings. These factors range from demographic characteristics of consumers, socio-economic aspects and health-knowledge related factors about the products. A number of studies of WTP for food products are influenced by demographic characteristics such as gender, educational attainment and age of consumers. Adepoju & Oyewole (2013), Chowdhury et al. (2011) and McGoldrick & Freestone (2008) found a positive relationship between gender and WTP for products. Other studies also found education to increase consumers' WTP for food products (see Basarir, Sayili, & Muhammad, 2009; Boccaletti & Moro, 2000; Krystallis et al., 2006; Oviahon et al., 2011).

Bhatta et al. (2009) found the information available to consumers an important determinant of WTP for organic products in Nepal. Munene (2006) used the ordered probit and CVM to evaluate consumer attitudes and WTP for functional foods. He found

that WTP for functional food products is influenced by beliefs about nutrition and health, concerns about different chronic diseases, current purchasing and consumption patterns and attitudes towards functional foods. Similarly, Gil et al. (2000) found health concerns to influence WTP for organic products in Spain. In a related development, Adepoju and Oyewole (2013) analysed households' perceptions and WTP for bread with cassava flour inclusion and found WTP to be influenced by household income, age and the share of bread in total household food expenditure. Mabiso et al. (2005) estimated consumers' WTP for country of origin labels in fresh apples and tomatoes using a double-hurdle probit model and found positive relationships between WTP and the origin of production, respondents' age and the income of the household. Oviahon et al. (2011) studied the determinants of consumers' willingness to pay for safety labels on bread, and found the educational level, the price of the product, marital status, attributes of the bread and sources of information as significant factors influencing consumers' WTP.

In terms of quality attributes, Chowdhury et al. (2011) analysed consumer WTP for micronutrient-dense biofortified foods in Uganda and found taste as a pivotal factor in determining WTP. In addition, quality attributes have been known to drive WTP decisions at large (Chang et al., 2013; Martínez, Anders, & Wismer, 2011; Peterson et al., 2008; Straub & Thomassin, 2006). Household characteristics that influence consumers' WTP the most are: the age of the consumer, the gender of the consumer, education, income, religion and household size (Bhatta et al., 2009; Boccaletti & Moro, 2000; Oviahon et al., 2011; Rodríguez, Lacaze, & Lupín, 2008). In this paper, it was hypothesized that older farmers are more likely to pay higher prices for good quality sweetpotato because, as they age, they become more health conscious. Consequently, they are more likely to be interested in buying nutritionally sound food products.

## 4. Methodology

### 4.1. Study area and instrument

This study was based on a consumer survey conducted in PNG in April 2013 as a component of a project funded by the Australian Centre for International Agricultural Research (ACIAR) and conducted in collaboration with the National Agricultural Research Institute (NARI) and Fresh Produce Development Agency (FPDA). The survey was conducted across selected districts in Port Moresby. The distribution of the respondents across these locations is presented in Table 1.

**Table 1: Distribution of respondents by location**

Location	Code	No. of respondents	%
Gabutu	CS 1	25	7
Erima	CS 2	55	15
Gordon Ridge / 5 Mile	CS 3	44	12
Morata 2	CS 4	58	16
Segani/Ranugari/4mile	CS 5	84	24
Bomana	CS 6	43	12
Others*	CS 7	47	13
<b>Total</b>		<b>356</b>	<b>100</b>

\*Others include Boroko, Taurama and Port Moresby Central

Sampling of respondents was undertaken in two stages. First, key districts were identified upon consultation with market experts from the FPDA Office. Second, consumers were selected from each district on a voluntary basis. The survey sites were selected after taking into account the ethnic and economic background of consumers, proximity to open markets within the locality, timing of the survey, safety issues and

availability of respondents<sup>3</sup>. The selected districts represent different ethnic backgrounds and economic conditions. In total, 356 respondents were interviewed from 9 locations, grouped into 7 categories in Table 1, consisting of the following:

- Gabutu: This area consists mostly of settlers from the various Highlands provinces. They are of lower social class and earn a living through the informal market sector;
- Erima: This area consists of a mixture of people from all over PNG. However, it is dominated by the Highlanders, which account for more than 80% of the area population. Most are of low class and only a few are middle class people;
- Gordon Ridge/5mile: Residents in this area are a mixture from all over PNG, consisting of mostly middle class people with few being low class;
- Morata 2: This area is dominated by the Highlanders with mixed classes. However, middle class and transport business personal are the majority;
- Segani/Ranuguri/4mile: These are a low class group and are dominated by the Highlands people. However, some respondents from the Segani/Ranuguri area have come from the Gulf and other coastal provinces;
- Bomana: low to middle class and mostly families of police personnel. They are also a mixed group from all over PNG; and
- Boroko/Taurama/Port Moresby Central: low to middle class and business personnel from all over PNG.

The survey instrument used in this study was developed based on the initial results of reconnaissance and a market survey conducted by the project team. The survey form was pre-tested and the enumerators were trained. The trial interview was conducted with selected housewives from Taurama District. The form is divided into four sections. Section A focused on the consumption patterns and preferences for sweetpotato and other staple food crops. This section also includes information regarding the preparation of sweetpotato and the awareness of consumers about sweetpotato by-products. Section B dealt with the important attributes of sweetpotato and consumer preferences for these attributes. Information regarding preferred quality attributes, varietal preferences, quality preferences and buying preferences are also covered in this section. An index card showing coloured pictures of the most common varieties of sweetpotato were shown to the respondents for ease of identification of the varieties consumed and their respective characteristics. Section C considered all information regarding sweetpotato marketing – the place where they normally purchase the product, perceptions about market conditions and pricing information. The form concluded with demographic information pertinent to the respondents and households in Section D.

Overall, there were more female respondents (77%) than male in the sample (Table 2). The mean age of the sample is 35 years, with 61% above 31 years old. Most respondents have attended school, and had primary education, secondary education or a higher level of formal education. More than 50% reached Grade 9 or higher. Thirty-five percent of the respondents have regular employment as the main source of household income, while 24% are dependent on self-employment. Finally, 52% of respondents have reported household income of less than K400 per week. Respondents were asked how long they have been residing in Port Moresby. Thirty percent of households are relatively new to the city (less than five years). The majority of these households are settlers from Chimbu (21%), Southern Highlands (18%), Eastern Highlands (10%) and Jiwaka province (9%).

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<sup>3</sup> Due to security and logistical issues in the open market, the actual interview was conducted in community centres in the sampled districts.

**Table 2: Basic characteristics of respondents**

Variable	Category	% of respondents
Gender of respondent	Male	23
	Female	77
Age of respondent	Less than or = 20	10
	21-30	29
	31-40	33
	41-50	18
	More than 50	10
Highest level of education	Nil	16
	Grade 1 to 4	8
	Grade 5 to 8	20
	Grade 9 to 12	40
	Vocational/College/University	11
Main source of family's income	Regular employment	35
	Casual employment	19
	Self-employed	24
	Others	1
	No response	20
Average household income (k/wk)	0 to 100	7
	101 to 200	10
	201 to 300	13
	301 to 400	22
	> 400	48
Residency status at POM	Less than a year	3
	1 to 5 years	27
	6 to 10 years	16
	11 to 20 year	22
	21 to 30 years	20
	More than 30 years	11
Home province of head of household	Simbu (Chimbu)	21
	Southern Highlands	18
	Eastern Highlands	10
	Jiwaka	9
	Other provinces	42

#### 4.2. Empirical application

The estimation of consumers' WTP decision process assumes that consumers will make choices based on the alternatives that will provide them the highest utility. The decision process can be divided into two stages; first the discrete decision and second the consumption decision. In the context of WTP for sweetpotato, the participation decision is the choice consumers are making as to whether they are willing to pay a premium for sweetpotato or not, whilst the consumption decision denotes the actual premium if consumers' are willing to pay for the product. It is further assumed that the individual consumer obtains utility from specific product attributes of sweetpotato. This utility is thus a function of consumer characteristics that influence consumer choice, as well as the premium that the consumer is willing to pay in order to obtain a given attribute.

Since the decision process on WTP for sweetpotato is a two-step process, the WTP discrete choice model is first specified as:

$$WTP_i^* = \alpha_0 + \sum_i^j \alpha_i X_i + u_i \quad (1)$$

and, second, the quantitative consumption part of the framework is represented as;

$$PMP_i^* = \beta_0 + \sum_i^j \beta_i Y_i + \varepsilon_i \quad (2)$$

where  $WTP_i^*$  in (1) denotes the consumer willingness to pay and it assumes 0 if not and 1 if willing to pay a premium for good quality sweetpotato. This dependent variable represents the underlying utility associated with the participation decision; basically as to whether or not the consumer derives utility from the attribute. While  $PMP_i^*$  in (2), is the actual premium consumers are willing to pay for good quality sweetpotato, if  $WTP_i^*$  provided in (1) was equal to 1. This represents the magnitude of the latent utility associated with the quality attributes of the sweetpotato.

The  $X_i$  and  $Y_i$  are vectors of explanatory variables while  $\alpha_i$  and  $\beta_i$  are parameters to be estimated for the respective predictor vectors. If the  $X_i$  and  $Y_i$  are equal and the  $\alpha_i$  and  $\beta_i$  are equal, then we can estimate the model with the Tobit model instead of the two step model. The error terms  $u_i$  and  $\varepsilon_i$  are thus normally and independently distributed with zero mean and variances  $\sigma^2$  and 1 respectively. The probit model is thus estimated using the maximum likelihood function while the second step equation is estimated using the cumulative density function. To justify the use of the two-step model, a joint decision test was conducted using the likelihood ratio test. This test involved the estimation of the WTP with the probit model, the truncated model, and the Tobit model (Mal et al., 2012). The log likelihood ratios of the models were then used to compute the test statistic,  $\lambda$ , as follows:

$$\lambda = -2(LL_{\text{Probit}} + LL_{\text{Truncated}} - LL_{\text{Tobit}}) \quad (3)$$

where  $LL_{\text{Probit}}$ ,  $LL_{\text{Truncated}}$  and  $LL_{\text{Tobit}}$  denote the log likelihood ratios of the probit, Truncated, and Tobit regression models, respectively, for the WTP. The estimated  $\lambda$  should be greater than the critical value to justify the use of the two-step model (Mal et al., 2012). The truncated regression is proven to be a superior fit ( $\lambda = 49.04$ ); thus, the null hypothesis is rejected and a two-step model is preferred.

The list of explanatory variables defined in vectors X and Y are presented in Table 3. *Female* was used as a proxy for gender. Given that most household food purchases among urban consumers in PNG are made by females, they are likely to make more informed choices in terms of quality attributes and also have influence on the WTP. If this is true, then the variable female is likely to have a positive influence on WTP. The number of years of schooling was used to represent *education*. With the increasing awareness of the relevance of nutritional quality and health consciousness, educated consumers are more likely to be more willing to pay a premium for such attributes. The age variable was measured in years and is expected to have a negative effect on consumers' WTP. This is because, in view of the current change in lifestyle and interest in quality food products among the urban youth, younger consumers are more likely to be willing to pay a premium for quality than older ones. For instance, the existence of a real interest in keeping a balance between work and private life, living in a methodical and ordered way in order to reduce stress has been the interest of young urban consumers (Gil et al., 2000) and this is likely to enhance their WTP for quality food products. Given the importance of sweetpotato in the average household diets, the average size of the household is likely to have a negative influence on the WTP decision. This is because large *household size* already implies high expenses on sweetpotato, thus reducing the probability of paying additional premium for good quality.

The *number of household members* living on Port Moresby and the *number of years* they have lived there were all measured numerically. These variables are expected to have a negative influence on consumers' WTP because Port Moresby is an urban centre; hence, it is expected that consumers will be more interested in food quality and thus more likely to pay a premium in order to obtain a give quality attribute. All the quality attributes were measured as a dummy and are all expected to positively influence consumers WTP because they add value to the sweetpotato roots. The effect of product attributes on consumers' WTP is positive and extensive (Boccaletti and Moro, 2000; Chowdhury et al., 2011; Gil et al., 2000).

**Table 3: Description of explanatory variables used in the models**

Variable	Description	Expected sign
Female	Binary: female (1) male (0)	+/-
Age	Number of years of respondent	+/-
Education	Years of schooling	+
Highlander	Binary: 1 if respondent hails from the highlands, otherwise (0)	+
Household size	Number of household members (N)	+
Years in Port Moresby	Number of years in Port Moresby	+
Uniform shape and size	Binary: 1 if shape and size is a good quality attribute to respondent, otherwise 0	+
Physical appearance	Binary: 1 if the physical appearance of roots is a good quality attribute to respondent, otherwise 0	+
Maturity	Binary: 1 if maturity is a good quality attribute to respondent, otherwise 0	+
Sweet taste	Binary: 1 if the sweet taste is a good quality attribute to respondent, otherwise 0	+
Fresh and clean	Binary: 1 if fresh and clean is a good quality attribute to respondent, otherwise 0	+
High price	Binary: 1 if respondent perceive the price of SP to be high, otherwise 0	-
Market information	Binary: 1 if respondent have access to market information, otherwise 0	+
Income category 3 (401-500 kina)	Binary: 1 if respondent falls in income category 3, otherwise 0	+

Likewise, *high prices* and *access to market information* were also binary variables. However, while high prices of sweetpotato are likely to decrease WTP, access to market information is expected to increase consumers' WTP. Lack of access to information and higher prices have been found to impede consumers' WTP for food products (Bhatta et al., 2009). The *income variable* went into the model as a dummy; using all the other income categories as the base, an income dummy was created for the third income category (401-500 kinas). Higher incomes have been found to relate with higher willingness to pay. Higher incomes empower consumers by raising their purchasing power and thus increasing how much they are willing to pay for good quality products (Boccaletti and Moro, 2000; Loureiro and Umberger, 2002; Mabiso et al., 2005).

## 5. Results

### 5.1 Good quality sweetpotato attributes among consumers

In Table 4 the attributes that consumers prefer are listed. The table shows that physical appearance, sweet taste, uniform shape and size, fresh, clean and strong tuber (in order of importance) are the major attributes consumers expect to see in a good quality sweetpotato. Surprisingly, attributes such as maturity of the roots and nutritional value (each accounting for 7%), were of minimal interest to consumers. Given the above distribution, it is good to examine whether these attributes do have any influence on consumers' WTP and the premiums they are willing to pay for good quality sweetpotato. Subsequently, we include these attributes, consumer characteristics and information-related factors and examine their effect on consumers' WTP.

**Table 4: Distribution of good quality sweetpotato attributes among consumers**

Good quality attribute	No. of responses	% of responses
Uniform shape and size	118	33
Fresh and clean	109	31
Physical appearance - No Pest/Insect Attack	271	76
Strong tuber	44	12
Maturity	24	7
Nutritional/Dietary value	25	7
Taste (sweet)	156	44
Others (Inherent varietal preference)	22	6

## 5.2 Characteristics of sweetpotato consumers in PNG

The summary statistics of explanatory variables used in the models are presented in Table 5. The estimated mean premium<sup>4</sup> that consumers are willing to pay for good quality sweetpotato in PNG is 3.47 kinas per kg. In all, 88.2% of the consumers were willing to pay a premium for good quality attributes in sweetpotato. Over 70% of the consumers are females. The average age of the consumers was 35 years with the average of 7.8 years of schooling. An average of 55% of the respondents hails from the Highland regions. The mean household size was 3.8. Typically, the numbers of household members living in Port Moresby averaged 3.6 and have been living there for an average of 15 years. In terms of quality attributes, 76% of sample consumers perceive maturity of the root as an important attribute. Uniform shape and size as well as physical appearance accounted for about 33% of the consumers. The sweet taste of the roots represented 13.5% of the consumers 83% of the consumers perceived the current sweetpotato price to be high while 27% of them has access to market information (Table 5). Almost half of the respondents were in income category 3, earning incomes above 400 kina. The high proportion of the respondents falling into the high income category indicates that there is a high prospect for enhanced willingness to pay for good quality attributes among the consumers.

## 5.3 Factors influencing the probability of consumers' WTP for good quality sweetpotato

Probit estimates of the factors influencing the discrete consumers' willingness to pay decision for good quality sweetpotato are presented in Table 6. The highly significant likelihood ratio statistic (43.68) suggests that the explanatory variables adequately explain the variations in the dependent variable (*discrete consumer WTP for good quality sweetpotato*). The results indicate that the discrete WTP decision among consumers was influenced by household factors such as education, households that have migrated from the Highlands region and the size of the household. Significant quality attributes included uniform shape and size roots, physical appearance, matured roots and finally high sweetpotato price (Table 6).

<sup>4</sup> The premium was estimated by multiplying the price per heap by the average KGs of each of the heaps. Thus, this allows us to at least have an idea of the maximum amount consumers are willing to pay for the quality attributes for a kg of tuber.

**Table 5: Summary statistics of explanatory variables used in the models**

Variable	Mean	Standard Deviation
WTP (Kinas)	3.47	2.09
WTP (%)	88.2	0.3
Female (%)	76.7	42.3
Age (years)	35.0	11.7
Education (numbers of years)	7.8	5.1
Highlander (%)	55.9	49.7
Household members consuming SP (N)	3.8	1.4
HH living in Port Moresby (N)	3.6	1.4
Years in Port Moresby (years)	15.4	12.6
Uniform shape and size (%)	33.1	47.1
Physical appearance (%)	33.4	47.2
Maturity (%)	76.1	42.7
Nutritional value (%)	6.7	25.1
The sweet taste (%)	13.5	34.2
Fresh and clean (%)	50.6	50.1
High price (%)	82.9	37.7
Market information (%)	27.0	46.3
Income category 3 (401-500 kina)	48.3	50.0

**Table 6: The probit estimates of the determinants of the discrete consumers' WTP for good quality sweetpotato**

Variable	Coefficient	Standard error	Marginal effects
Female	0.22	0.24	0.0286
Age	-0.0059	0.0090	-0.0007
Education	0.041 <sup>*</sup>	0.021	0.0050
Highlander	0.46 <sup>**</sup>	0.21	0.0591
HH Size	-0.20 <sup>**</sup>	0.10	-0.0245
Years in POM	0.0089	0.0088	0.0011
Uniform shape and size	0.69 <sup>***</sup>	0.27	0.0717
Physical appearance	0.52 <sup>**</sup>	0.25	0.0556
Maturity	-0.75 <sup>**</sup>	0.31	-0.1360
The sweet taste	0.63	0.43	0.0543
Fresh and clean	0.31	0.22	0.0373
High price	0.58 <sup>**</sup>	0.25	0.0941
Market information	-0.38 <sup>*</sup>	0.21	-0.0461
Income category 3 (401-500 kina)	0.12	0.27	0.0149
Constant	0.64	0.63	
log likelihood	-94.45		
LR $\chi^2$	43.68		
P-value ( $\chi^2$ )	0.0001		
Pseudo $R^2$	0.1878		
N	353		

\*10% significant, \*\*5% significant, \*\*\*1% significant.

Except for the household size, maturity of roots and market information, which had negative effects on the discrete WTP decision, positive relationships were found with the remaining factors such as education, migrants from the Highlands regions, uniform shapes and size and physical appearance. Surprisingly, the income variable was insignificant on the discrete WTP decision. This could be because the actual effect of income could be clouded by the proportion of respondents who indicated that they are not willing to pay for good quality sweetpotato.

#### **5.4 Factors influencing the WTP premium consumers are willing to pay for good quality sweetpotato**

Truncated regression estimates of the factors influencing the premiums consumers are willing to pay are presented in Table 7. The p-value of the Wald chi square test is highly significant indicating that on the whole the model is statistically significant and that the explanatory variables explain a great deal of the variations in the value of WTP. In addition, the ancillary statistic /sigma is highly significant (p-value of 0.000); this indicates a highly significant difference between the standard error of the truncated regression and the standard error if we had used the OLS to estimate the model, hence, lending support for the use of the truncated regression model.

**Table 7: Truncated regression estimates of the determinants of the extent of consumers WTP for good quality Sweetpotato in PNG**

Variable	WTP		
	Coefficient	Standard Error	Marginal Effect
Female	-0.43 ***	0.17	-0.387
Age	0.006	0.007	0.005
Education	0.001	0.015	0.001
Highlander	0.28 *	0.15	0.249
HHsize	-0.321 ***	0.060	-0.290
Years in Port Moresby	-0.011 *	0.006	-0.010
Uniform shape and size	-0.20	0.17	-0.179
Physical appearance	0.77 ***	0.16	0.692
Maturity	0.41	0.25	0.373
The sweet taste	0.84 ***	0.20	0.757
Fresh and clean	0.27 *	0.15	0.245
High price	-0.32	0.19	-0.285
Market information	0.08	0.16	0.068
Income category 3 (401-500 kina)	0.87 **	0.18	0.783
Constant	3.04 ***	0.44	
Sigma	1.149 ***	0.055	
Number of observations (N)	317		
Wald $\chi^2$	109.54		
p-value	0		
Log likelihood	-463.19		

10% significant, \*\*1% significant.

The results of this study indicate that the premiums that consumers are willing to pay have been influenced differently by different factors. Positive significant effects were found with migrants from the Highlands regions, high income and other quality attributes such as the physical appearance of the roots, fresh and clean roots, and the sweet taste. On the other hand, negative relationships were found with gender, household size, and number of years the household has been living in Port Moresby.

## 6. Discussion

### 6.1 Household consumption decision making and WTP

Households make consumption decisions on the quantity of food products they intend to purchase. In PNG, the mean premium consumers are willing to pay for good quality sweetpotato is 3.47 kinas per kg. This suggests that, generally, consumers pay attention to the quality attributes in sweetpotato and are, subsequently, prepared to pay a premium for such attributes. Additionally, it presents an opportunity for farmers and other stakeholders in the sweetpotato value chain in terms of the potential incomes from the sweetpotato industry in PNG. Within the household decision making process on consumption expenditure, the discrete decision on WTP (whether consumers are willing to pay a premium or not) comes before the decision on the premium they are actually willing to pay. Thus, it is appropriate to apply the two-step model in estimating the factors influencing these two decisions (Mabiso et al., 2000). The results indicate that WTP decisions can be influenced by the same sets of factors, but differently. Interestingly, the results show that high income is associated with higher WTP premium. This supports and confirms the positive effects of incomes on WTP for consumer products in the literature (see for example Loureiro and Umberger, 2002; Mabiso et al., 2005)

### 6.2 Household characteristics and consumers WTP

Household-level characteristics that influenced the two WTP decisions included education and gender of the household head, whether the household head has migrated from the Highlands provinces, household size, and the number of years they have lived in Port Moresby. The education variable had a positive effect on the discrete WTP decision for good quality sweetpotato. This means consumers who have attained more years of education have a higher probability of being willing to pay for good quality sweetpotato. Educated consumers are more enlightened about the importance of nutritional quality and thus are more likely to embrace the decision to pay for such attributes. This result accords with those reported in similar studies on WTP for food products (Adepoju & Oyewole, 2013; Krystallis et al., 2006).

Gender had a negative influence on the premium consumers are willing to pay. As gender was represented by females, it implies that among the consumers who were willing to pay a premium, a household headed by female decreases the WTP premiums by 0.39 kinas per kg. Typically in PNG, purchasing of household food items and its preparation is mostly done by females. A possible reason for this result is that females are more budget conscious and they may not necessarily place much prominence on the quality attributes, and hence they are less likely to pay more for better qualities. Although, consistent with Chowdhury et al., (2011), conflicting results were however found by McGoldrick and Freestone (2007) where higher WTP was found with female consumers.

Most of the sweetpotato produced in PNG comes from the Highlands regions. Hence, sweetpotato consumption among consumers from these regions is also prominent. As expected, positive effects were found with household head that has migrated from the Highlands regions and both the probability and the actual premiums consumers are willing to pay for good quality sweetpotato in PNG. Moreover, sweetpotato-consuming households from the Highlands provinces are more likely to pay increased premiums for good quality attributes.

The size of the household among sweetpotato consumers in PNG had consistently negative effects on both WTP decisions. Unsurprisingly, a large number of consuming

household members implies an increased expenditure; such households generally do not pay attention to quality; rather, they are more likely to consider quantity in their purchasing decisions given their budget, hence, may not be willing to pay an additional premium for quality attributes. Hence, in order to exploit the prospects of increasing incomes of farmers and other stakeholders, efforts should include targeting households with relatively smaller size. Conversely, the number of years the household members have been living in Port Moresby had a positive effects on both decisions.

Another important household factor that consistently influenced the extent of WTP decisions is the income variable. The results signify that consumers with high incomes, i.e. earning more than 400 kinas, were willing to pay premiums for good quality sweetpotato attributes. Specifically, the results indicate that, increasing incomes of consumers within the high income category increases the premium they are willing to pay by 0.783 kinas per kg. This presents a bright future for the sweetpotato industry; it highlights significant information for the various stakeholders and actors along the sweetpotato value chain. For instance, research and development as well as extension efforts in developing and disseminating sweetpotatoes with good quality attributes, have the potential of achieving the desired results. In addition, farmers are able to obtain higher incomes for their efforts at producing roots with good quality attributes.

### **6.3 Quality attributes of sweetpotato and consumers WTP decisions**

Significant attributes that describe good quality sweetpotato include: the sweet taste, matured roots, fresh and clean roots, physical appearance and uniform shape and size. These attributes influenced both the WTP decisions. For instance, the physical appearance and maturity consistently influenced both the discrete WTP decision as well as the premium that consumers were willing to pay for good quality sweetpotato. The probability of consumers' willingness to pay for good quality increases by 0.05% for physical appearance. Although the sweet taste did not influence the discrete WTP decision, it did have highly significant impacts on the magnitude of WTP. This indicates that the consumers place more prominence on the sweet taste as a unique good quality attribute. In order to encourage consumers to pay an extra premium for good quality sweetpotato, it is necessary for farmers, researchers and extension to produce the sweet taste of the roots. Elsewhere in Uganda, the taste of bio-fortified foods has been an essential determinant of consumers' WTP (Chowdhury et al., 2011). The results for fresh and clean roots showed positive effects in the magnitude of WTP, but only significantly increase the premium consumers will be willing to pay.

In the case of uniformly shaped and sized roots, it had a positive effect only on the discrete WTP decision, suggesting that the uniform shape and size of roots becomes less important as a quality attribute when the premium increases. Hence, in order to obtain higher incomes through the magnitude of the WTP premium, there is the need to include other quality attributes alongside freshness and cleanliness of roots. The results conform with other studies where quality product attributes such as nutritive value, taste, freshness, appearance, and other sensory characteristics are found to influence consumer preferences and thus their WTP (Makatouni, 2002; Bonti-Ankomah and Yiridoe, 2006). Consequently, for major stakeholders along the sweetpotato value chain to obtain increased incomes, there is the need to explore the attributes such as nutritive value, the sweet taste, matured roots, fresh and clean roots, physical appearance and uniform shape and sized roots as a package, not individually.

Further, the high price determined the discrete consumers' WTP decision. Consumers who perceived sweetpotato prices as high were not willing to pay for good quality attributes regardless of the nature of the quality in question; thus, the results show a decreasing effect on the WTP. High prices have been found to have similar effects on consumer WTP decisions (Bhatta et al., 2009; Oviahon et al. 2011).

## **7. Concluding remarks**

This study examined consumers' willingness to pay for good quality sweetpotato in Papua New Guinea in two distinct stages. In the first stage, whether the consumer was willing to pay or not, and the factors influencing that discrete decision, were estimated using the probit model. In the second stage, the magnitudes of the WTPs (premiums), and their determinants, were examined using the truncated regression models.

Our results indicated that, overall, 88.2% of the consumers were willing to pay a premium for good quality attributes in sweetpotato – with good physical appearance, no insect bites or rat damage and uniform shape and size. The average premium that consumers were willing to pay extra for good quality sweetpotato in PNG was 2.22 kinas per kg, with a minimum of 0.96 kinas per kg and a maximum of 3.47 kinas per kg. Further, the probability of consumers' WTP for good quality sweetpotato was positively influenced by the consumers' level of education and whether they have migrated from the Highlands regions, as well as the sweetpotato's physical appearance (such as uniform shape and size and the freshness and cleanliness of the roots). However, high prices of sweetpotato and the household size were negatively associated with the consumer's WTP. Among the consumers who indicated that they were willing to pay, the premiums they would pay were influenced by factors such as gender, income, migration from the Highlands regions, the number of years the household has been living in Port Moresby, as well as quality attributes such as the physical appearance of the roots, the sweet taste and the freshness and cleanliness of the roots. On the other hand, the premium was negatively associated with the size of the household.

The results confirmed that the discrete decision on whether a consumer is willing to pay for good quality produce, and the extent of how much they are willing to pay, are determined by different sets of factors. Estimating the discrete decision alone does not provide adequate understanding of the factors affecting the full decision making process. Moreover, our study confirmed the importance of testing whether decisions are made jointly. The test on separability in the two decisions allows the relevant sets of factors that influence the two decisions to be adequately captured.

These results present relevant information for the sweetpotato industry in PNG in terms of the factors to consider when developing interventions to enhance the incomes of different stakeholders. In particular, information regarding consumers' preferences can be used by farmers as a guide for variety selection and by research institutions for their breeding programs.

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