# Consumers' Willingness to Pay for Food Safety in Nairobi: The Case of Fresh Vegetables

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*Abstract:* Large urban areas in developing countries represent currently the most dynamically growing markets for food products. This study investigates the willingness to pay of consumers in Nairobi for safer leafy vegetables. We survey individuals' perceived food safety across four major market categories, while also considering the explanatory role of trust and behavioral, psychological, and socio-demographic covariates. Results show that willingness to pay is market-specific and multi-faceted, with trust and perceived risks as important drivers, while income plays only a subordinate role. We conclude that policy makers should aim to reduce asymmetric information within the value chain without raising food prices such that safer vegetables would become unaffordable for the poor.

*Keywords: Food safety, perceived risk, willingness to pay, regression tree, urban agriculture*

## *1. INTRODUCTION*

Urban areas in the developing world represent some of the fasted growing markets for food products (FAO, 2010), and urban and peri-urban farming is becoming increasingly important especially for the supply of perishable food. World-wide, urban and peri-urban farming involves some 800 million people (Midmore and Jansen, 2003) and it generates significant livelihood opportunities, not only for urban and peri-urban farmers but also for traders, input suppliers and other service providers along the value chain for domestic produce (Scott et al., 2004).

However, especially vegetables for domestic consumption in urban and peri-urban centers of the developing world are associated with a plethora of food safety hazards. Farmers' access to clean water for irrigating vegetables is a major challenge. Use of polluted or contaminated water from residential areas or rivers is widespread. Indeed, it is estimated that over 20 million hectares are cultivated with this water globally (Nabulo et al., 2008). In Nairobi, for example, about 3,700 farmers within a 20km radius of Nairobi city centre practice irrigation agriculture and 36% of them use raw sewage water (Karanja et al., 2010). Sewage water contains a spectrum of pathogens, many of which can survive for several weeks when discharged onto fields (Amoha et al., 2006). Use of sewage water for farming also results in excessive accumulation of heavy metals in soils which in turn leads to elevated levels of heavy metal uptake by crops, therefore affecting food safety (Muchuweti et al., 2006). Other production-level hazards associated with fresh produce consumed in urban centers include contaminants originating from industrial wastes, vehicle exhaust, dusts from the roads and the use of uncured animal manure (Hide et al., 2001). Demand for aesthetic attributes such as color, size and spot-less leaves by urban consumers has also encouraged excessive use of pesticides and chemical fertilizers.

From a perceived food safety perspective, a dual situation seems to be emerging, in which perceived food safety conditions at supermarkets or high-end markets are very different from traditional markets, which may also have implications for international trade of food products between developed and developing countries. From an objective food safety perspective, however, the situation is different. Recent results by Kutto et al (2010) for Nairobi show that postharvest and retailing practices are the major contributors to the incidence of microbiological contamination in fresh vegetables and although the prevalence of pathogens were higher in traditional markets as compared to high-end markets, the levels of E. Coli were as high as at the 20% level even at high-end markets such as supermarkets and specialty stores.

Using a quantitative approach to gain insight into the valuation of food safety in a developing country context, this study attempts to understand what determines consumer preferences for

vegetables that would meet an objective definition of a satisfying safety requirement. This study focuses on kale (Brassica oleracea L.) which is the most important green leafy vegetable consumed by households in Nairobi and which plays an important role in the nutritional balance in developing countries (WHO, 2004). The analyses are provided for four major food market outlet categories in order to establish how consumers differ with respect to their driving forces to purchase safer vegetables. A metropolitan area is chosen as the study object since such areas usually have a leading role in the food system transformation for the rest of a country (Pingali, 2007).

A growing body of literature has examined consumers demand for food quality and safety by analyzing developed-countries consumers' WTP for added food quality and safety features (e.g. Eom, 1994). With the exception of the work by Huang (1993) and Payne et al. (2009) the available literature has not addressed the complexity of the inter-relationship between determinants of consumer's subjective food safety perceptions and their purchase intention (such as expressed by their WTP for safer produce). Previous studies of consumer WTP for food quality and safety in a developing country context have focused on a narrow range of safety attributes in isolation, including: quality perception given variation in provided product information (Poole et al., 2006), GM use and pesticide residue (Akgüngör et al., 2007), pesticide use and product origin (Ehmke et al., 2008; Krishna and Qaim, 2008), environmental friendliness (Vanit-Anunchai and Schmidt, 2004), as well as convenience attributes (Mergenthaler et al., 2009).

Contrary to the approach taken in the existing literature, this study views food safety as a multi-dimensional phenomenon, described by a range of production- as well as processing characteristics which are comprised into the produce along the value chain. In order to develop insights into what determines consumer preferences for food safety as an overall attribute, this study seeks to identify the factors influencing consumers' WTP for food safety as such an agglomerated construct. In this study, we apply an integrated approach where we bring together behavioral, psychological, risk, trust and demographic characteristics as potential determinants of consumer's WTP for food safety.

## *2. MATERIALS AND METHODS*

To determine the willingness-to-pay for food safety as an agglomerated attribute, a payment card (PC) contingent valuation (CV) method was employed. The PC and the dichotomous choice (DC) approaches have been widely used in the health economics literature and the WTP estimates derived from these approaches have been compared (Frew et al., 2003). Vast findings suggest that: open-ended methods of valuation (such as the PC) results in lower WTP estimates than closed-end estimates (like the DC) (e.g. Frew et al., 2003), and that no significant differences in WTP estimates are found in between DC CV and discrete choice experiments (DCE) (e.g. Adamowicz et al. 1998) with the exception from Boxall et al. (1996). Comparing welfare estimates a recent study by Ryan and Watson (2009) found that DCE resulted in higher WTP estimates than PC. In our context, WTP can be interpreted as an indicator of demand for vegetables characterized as safe food.

In answering the PC, respondents were asked to tick the price of kale they were almost sure to pay in buying the second kale. Use of the PC therefore allows for direct observation of individual WTP. The monetary amount in the PC ranged from 0 in increments of 1 Ksh up to 19 Ksh per bundle (see Figure 1 for a presentation of the instructions of the PC). The range of the price

proxy was determined based on typical prices per bundle of kale at markets in Nairobi. As with other stated preference methods, there were several potential disadvantages associated with PC requiring attention in this study. The hypothetical nature of the experiments may induce respondents to exaggerate their stated willingness to pay (WTP) even though hypothetical bias generally is of lesser relevance when respondents have familiarity with the object, especially in a context of a marketable good. For this reason price premiums were chosen as payment vehicle within the PC method due to its simplicity and ability to obtain precise WTP estimates and also minimized the probability biases found in interactive bidding techniques. Furthermore, hypothetical bias arising from respondents failing to recognize budget constraints is a well known problem in stated preference studies. Therefore, respondents were presented with a cheap talk script in the PC (Cummings and Taylor, 1999) to mitigate such potential biases. The extent to which hypothetical WTP can effectively predict actual market behavior is also challengeable. Results from Lourerio et al. (2003), however, support the existence of a relationship between hypothetical WTP intensity and actual purchase choices.

**Figure 1: Instructions and Design of the Payment Card Used for Eliciting WTP for Food Safety of Kale.**

"Starting at the top of the list and moving down please ask yourself: 'Am I willing to pay 1 shilling extra per bundle of Kale to buy the second Kale just described? Or would I rather not pay this amount and have the first kale described? If you are almost certain you would pay the amounts of money in the card to buy the second kale then place a tick (√) in the space next to these amounts.

| Kale Product Scenario 1 | Kale Product Scenario 2 |
|---|---|
| This product is grown using polluted water and harvested even after pesticides have just been applied. It is washed/dipped/sprinkled with brown (dirty) water contained in a bucket in the market. Sellers don't wash their hands before handling the product and keep/display the product in dirty areas. | For this product clean water has been used for irrigation. The amount of residues from pesticides, herbicides, and water sources are within acceptable levels from a human health perspective. The product is washed in running tap water at the market. The product is hygienically stored, handled, and presented. |

Please don't agree to pay an amount if you think you can't afford it on a regular basis or if you feel that there are more important things for you to spend your money on, or if you are not sure about being prepared to pay or not. We are asking for your most truly willingness-to-pay here so please provide the sincere response".

Personal interviews were conducted with a sample of 449 people at the time and point of purchase of kale. Collecting WTP data from consumers in relation to a situation where an actual purchase decision is made is supposed to affect the involvement, the understanding as well as the affective judgment (i.e. the sense of overall goodness or badness) in relation to the choice situation. The interviews were conducted at four different market types: (i) *roadside market* (Githurai) ($n$=84), (ii) *open-air markets* (Kawangware and Kangemi ) ($n$=215), (iii) *supermarkets* (Uchumi stores in Buruburu and Westlands ) ($n$=113), and (iv) *specialist shops* (The Zucchini Greengrocer chain) ($n$=37). Probability proportionate to size (market type) sampling was used. The sampling procedure encompassed systematic selection of every third person until the quota for the market segment was reached. In roadside and open air markets, a zoning sampling method was applied. Enumerators, specifically trained for the questionnaire, were located in different zones in the markets and sampled every third person from that zone. To avoid biases related to the time and day of purchase, the survey was conducted at each location on at least one weekday and one weekend day. The survey was conducted between April and May 2010 following pre-testing of the questionnaire. The Githurai roadside market is located along the main Nairobi-Thika road and traders are attracted to it because of accessibility to the city centre. Roadside markets take advantage of busy consumers who do not have time, or lack

opportunities, to go into the City Council markets. The open-air markets at Kawangware and Kangemi are located in densely populated areas with low income earners, situated towards the western side of Nairobi, around 15 km and 6 km from the city centre, respectively. Zucchini Greengrocer shops are perceived by their customers to be highly dependable for a wide range of clean vegetables. The Zucchini Greengrocer chain enforces a system of quality and processing control on its farm suppliers and has a detailed food safety/quality protocol for handling fresh produce.

A series of measures was required to investigate the determinants of consumers WTP of food safety:

**Social pressure:** Elements of social pressure can be present in choice situations where consumers believe that other people may evaluate them negatively due to a purchase they make (Aqueveque, 2006). This might equally well apply to an individual's choice of market place or his/her WTP in an interview situation. Fear of negative social evaluation (*FNE*) is a psychological construct that describes and captures how people with such anxiety behave in ways that make them more responsive to situational factors.

**Demographics and Structural Determinants:** *gender*, *age, marital status, education, employment status* and *average monthly household income*, *number of children in the household* of the interviewee and on *type of residential area* (urban, peri-urban, rural). Data was also collected on *levels of consumption of kale and other vegetables*. A level of consumption is taken to reflect involvement as well as product experience.

**General awareness of vegetable production** and handling practices was represented by a set of familiarity items with a yes/no response: '*I have/my parents grow vegetables […]; 'My grandparents or relatives grow vegetables […]; 'I grow vegetables […]'; 'I do not have any experience of growing vegetables*'. In addition, a revealed preference question was included. Finally, both the frequency of leafy green vegetables purchases were recorded separately, using the alternatives: *daily, 2-3 times per week, at least once per week, seldom, or never*. Familiarity with production, revealed preferences and purchasing habits manifest product experience. Recent work by de Groot et al. (2009) found that the WTP for a sample of Dutch consumer's (student's) decreased with direct product experience but increased when the experience effect was measured indirectly through attitude. Similarly, results from Lusk and Briggeman (2009) regarding food values support that the price attribute was less important to consumers with previous experience of purchasing organic food than for consumers without such experience.

**Motivational variables** referring to the reasons for selecting the place of purchase (point of survey) as the preferred market option was therefore assessed using the exclusive answer to a list of three options with the opportunity to mention another, more important reason. Answers were coded into ten options: '*It is closer to my home […]'; 'The prices are cheaper than at other places'; 'There are always fresh leafy vegetables available'; 'They are clean'; 'They are transparent and trustful'; 'Packaging is good'; 'Very customer-friendly'; 'Wide variety of other vegetables'; 'Have very high quality';* and finally *'Other'*. In addition, to assess the extent to which respondents were consistent in the choice of shopping place they were asked to identify their *first best shopping alternative*. Answers were coded as dummy variables referring to either having an up-scale or down-scale market type alternative from a food safety perspective.

**Subjective knowledge about food safety** (SKN) was assessed as the total score of four items with agree(1)/disagree(0) response formats, drawing upon the approach by Flynn and Goldsmith (1999). SKN items were e.g.: '*Compared to an average person, I know a lot about…: - food safety'; '- leafy vegetables'; '-how leafy vegetables […]are handled from farm to retailers*'; and finally '*My friends and family consider me as being very knowledgeable on food safety issues*'.

The Cronbach alpha coefficient for SKN was 0.57 which is slightly lower than the 0.6 cut-off rate for exploratory scale design (Hair et al., 2010).

**Subjective quality assessment** (SQA) was assessed using a 5-item agree-disagree zero-centred Likert-scale in line with Vanhonacker *et al*. (2007). SQA items were: '*When I buy Kale I am concerned that it will not meet my requirements/be as I expected*' and '*When I buy Kale I am never sure if I have chosen the right quality*'. The Cronbach alpha for SQA was 0.57.

**Objective knowledge about food safety** (*OKN*) was investigated using the sum of four statements using a true(1)/false(-1) format with a 'do not know' option (0). OKN statements were: '*Eating vegetables irrigated with contaminated water can cause diarrhea'; Long term consumption of foodstuff produced with excessive use of pesticides can cause cancer'; 'Washing vegetables with clean water and vinegar prior to consumption makes them safer to eat*'; and finally '*Vegetables cooked thoroughly are safer to eat than un- or semi-cooked vegetables/salads*'.

**The confidence and consistency** (*CC*) scale were drawn from the work of McCarthy and Henson (2005) and included the sum of three statements on a 5-item agree-disagree Likert-scale: '*To buy Kale of the highest quality I definitely go to a specialty store'; 'Kale sold at a road market is never as fresh as in a supermarket*'; and finally '*When buying Kale I have more confidence in a specialty (such as Zucchini) store than in a supermarket*'. The Cronbach $\alpha$ for the CC scale was 0.74.

**An ability** (*A*) scale were drawn from the work of McCarthy and Henson (2005) and refined for the present study to include the sum of four statements using a 5-item agree-disagree zero-centred Likert-scale : '*I am confident in my ability to select good quality Kale'; 'It is easy to select good quality Kale'; 'I feel that I have control over the quality of kale that I buy'; 'I am a good judge of quality Kale*'. The Cronbach $\alpha$ for the ability scale was 0.76.

**Trust related to health risk information** from each of the following sources: *framers; traders; transporters; sellers at markets/retailers; supermarkets; specialty stores; and organic shops*, respectively, were collected using a 5-item Likert-scale format for each source, respectively.

The subjective importance of the health risk (*SOR*) entailed from consuming vegetables was assessed thru a single 5-item agree-disagree attitudinal statement '*eating kale is very risky to my health*'.

**Consumer's perceived health risk attributable to seven risk sources** along the food supply chain: (1) The water used for irrigation may have contained waterborne pathogens (typhoid, cholera, amoeba); (2) The manure may have contained fecal coliforms which can cause watery and or bloody Diarrhea, severe Stomach pains; (3) Water used by traders may cause typhoid, and cholera, amoeba; (4) The soil (from added manure) may contain Cryptosporidia parvum and/or other anti-microbials. This can cause persistent watery diarrhea; (5) Failure to observe pre-harvest intervals after the application of fertilizers and manure may create overloading of nitrates. This can lead to cancer; (6) Failure to observe pre-harvest intervals after the application of pesticides may leave residues. This can cause short-term illnesses such as Diarrhea, Stomach pains, Nausea, and weakness as well as long-term diseases like cancer; and finally (7) Product has been contaminated with heavy metals by the use of certain fertilizers, dust as well from emissions from vehicles during transport. This can cause long-term diseases like cancer.

**Classification and Regression Analysis:**

Yohannes and Hoddinott (1999) argued that the complexity surrounding household food consumption can only be approximated by taking several indicators simultaneously into account

which poses an analytical problem of having to select from a large number of potentially relevant factors in order to identify those with both the highest relevance and the largest explanatory power in statistical terms. Recently, Payne et al. (2009) used the non-parametric method of Classification and Regression Trees (CART) proposed by Breiman, Friedman, Olhsen, and Stone (1984) to identify which subgroups of consumers that were most vulnerable to food scare information based on similarities in behavioral, psychological and demographic characteristics. The conventional CART model has the advantage that it represents a flexible category of algorithms for exploratory data analysis. For the purpose of explanatory analysis given a complex set of explanatory variables conventional CART algorithms has, however, limited tractability since they theoretically will go on until each observation of the dependent variable within a given dataset is represented by an individual node from the regression tree. This can result in overfitting of the classification tree. For the purpose of this study, we instead adopt a refined version of the CART model by Hothorn, Horning and Zeileis (2006) (HHZ) to assess the probability to observe a particular WTP given the set of explanatory variables used. In the HHZ framework conditional distributions are estimated between a dependent variable and the set of explanatory variables under consideration. The HHZ algorithm is still similar to the conventional CART algorithm but binary splitting at each node is performed according to the variable that shows the strongest explanatory power in terms of an estimated *p*-value. The algorithm therefore does not split the sample into individual observations, but stops instead as soon as no statistically significant split can be detected any more. Hothorn, Horning and Zeileis (2006) demonstrate that the 'Conditional Binary Recursive Inference Algorithm' is not subject to variable selection bias, as a conventional CART may be. Estimation of the HHZ model was performed using the R software (R Development Core Team, 2010).

## *3. RESULTS:*

Table 1 presents the differences in mean WTP with associated post hoc tests for equality in means. The results suggest that the equality in mean WTP between roadside and open-air markets cannot be rejected. However, the differences in mean WTP are significant between all other pair wise comparisons of market categories.

The overall mean WTP for kale safety was Ksh 8.24 per Kilogram which represents a price premium greater than 39 percent per kilogram for safety attributes of kale. Price premiums per market category amount to 68 percent in specialty stores, 34 percent in supermarkets, 39 percent in open-air markets and 28 percent in roadside markets.

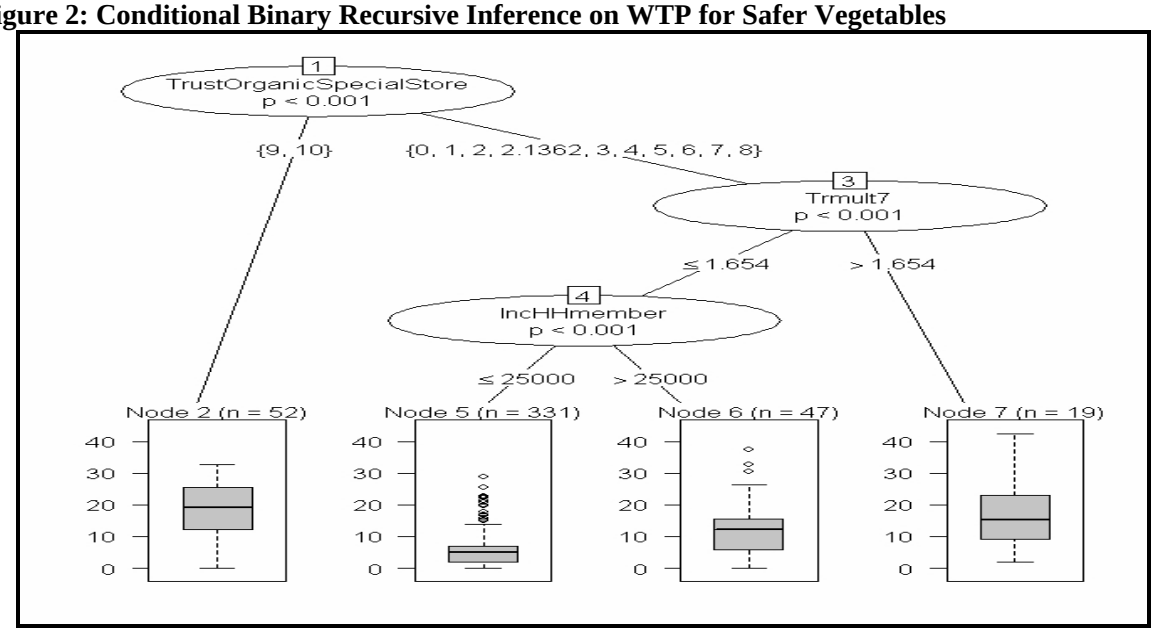
**Table 1: Differences in Mean Willingness-to-Pay for Safer Kale Between Market Categories. Kenyan shillings per kilogram**

| (I) Market category | (J) Market category | Mean Difference (I-J) | Std. Error | Sign. | 95% Confidence Interval Lower- | Upper Bound |
|---|---|---|---|---|---|---|
| Roadside | Open air | -1.16 | 0.59 | 0.264 | -2.73 | 0.40 |
| | Supermarket | -7.76 | 0.91 | <0.001 | -10.17 | -5.34 |
| | Specialty store | -15.11 | 1.47 | <0.001 | -19.17 | -11.04 |
| Open air | Supermarket | -6.59 | 0.88 | <0.001 | -8.94 | -4.25 |
| | Specialty store | -13.94 | 1.46 | <0.001 | -17.97 | -9.92 |
| Supermarket | Specialty store | -7.35 | 1.61 | <0.001 | -11.74 | -2.97 |

The conditional inference between the full set of determinants and the stated WTP were analyzed by the HHZ algorithm. Various specifications for the included perceived risk attributes were tested, but only a disaggregation with a measure for of the seven risk types provided explanatory

power to the model. As shown in Figure 2, the most significant split criterion among the determinants for WTP for safe vegetables is the combined rust in organic and specialty stores. Consumers with high levels of trust in such outlets have a higher mean WTP (20 ksh per kg) compared to other consumers. With lower levels of trust in organic and specialty outlets, the perceived risk related to the produce being contaminated with heavy metals by the use of certain fertilizers, polluted water, dust as well as from emissions from vehicles during transport is the next most significant split criterion. Consumers with relatively higher levels of perceived risks have a higher mean WTP (15 ksh per kg) compared to consumers with lower levels of such perceived risks. With relatively lower levels of perceived risks, the income of the household is the third most significant spilt criterion. Consumers with relatively lower incomes have the lowest mean WTP for safer vegetables (7.5 ksh per kg), while consumer with relatively lower levels of perceived risks but with higher incomes have a higher mean WTP (12 ksh per kg).

**Figure 2: Conditional Binary Recursive Inference on WTP for Safer Vegetables**

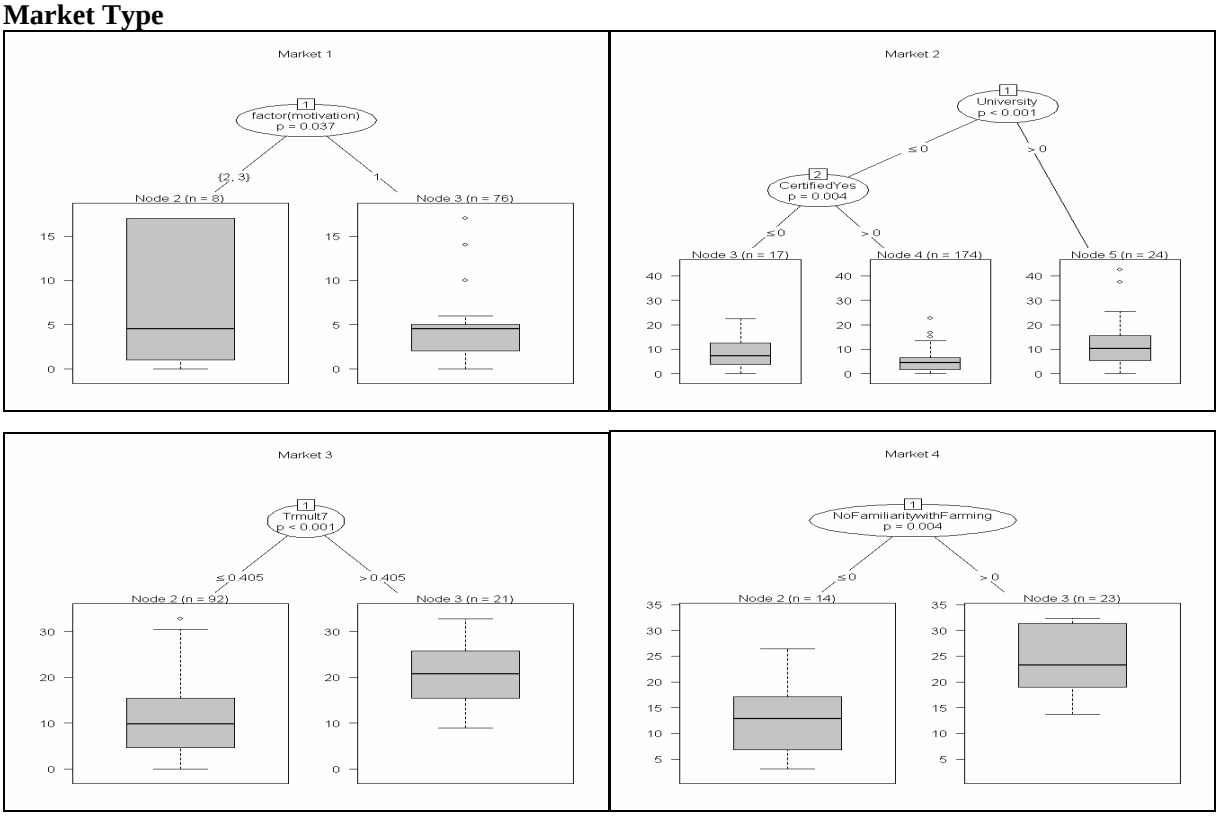



*Note: Missing values for trust in organic and specialty stores have been replaced by the sample mean (2.1362). End nodes are Box plots of WTP (ksh/kg).*

The determinants of WTP for each market type were analyzed in a similar way. Figure 3 (upper-left panel) reveals that the motivation for selecting the place of purchase is the most and only, significant splitting criterion for consumers at road-side markets. The WTP for safer vegetables are here depending on if the motives are either price or product quality related (‘*The prices are cheaper than at other places’ (2);* and *‘There are always fresh leafy vegetables available’ (3))* or related to convenience *(‘It is closer to my home/work place and easy/cheap to get to’ (1))*. Although the mean is the same irrespectively of motive, the distributions of the WTP are skewed in opposite directions. The upper-right panel of Figure 3 reveals that the most significant splitting criterion for consumers at open-air markets is university degree or not. Consumers with such a degree have a higher mean WTP than consumers without this degree. However, for consumers without this degree the experience of buying kale that is certified with respect to production methods, or not, is the second most significant split criterion. Interestingly, consumers with such experiences have a lower WTP than consumers without such experience. This type of result is consistent with the results regarding product experience by de Groot et al.

(2009). The lower-left panel of Figure 3 reveals that the most significant (and only) split criterion for consumers at supermarkets is the level of their perceived risks related to the produce being contaminated with heavy metals by the use of certain fertilizers, polluted water, dust as well from emissions from vehicles during transport. Consumers with higher levels of such perceived risk are willing to pay, on average, more that the double for a safer produce than consumers with lower levels of perceived risks. Finally, the lower-right panel in Figure 3 reveals that familiarity with farming is the most (and only) significant split criteria for consumers at the high-end specialty outlets. Consumers without such familiarity are found to have a substantially higher mean WTP for safer produce as compared to consumer with such familiarity.

**Figure 3: Conditional Binary Recursive Inference on WTP for Safer Vegetables in Subsets per Market Type**




*Note: End nodes are Box plots of WTP (ksh/kg).*

## *4. DISCUSSION AND IMPLICATIONS*

Our conditional binary recursive inference estimations reveal a rather simple but nested explanatory structure. Interestingly, the structure leaves out many of the explanatory factors suggested in the literature as relevant in relation to food safety. This unexpected result can be due to either the context of our study, or to the estimation method, or both. For the context, no comparable study of perceived food safety as an agglomerated construct in a developing-country exists. For the estimation method it is noted that Figures 2-3 reveal substantial heterogeneity in relating WTP to the set of explanatory variables. This implies that any conventional parametric approach, such as Logit/Probit approaches, would likely miss important effects within subgroups of the sample unless an appropiate splitting of the sample is introduced through (interacting)

fixed effects. On the other hand, if parametric models are misspecified due to omitted variables, they may heavily overstate individual explanatory components. Many of such individual components may appear insignificant wihtin our anlysis because the HHZ algorithm allows us to inlude a wide range of potential individual WTP determinants at the same time, without having to do any pre-selection of variables according to e.g. multicollinearity criteria.

As expected, income is found to influence WTP. But, more surprisingly, this influence is found to be a subordinate to trust as well as to perceived risk of heavy metal contamination. This finding is relevant since part of the discussion related to food safety in developing countries concerns the consumer's lack of ability to pay for safety-improved products. In this respect, although our findings confirm that food safety is a normal good, the aspect of trust and perceived risk is more important in explaining purchase intentions than income.

The finding that a higher level of perceived risk from heavy metal contamination (*Trmult7*) is related to higher WTP is also interesting: Non-sheltered transportation of vegetables to markets as well as irrigation with polluted water is something that consumers can observe every day. From a public health aspect, policy makers should therefore inform farmers, traders as well as transporters about this concern of consumers because it constitutes potential marketing opportunities.

Furthermore, we find a substantial difference in determinants of food safety between every food market type. Consumers at open-air markets with prior experience in buying vegetables labeled with respect to how it was grown and handled show a lower WTP than those without this revealed experience (compare de Groot et al. 2009). Results suggests that the value of product information is a credence good. It might also suggest that consumers are not willing to pay for something that they think themselves of already being assured of.

At supermarkets, levels of perceived risk related to heavy metal contamination separate consumers with respect to their WTP and appropriate measures to inform consumers about production, handling and transport is to be argued for. Finally, at high-end markets our results suggest that consumers with farming familiarity have a lower WTP than consumers without such familiarity. Reasonably, these groups of consumers can differ with respect to levels of safety acceptability or awareness. It seems that the high levels of WTP found for the group without familiarity correspond to a risk premium. There is a possibility here that the uninformed chooses this market category on expectations of higher levels of safety.

With respect to policy recommendations we therefore conclude that appropriate and cost efficient ways to increase levels of trust as well as to communicate risk mitigation measures would potentially be a viable investment into a public good.

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