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# JENA ECONOMIC RESEARCH PAPERS



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## **Eliciting Environmental Preferences of Ghanaians: an Experimental Approach**

by

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# Eliciting environmental preferences of Ghanaians: An experimental approach<sup>♦</sup>

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**ABSTRACT:** In this paper we aim - through an ‘experimentally-adapted’ Contingent Valuation survey - to look into the attributes of Ghanaians’ willingness-to-pay for green products. This would help us addressing two main issues: first, from a theoretical point of view, we shall assess whether Ghanaians show a preference towards environmental goods - hence, countering the ‘too poor to be green’ argument. Secondly, from a methodological point of view, we shall try to see if the incentive compatible CV analysis provides a good measurement of subjects’ willingness-to-pay for environmental premium. Our investigation provides an answer to both issues, showing how using an incentive compatible experiment produces, in the case of Ghana, reliable results and that Ghanaians consistently show that they are willing to pay an extra premium for green products.

**JEL codes:** C9; Q5

**Keywords:** contingent valuation, experiment, incentive-compatible, Ghana, organic products, willingness to pay.

**Abbreviations:** CV, WTP, WTA, BDM, CE, CRRA

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## 1. Introduction

The idea that consumers are among the strongest actors in market economy is as old as the study of Economics.<sup>1</sup> The idea, however, that consumers also hold power to influence production patterns and direct them into being more environmentally-friendly, expressing, on the market, their willingness to pay a higher premium for products which generate smaller environmental damage has emerged with the rise of the environmental movement in the 1970s, gaining momentum only in the last two decades or so.<sup>2</sup> For example, it has been shown that US consumers may be willing to pay as high as 12 percent more for certified wood products, knowing that their purchase will contribute to the conservation or protection of forests (Ozanne and Vloskey, 2003).

In order to assess the extra premium that consumers are willing to pay for green products or services, which typically have no real markets, environmental economics has developed several methods. Among such techniques we can list the hedonic prices method, the travel cost method, the contingent valuation (CV) method and the solicitation of the willingness to pay (WTP) for an environmental good or service or, alternatively, willingness to accept compensation (WTA) for environmental damage or for the loss of an environmental good or service.<sup>3</sup>

In this paper we will tackle this very issue concentrating our attention on less developed countries (LDCs). Specifically, we shall consider the Ghanaian case study, trying - through an 'experimentally-adapted' CV survey - to look into the attributes of a group of Ghanaian students' willingness to pay for green products (an organic banana in our case). This study shall help us addressing two key questions in our investigation: first, from a theoretical point of view, we will try to answer the question whether in our experimental sample there is a tendency to value environmental goods or not. Secondly, from a methodological point of view, we will try to see if the incentive compatible experimentally-adapted contingent valuation analysis (widely used in developed countries) provides a good measurement of subjects' willingness to pay in an LDC. In doing so we will first briefly review the debate on environmental issues and less developed countries (section 2). After providing a brief review of the core theoretical issues (section 3), we will present a description of the experiment we

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<sup>1</sup> Hirschman (1970), for example, has divided consumer sanction power over corporate behaviour into three types: a positive sanction "loyalty", a negative sanction "exit" (terminating a business relationship) and "voice" (complaining or negative word-of-mouth).

<sup>2</sup> See, for instance, Kinnear and Taylor (1973); Martin and Simintiras (1995); and Prothero and McDonagh (1993).

<sup>3</sup> For a more thorough analysis of these methods, see Pearce and Turner (1990). It is worth-noting, though, that these techniques are used not only to estimate the value of "greener" market products, but also (and mainly) to elicit the value of non-market goods such as a beautiful landscape, clear air or an endangered species.

have conducted at the University of Ghana at Legon (section 4) to be followed by an interpretation of the main results obtained (section 5). Section 6 contains some concluding remarks and suggestions for possible extensions of this work.

## **2 . Environment, contingent valuation and Developing Countries**

An inquiry into the demand for green products (or, more generally, into the issue of environmental concern) is quite common in the case of developed countries, where the willingness to pay for organic products was often investigated.<sup>4</sup> However, in the case of LDCs, this field of study does not represent a very attractive research objective. In fact, many studies argue that this pattern of demand is very much correlated with the level of socioeconomic development (understood in terms of the level of GDP per capita). In other words, the assumption is that the demand (and with it, the willingness to pay) for products that are associated with more sustainable practices grows hand in hand with income.<sup>5</sup> In this context, LDCs, where a huge portion of the population is still concerned with everyday survival, are not considered an appropriate milieu for the emergence of environmental, or green, consumerism.

However, in the last 15 years or so CV has become a common method for the appraisal of WTA and WTP of the population in LDCs for improvement/worsening of environmental conditions (Carson *et al.*, 1995). Nonetheless, this method - as well as other stated-preference techniques - was applied mainly as a tool to elicit local responsiveness to programmed projects (usually large infrastructure), policies and regulations.<sup>6</sup> One example of such use is given by the World Bank that often applies the CV method before financing big infrastructural projects such as water supply or sanitation (see, for example, Pattanayak *et al.*, 2002; Cropper *et al.*, 1999).

Indeed, there are obvious difficulties of various natures which the application of stated-preference techniques in LDCs presents. It is true that in practical terms, gathering correct and valuable information (through polls, surveys, questionnaires or experiments) could be an

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<sup>4</sup> See, for instance, Gil *et al.* (2000) for Spain; Boccaletti and Nardella (2000) for Italy, and Cranfield and Magnusson (2003) for Canada.

<sup>5</sup> The Environmental Kuznets Curve hypothesis, which suggests that environmental damage first rises with economic growth and then declines, is at the heart of this assumption. According to this hypothesis, environmental damage is bound to decline since the increase in economic indicators represents structural changes that lead the economy towards more information-intensive practices. This change is coupled with growing environmental awareness - associated with post-modern societies - which gives rise to green consumerism. See Panayotou (1993), and Dasgupta *et al.* (2002).

<sup>6</sup> The discussion whether contingent valuation is a valid tool in general is not addressed here. For the criticism on the application of CV in both developing and developed countries see Diamond and Hausman (1994); Diamond *et al.* (1993) and Carson *et al.* (2001).

extremely difficult and problematic task to accomplish in such a context.<sup>7</sup> Such practical concerns are coupled with a logical one, which can be found in the literature on environment and developing countries. The argument posed is the following: can we really expect people who suffer severe problems of poverty to pay, let's say, for organic tomatoes, which are quite often more expensive?<sup>8</sup> In other words, under the logic of 'too poor to be green' (as poignantly put by Martinez-Alier, 1995), some economists maintain that due to the low income level, developing countries' citizen are not in a position to express a preference for environmental goods (see, for instance, Wolf, 2004 or Thurow, 1980). Such view is countered by other environmental economist and sociologists who argue that the environmental awareness of the population of LDCs should be examined not only in relation to their income, but also to their everyday struggles to a better environmental quality (see, for instance, Martinez-Alier and Guah, 1997; Martinez-Alier, 1995 or Brechin and Kempton, 1994).

A prominent aim of this work is hence to test the 'too poor to be green' hypothesis by means of an experimental analysis. Due to the nature of experiments (which are typically conducted among a small group of students), we are aware that our findings could hardly be generalised to the whole developing world or even to the single case of Ghana;<sup>9</sup> however, we believe this is a first step towards an empirical validation of the above discussed theoretical debate.

As already mentioned, information on the willingness to pay of consumers in developing countries for goods with more sustainable attributes is quite scarce. As also observed by Ara in a study about consumer WTP for organic rice in the Philippines, "a large number of consumer surveys on organic agricultural produce as well as food safety have been conducted in developed countries, yet the number of studies in developing countries is very limited" (Ara, 2003: 2). This observation is true also in the case of Ghana, where there are hardly any studies on this question.<sup>10</sup> Indeed, organic food production in Ghana is quite limited.

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<sup>7</sup> For a discussion on the technical difficulties and problems associated with the conduction of CV in developing countries, see Whittington (2002).

<sup>8</sup> For instance, in Ghana, our case study, the cost of living is incredibly high in relation to incomes. In a speech delivered at the launching of the Trade Union Congress of Ghana in July 1998, the Secretary General of the Union declared: "(The) standard of living of the average worker and for that matter the average Ghanaian has fallen during the last fifteen years of adjustment. Unemployment has been high [and] real incomes have reduced drastically" (see Anyemedu, 2000, and also WEFA, 2001).

<sup>9</sup> Note that the issue of generalising experimental results is a much debated one. See, for instance Smith (1976), Samuelson, (2005), Levitt and List, (2007).

<sup>10</sup> Two exceptions are worth noting in the literature vacuum context: the first is of a study which examined consumers' WTP for tomatoes produced without chemicals. According to the study, which consisted in a household survey in various cities throughout Ghana, about 50 percent of urban households were willing to pay, on average, 80 percent more for organic food, 10 percent were indifferent and 40 percent believed that a price lower by 50 percent would be appropriate<sup>10</sup> (IWMI, International Water Management Institute, cited in Danso *et al.*, 2002). Other results were obtained by another study on consumer WTP for pesticide-free and germ-free

However, it has been steadily growing in the last years and various products (amongst them bananas, pineapples, tomatoes, coconuts, etc.), some for local consumption while others for export, have followed the organic production protocol to various extents (Scialabba, 2000; Willer and Yussefi, 2004). The organic product referred to in this study (bananas) is a case in point: VREL (Volta River Estates Limited), the organic bananas producer in Ghana, although relatively small, is currently one of the leading agricultural companies in the country and the only exporter of organic bananas.<sup>11</sup>

### 3. Aim and Methodological Background of the Experiment

As explained above, we address the issue of *poor countries and the environment* by means of a laboratory incentive compatible experiment which was conducted at the University of Ghana at Legon (Accra) in October 2005. We structured the experiment into two parts; the first one, concerned with the elicitation of individuals' preference functions, serves to control for any possible bias generated by the specific cultural setting and religious beliefs of the participant. As acknowledged by many scholars, cultural specificity might affect the structure of individuals' preference function (Kachelmeier and Shehata, 1992; Ottaviano and Peri, 2006). Several authors studied the effects of cultural traits on individual behaviours and found that culture has significant and direct influence on the determination of individual preferences.<sup>12</sup>

The influence of cultural background upon individual behaviour could be particularly relevant in our case where we elicit subjects' preferences toward green products using the Becker-DeGroot-Marschak (BDM) mechanism.<sup>13</sup> Such elicitation mechanism could be perceived by players as a gamble and therefore answers could be biased by cultural adversity towards gambling. This issue is particularly relevant in Ghana, where there might be some cultural adversity towards gambling due to religious beliefs (this is pertinent mainly in the case of the Muslim minority). In light of this observation, starting our experiment by estimating risk aversion is particularly important. Such preliminary estimates would allow us to control for any possible cultural bias and therefore address our first research hypothesis:

**H<sub>1</sub>:** *It is possible to estimate Ghanaians preferences using a lottery incentive scheme and such estimates would produce results unaffected by cultural bias.*

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fresh vegetables. In this case, on average, the sampled consumers in the capital Accra were willing to pay 20 percent more for a germ-free cabbage and almost 30 percent more for a pesticide-free one (Al-Hassan and Jatoe, 2005).

<sup>11</sup> See Siaw (2003). Here, it is worth mentioning that 15 percent of the produce is sold in big cities' markets in Ghana (with no particular tag or label) (see VREL's website).

<sup>12</sup> See, among others, Roth *et al.* (1991), Burlando and Hey (1997), Bowles (1998), Henrich (2000), Oosterbeek *et al.* (2004), and Alm and Torgler (2006).

<sup>13</sup> We discuss the BDM elicitation mechanism in section 3.1, presenting the empirical properties of such mechanism.

Once having dispensed with any possible bias caused by cultural or religious beliefs, we shall move on to the second, and more relevant, part of our experimental investigation, where we attempt to estimate individual preferences for green products and more specifically for organic bananas. This second part of the experiment will allow us to test our second research hypothesis.

**H<sub>2</sub>:** *Ghanaians display a preference for green products (organic bananas) when compared to non-green products.*

If proved to be true, this theoretical hypothesis would allow us to infer that Ghanaians do have a preference for the environment and that they are willing to pay an extra premium in order to preserve it, hence countering the ‘too poor to be green’ argument. However, we should bear in mind that our experiment is conducted among a small group of students which probably do not represent the average Ghanaian due to the high level of income inequality present in the country, hence we shall be very cautious in inferring any generalisation from our empirical findings.

### *3.1 Preference Elicitation: Theoretical Background*

As mentioned in section 2, there are different strategies which are typically employed to evaluate peoples’ attitude towards green products, the most prominent approaches being the willingness to pay (WTP), i.e. the maximal buying price for a good, and the willingness to accept (WTA), i.e. the minimal selling price.<sup>14</sup> However, the empirical literature has clearly shown that the choice of one approach over another (WTP or WTA) could generate different results. More precisely, in experimental studies the WTA is generally much higher than the WTP (e.g. Knetsch and Sinden, 1984).

In this paper we shall use none of these approaches (i.e. WTP and WTA). In fact, we will attempt to estimate subjects’ preference functions using two alternative elicitation mechanisms. Specifically, we shall confront subject preferences elicited in a *choice context* (i.e. pairwise choice mechanism) and subject preferences elicited in a *price context* (i.e. certainty equivalent, CE). In the former case, the subject faces a choice between two goods (two lotteries or two different quantities of a good, organic versus non-organic bananas in our case); after having expressed his/her preference, the subject receives the good opted for.<sup>15</sup> In the latter case subjects are asked to indicate the certainty equivalent that they attribute to a lottery (in the case of an organic product this figure will coincide with the reservation price).

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<sup>14</sup> In the environmental economics literature, this notion is usually understood as the willingness to accept compensation for the loss of an environmental amenity or service.

<sup>15</sup> This factor should serve as a guarantee that subjects express their true preference.



The latter case requires the implementation of the so-called BDM mechanism<sup>16</sup> (Becker, DeGroot and Marschak, 1964). This specific incentive scheme was originally developed to construct a von Neumann-Morgenstern utility function by determining a series of certainty equivalent of binary lotteries. Here subjects are asked to state an amount of money such that they do not care whether they will receive this amount or the good. Then, a number  $z$  is randomly drawn between 1 and  $y$ , where  $y$  is higher than the value of the good in question. If  $z$  is greater or equal to the amount stated by the subject, he/she receives  $y$ , otherwise he/she receives  $y - z$  and the good itself.

In our experiment we chose to adapt a typical CV survey to include both choice-context and CE-context components, inserting it in a general incentive-compatible framework. This shall allow us to investigate if our experimental sample behaves accordingly to the ‘too poor to be green’ hypothesis or not ( $H_2$ ). However, before stepping into the ‘environmental evaluation’ part of our analysis we shall address the first research hypothesis, namely whether estimating Ghanaians preferences using a lottery incentive scheme produces results unaffected by cultural biases ( $H_1$ ).<sup>17</sup>

### *3.2 Preference Elicitation: Some notes on estimation techniques*

As just discussed we estimate Ghanaians’ preferences using both certainty equivalent method and pairwise choice data. We shall now briefly explain how such estimations are actually made.

The estimation of the parameters of the utility function from pairwise choice data follows Hey and Orme (1994). Let’ indicate the two lotteries in the pairwise choice by  $L$  and  $R$ ; then, assuming that there is no noise or error in the subject’s responses, she/he will report a preference for  $L(R)$ , if and only if  $Eu(L) > (<) Eu(R)$  - that is, if and only if  $E[u(L) - u(R)] > (<) 0$ . However, as we know from the existing literature, subjects’ responses are typically affected by noise. If we denote this noise or measurement error by  $\varepsilon$ , then the subject will report a preference for  $L(R)$ , if and only if  $E[u(L) - u(R)] + \varepsilon > (<) 0$ , that is, if and only if  $\varepsilon > (<) E[u(R) -$

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<sup>16</sup> There are two orders of reasons which support our decision to use BDM: first and foremost, Hey, Morone and Schmidt (2007) showed in a recent paper how (under the assumption that subjects have Expected Utility functions) “BDM performs better than ASK [WTA], which, in turn, performs better than BID [WTP]” (2007: 13); secondly, given the fact that at the University of Ghana there was no computer laboratory available to conduct the experiments, BDM turned to be more suitable for paper and pencil experiments.

<sup>17</sup> In our experiment we presume that all individuals behave according to Expected Utility theory. Note that, however strong, this assumption is supported by a wide empirical and theoretical literature. Using solely choice data, Harless and Camerer (1994), Camerer and Ho (1994), Hey and Orme (1994), Hey (1995), and Harrison (1994) found that expected utility is, at least from a statistical point of view, not dominated by its more general alternatives. Using both price and choice data, a similar finding was obtained by Schmidt and Hey (2004), and by Morone and Schmidt (2003).

$u(L)]$ . Following this line of reasoning we can now write the probability that the subject reports a preference for  $L$  ( $R$ ) as:  $\text{Prob}\{\varepsilon > (<) E[(R) - u(L)]\}$ .

Given the actually reported preferences, we will proceed to the estimation of the parameter  $r$  (the relative risk aversion coefficient) using maximum likelihood methods. To do so we need to specify the distribution of the measurement error which we shall assume to be normally distributed with mean 0 and variance  $s^2$ . As noted by Hey and Orme (1994), the magnitude of  $s$  measures the noisiness of the subject's responses: if  $s = 0$  then the subject makes no mistakes - as  $s$  increases, the noise gets larger and larger. In the limit, when  $s$  is infinite, there is no information content in the subject's responses.

For the certainty equivalent methods, we follow the same route. If the subject is asked to provide his/her certainty equivalent for some gamble  $G$ , we will assume that the subject calculates the Expected Utility of the gamble, according to his/her utility function, and then calculates  $V$  - that is, certain amount of money that yields the same utility. We can now write  $u(V) = EU(G)$ . However, if we acknowledge the existence of error and model it as above, then we have  $u(V) = EU(G) + \varepsilon$ , and can hence note that the probability density of  $V$  being reported as the certainty equivalent of the gamble, is given by  $f\{u^{-1}[EU(G) + \varepsilon]\}$ , where  $f(\cdot)$  is the probability density function of  $\varepsilon$ . If we now make the same assumption about the distribution of the measurement error  $\varepsilon$  - namely that it is  $N(0, s^2)$  - we can proceed to the estimation of the  $r$  and  $s$  parameters by maximum likelihood.

Note that when estimating an utility function from an experiment, there are two usual approaches: (a) to assume a particular functional form and estimate the parameters of that form; or (b) to estimate the utility at the various outcome values used in the experiment. In the experiment which we conducted, there were four outcome values (\$0, \$1, \$3 and \$4) which we denote by  $x_1, x_2, x_3$  and  $x_4$ . If we adopt the usual normalisation, we put  $u_1 = 0$  and  $u_4 = 1$ , where we denote  $u(x_i)$  by  $u_i$ . This means that, following approach (b), we simply estimate  $u_2$  and  $u_3$ .

However, when we are using certainty equivalent estimation we need to know the value of the utility at outcome values other than  $x_1, x_2, x_3$  and  $x_4$ . This requires assuming a particular functional form for subjects utility - i.e. following approach (a). To make this equivalent to the estimation following approach (b) we need to choose an appropriate functional form. We assumed that subjects have a Constant Relative Risk Aversion (CRRA) utility function. Further, to over impose the normalisation used above - that is,  $u_1 = 0$  and  $u_4 = 1$  - we need to adopt the following specific form:

$$u(x) = (x/4)^r$$

We then need to estimate only the parameter  $r$  as it fully describes the utility function of each individual. However, we assume that the standard deviation of the noise - that is, the magnitude of  $s$  - is different for the different elicitation methods (i.e. choice and price), and we estimate them individually. So we estimate the noise for each of the elicitation methods. Once having calculated  $r$  and its noise standard deviation ( $s$ ), we will attempt to see if there is any bias in the elicitation methods. Following again Hey and Orme (1994) we model any potential bias in the CE elicitation method assuming that there is a *true* valuation  $V$  and a *reported* valuation  $v$ , which are related by:

$$v = a + bV$$

Here the parameters  $a$  and  $b$  determine the bias in the reporting of the certainty equivalents. If  $a = 0$  and  $b = 1$  there is no bias. We assume no bias in the pairwise choice elicitation method as it is hard to believe that subjects, when expressing their preferences in a pairwise choice gamble (i.e. where they have to choose between the left-hand side or the right-hand side lottery), err systematically in favour of one or the other (i.e. the one on the right or the one on the left). Note that we are not assuming by any means that in such context there is no error; however, we can confidently state that subjects will hardly be affected by systematic errors (hence, error preserves the characteristics of white noise). In this regard, some further explanation is perhaps needed. With the certainty equivalent methods, particularly with the willingness to pay and the willingness to accept questions, there are well known biases: when asked how much they are willing to pay, it is widely agreed that subjects underbid; and they are asked how much they are willing to accept, they over-ask.<sup>18</sup> This is partly because subjects do not appear to fully understand the question and perceive of it as some kind of strategic game. In contrast, a pairwise choice question is not open to such a misinterpretation, particularly in the context of the usual incentive mechanism; in other words, if the subject knows that her/his stated choice on any pairwise choice question is to be played out (and he or she is paid accordingly), what (conscious or unconscious) reason is there for not replying according to his/her true preferences?

#### 4. The Experiment

As mentioned, our experiment was conducted at the University of Ghana at Legon (Accra) in October 2005. 38 subjects participated in the experiment:<sup>19</sup> 19 undergraduate and postgraduate Geology students and 19 undergraduate students of Agricultural Economics.<sup>20</sup> As aforementioned, we do not believe that these students are wholly representative of

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<sup>18</sup> See, among others, Kahneman, Knetsch and Thaler (1991); Samuelson and Zeckhauser (1988).

<sup>19</sup> Note that we originally recruited 20 students for each treatment; however, in each treatment one student did not show up.

<sup>20</sup> An additional session was run in October 2006 where we interviewed 20 students following a standard CV approach. See Contingent Valuation Session in the Annex.

Ghanaian society; we are very much aware of the fact that higher education in Ghana is costly and that students are thus generally from families which are, at least to a limited extent, better-off. Even so, we believe that University students are most likely to produce, in the future, the new leadership class of the country; a leadership able to influence the ideas and patterns of behaviours of local communities, either through a direct participation in policymaking processes - for instance, as politicians - or through a grassroots type of activism - for instance, as tribal chiefs or as NGO activists. Having this in mind, we shall maintain that the Ghanaian students who participated in the experiments, while not representative of the entire population, are most likely to turn into important agents of change in their society. As such, their valuation of the environment appears to be particularly interesting and pertinent to the question of policymaking.

The experiment's administration was facilitated through the use of a booklet, handed out to each subject and divided into four parts; in the first part, subjects were asked to provide some socio-demographic information (age, age of father, as well as some indicators to help inferring the socio-economic status of the family) and information about their environmental awareness and knowledge.<sup>21</sup> In the second part of the booklet, subjects were provided with a briefing note containing some explanations on the costs and benefits associated with the production of organic bananas (see Annex). The last two parts consisted in the actual experimental design, which was divided into two sessions: in the first session we elicited preference towards risk (through the use of lotteries) and in the second session we elicited preference towards green products (to be referred to from now on as *organic*). Every group of students participated in one treatment: in the first we investigated *price* behaviour while in the second *choice* behaviour.

Overall, we conducted two sessions for each treatment (as summarised in table 1) that lasted about 1 hour each. As already mentioned, 19 subjects participated in the *price* treatment, and 19 subjects participate in the *choice* one. Subjects were admitted to only one treatment of the experiment to avoid anchor effects.

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<sup>21</sup> For instance, previous knowledge about risks associated with pesticides, importance attributed to environmental issues in Ghana, involvement in environmental grassroots or non-governmental organisation, etc. The results of this questionnaire shall not be discussed here. For the purposes of this study, it is sufficient saying that respondents, mostly, considered themselves *very much* aware of the risks associated with pesticide residues in fresh produce. For the complete questionnaire and its results, see the Annex.

	<i>Treatment 1</i>	<i>Treatment 2</i>
<b>Session 1</b>	Price-Lottery	Choice-Lottery
<b>Session 2</b>	Price-Organic	Choice-Organic

**Table 1:** The structure of the experiment

At the end of each treatment we randomly selected one subject who actually played the lottery with an endowment equal to about US\$ 4.5 (40,000 cedi) in the case of price-lottery, and equal to US\$ 2.25 (20,000 cedi) in the case of price-organic. All other subjects received approximately US\$ 3.3 as participation fee (30,000 cedi). The whole procedure was carefully explained to all participants before starting the experiments.

In the *Price-Lottery* session subjects were presented with 56 lotteries. A detailed list of all probabilities for each lottery is reported in the Annex. All lotteries were composed by as high as three of the four consequences \$0, \$1, \$3 and \$4. For each gamble subjects were asked to state their CE. In the *Choice-Lottery* session, on the other hand, subjects were presented with 28 pairwise choice lotteries. The complete probabilities list of each pair of lotteries is reported in the Annex.

In the *Price-Organic* session subjects were asked to state the price they were willing to pay to buy  $q$  organic bananas, where  $q \in [1, 20] \subset N$ . In the *Choice-Organic* session subjects were asked to choose between  $q$  organic bananas and  $(q + i)$  non-organic bananas, where  $q \in [1, 10] \subset N$ , and  $i \in [1, 10] \subset N$ . Subjects were requested to state their choices.

In all sessions we used incentive compatible elicitation mechanisms: CE was elicited with the Becker-DeGroot-Marschak mechanism, where each subject had to state his/her CE for the lottery/organic good. Once subjects have handed in their booklets, the experimenter randomly picked one of the 56 lotteries and a randomly selected subject got the right to play it out. Indifference was not allowed. In the case of pairwise choice, the experimenter randomly picked one of the 28 pairs of lotteries and a randomly selected subject got the right to play it out. Also in this case indifference was not allowed. A similar procedure was followed in the price-organic and in the choice-organic sessions.

## 5. Results

We will now report the main results obtained in the experiment. We shall first consider the results obtained in the two lottery sessions. As already mentioned, this part of the experiment is meant to allow us to investigate individuals' preference functions. Subsequently we will present the results obtained in the organic sessions which is meant to allow us to study Ghanaians' preferences for green products and more specifically for organic bananas.

### 5.1 Lotteries sessions' results

We estimate individual preferences functions subject by subject as players clearly differ in terms of their preferences. In order to estimate individual preferences we shall calculate the utility function  $u(x)$  as defined in section 3. As already mentioned, all we need to calculate to define the individual preference function is the parameter  $r$  (i.e. the relative risk aversion coefficient) as it gives a complete account of the utility function of the individual. Subsequently we will estimate the log-likelihood values of our estimates which provide a first measurement of their goodness of fit. Recalling the discussion conducted earlier we shall then attempt to measure the error and the bias attached to our estimates. Specifically, we will measure the estimated standard deviation of the measurement error ( $s$ ) and the parameters  $a$  and  $b$  which determine the bias in the reporting of the certainty equivalents intercept.

	Relative risk aversion coefficient	Goodness of fit	Bias		Standard deviation of the measurement error
			Intercept	Slope	
Subjects	$r$	Log-likelihood	$a$	$b$	$s$
1	0.742	-2.030	3.252	-0.047	0.668
2	0.122	-1.205	0.702	1.284	0.442
3	0.722	-2.027	3.267	-0.139	0.667
4	0.529	-1.856	2.524	0.426	0.612
5	0.469	-1.996	2.665	0.173	0.657
6	0.379	-1.456	1.883	0.601	0.501
7	0.021	-1.907	-0.331	1.440	0.628
8	0.230	-1.150	1.383	0.552	0.430
9	0.263	-1.493	0.959	1.203	0.511
10	0.223	-1.778	1.525	0.578	0.589
11	0.163	-1.260	0.795	1.327	0.454
12	0.104	-1.046	0.624	0.816	0.408
13	0.331	-1.572	1.965	0.576	0.531
14	0.685	-1.552	1.921	0.608	0.526
15	0.429	-1.953	2.544	0.276	0.642
16	0.498	-1.749	1.982	0.389	0.580
17	0.725	-2.017	3.294	-0.164	0.663
18	0.246	-1.935	2.118	0.254	0.637
19	0.504	-1.931	2.584	0.256	0.635

**Table 2:** Estimations of CRRA Model with BDM data (price-lottery)

In table 2 we present the estimations obtained using BDM responses. Looking at these results we can draw some preliminary conclusions: first, the relative risk aversion coefficient is always smaller than 1 and is, on average, equal to 0.38. As we know from our utility function,  $r$  equals 1 when the subject is risk neutral, smaller than 1 if she/he is risk averse and bigger

than 1 if the subject is risk lover. Hence, we can conclude that our subjects are, on average, risk averse. These findings are quite satisfactory as they are pretty much comparable to previous results obtained by the vast literature which refers to developed countries. All in all, this is a preliminary confirmation of our first hypothesis ( $H_1$ ), according to which when estimating Ghanaians preferences using a lottery incentive schemes, such estimates would produce results unbiased by the specific cultural setting and religious beliefs of the participant.

We shall now turn to consider the goodness of fit of our estimations, the error standard deviation and the estimation bias. In the third column of table 2 we report the log-likelihood values of our estimates which, as already mentioned, are a first measurement of the goodness of fit. The value is, on average, around -1.6 and varies moderately across estimations. The forth and the fifth columns of table 2 report the bias estimate and specifically the  $a$  and  $b$  coefficients. As noted earlier, an unbiased estimation would have produced a value of  $a$  equal to 0 and a value of  $b$  equal to 1. As this is clearly not the case here, we can conclude that there is a bias in our estimations. Finally, in the last column of table 2 we report a measure of the error standard deviation. At this stage, knowing that the standard deviation varies across 0 and  $+\infty$ , we can maintain that these estimates display a relatively small error standard deviation.

We shall now move on to estimate individual preferences using the choice data. In table 3 we present the estimations obtained using pairwise-choice responses. As already discussed, it is natural to assume that this elicitation method produces unbiased estimates. Hence, we report here solely the estimated risk attitude ( $r$ ), the log-likelihood values as a measure of the goodness of fit and the estimated standard deviation of the measurement error ( $s$ ).

As we can immediately notice, again subjects display, on average, a moderate risk aversion. However, in this case, risk aversion is slightly more pronounced as it reaches an average value of 0.29. This result corroborates our earlier finding that estimating Ghanaians' preferences using a lottery incentive scheme would produce results unbiased by the specific cultural setting and religious beliefs of the participants. The goodness of fit of these second estimates (choice-lottery) is generally higher than that obtained in the price-lottery case. As we can derive from Hey and Orme (1994), the higher the log-likelihood value is - the better is the model. Hence, we can conclude that the choice model produces a better fit. The reason behind such finding is probably that a choice problem is an easier task to solve.<sup>22</sup> Finally, when looking at standard deviation of the measurement error we can corroborate our earlier finding that choice data provides more accurate results. In fact, the choice data standard error is generally smaller than the price data one.

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<sup>22</sup> Note that this finding is in line with existing literature. See, among others, Morone and Schmidt (2003) and Hey, Morone and Schmidt (2007).

	Relative risk aversion coefficient	Goodness of fit	Standard deviation of the measurement error
Subjects	r	Log-likelihood	s
1	0.247	-0.210	0.115
2	0.234	-0.166	0.163
3	0.472	0.000	0.003
4	0.514	0.000	0.000
5	0.284	-0.117	0.096
6	0.273	-0.192	0.092
7	0.232	-0.098	0.107
8	0.314	-0.210	0.126
9	0.236	0.000	0.001
10	0.218	0.000	0.000
11	0.274	-0.268	0.094
12	0.348	-0.080	0.127
13	0.317	-0.233	0.165
14	0.291	-0.249	0.137
15	0.312	-0.202	0.103
16	0.249	-0.113	0.035
17	0.272	-0.137	0.078
18	0.265	-0.061	0.045
19	0.144	-0.140	0.138

**Table 3:** Estimations of CRRA Model with pairwise-choice data (choice-lottery)

We can conclude that this investigation, in the case of Ghana, is in line with results previously obtained in the literature. Specifically, we can maintain that Ghanaians are generally risk averse and that using choice problem to elicit individual preferences (although providing less information if compared to price lotteries) produces better results, i.e. smaller error and better fit.

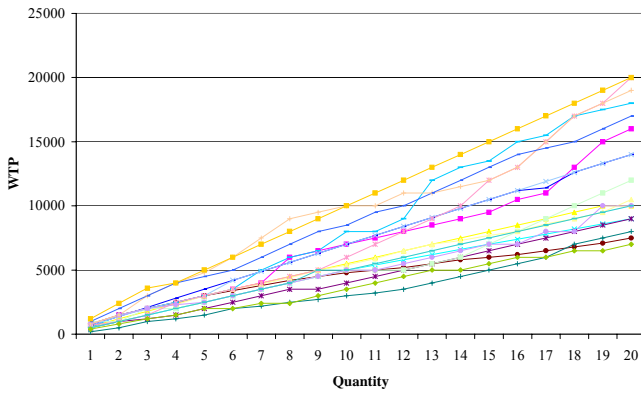
## 5.2 Organic sessions' results

In the environmental preferences evaluation part of our experiment we attempted to elicit the real extra premium that subjects, as consumers, are willing to pay for green products (organic bananas).<sup>23</sup> In figures 1 and 2 we report subjects' willingness to pay for a growing number of respectively organic and non-organic bananas. Consequently the slopes of these curves ( $\lambda$ ) represent the reservation prices attributed by players to both organic and non-

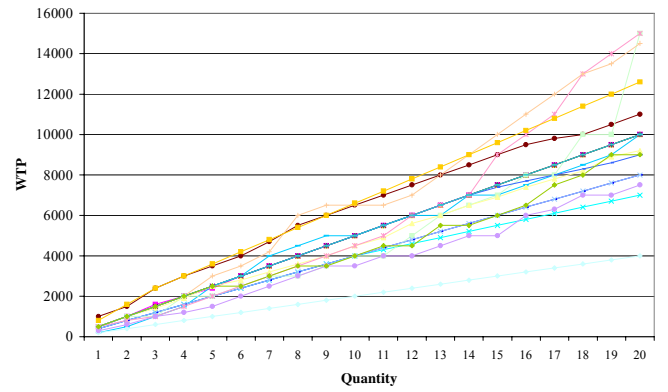
<sup>23</sup> As already discussed, we use an incentive-based mechanism in order to elicit the real willingness to pay for organic bananas. In the Annex we compare these findings with those obtained through the CV interviews (i.e. where subjects were not faced with a real payment scenario). We also provide socio-demographic as well as environmental awareness information gathered through a questionnaire identical to the one used for the incentive-based experiment.



organic bananas. As we can see, the slope of these curves is almost constant as the curves tend to be linear in fashion. This suggests that under the assumption of linearity, marginal price (i.e. the reservation price for each additional unit of the good considered) and average price coincide. Moreover, this implies that the marginal price expressed by subjects is independent from the quantity acquired, suggesting that players do not show the occurrence of income or substitution effects. Note that this finding should not come as a surprise given the relatively small number of bananas offered in our experiment.



**Figure 1:** Subjects' willingness to pay for organic products (price-organic)



**Figure 2:** Subjects' willingness to pay for non-organic products (price-organic)

Further to this, it is relevant to show how our result counters the Diamond *et al.* (1993) critique according to which WTP analysis does not pass the adding-up test due to the embedding effect - i.e. that willingness-to-pay is the same whether one or several items are valued. We are not, by any means, maintaining that our result contradicts the overall significance of Diamond *et al.*'s argument; however, we hold that it does not apply to the specific environmental good considered in this experiment.

We shall now estimate the slope of each curve, under the assumption of linearity, and

compare them across subjects.<sup>24</sup> Note that the price ratio  $\left( \frac{\lambda_{organic}}{\lambda_{non-organic}} \right)$  calculated subject by

subject represents the substitution rate of the two goods. Therefore, this rate can give us a measure of the 'organic premium' i.e. the appreciation of the environment as it is expressed directly by the Ghanaians who participated to the experiment. In other words, by looking at these ratios we are able to address our second research hypothesis (H<sub>2</sub>); more specifically we are able to verify whether Ghanaians display a preference for green products when compared

<sup>24</sup> We do this by means of OLS estimates.

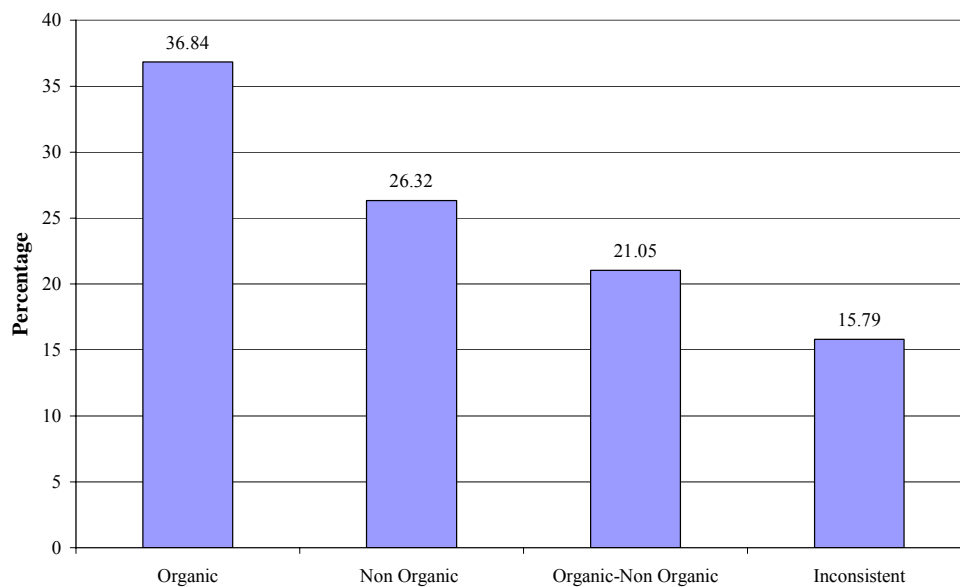
to non-organic ones. Note that a substitution rate higher than 1 implies a preference for green products (and a consequently higher willingness to pay), whereas a value smaller than 1 implies a preference for non-organic goods. Of course, if the ratio is equal to unity it implies that the two goods are perceived as perfect substitutes in a ratio of 1 to 1.

Subjects	$\lambda_{\text{organic}}$	$\lambda_{\text{non-organic}}$	substitution rate
1	700.800	499.930	1.402
2	532.400	500.000	1.065
3	467.420	367.420	1.272
4	433.830	500.000	0.868
5	411.500	593.620	0.693
6	349.790	500.000	0.700
7	697.040	400.000	1.743
8	806.450	485.440	1.661
9	463.420	200.000	2.317
10	465.160	511.150	0.910
11	482.970	460.310	1.049
12	647.080	400.000	1.618
13	726.100	612.400	1.186
14	440.980	363.900	1.212
15	839.870	678.710	1.237
16	793.210	477.530	1.661
17	465.160	500.000	0.930
18	332.340	429.090	0.775
19	928.230	643.620	1.442

**Table 4:** Organic-non organic substitution rate (choice-organic)

The data displayed in table 4 shows that in 13 out of 19 cases subjects exhibit a preference for organic goods. This finding suggests that almost 68.5 percent of the players that took part at the experiment have a clear preference for protecting the environment. This awareness to environmental issues results in the willingness to pay, on average, 20 percent more for green products. If we consider the premium only for those subjects who have stated a preference for green products, than the figure goes up to around 35 percent. We note that this finding, obtained through an incentive-compatible experiment in a laboratory environment, confirms previous results obtained using a WTP survey approach. The already cited study of Al-Hassan and Jatoe (2005) found that consumers interviewed in the capital Accra were willing to pay 20 percent more for a germ-free cabbage and almost 30 percent more for a pesticide-free one. It should be stressed, however, that while the aforementioned study was focused on the health implications of pesticide use, our study investigated attitudes towards environmentally-sound practices, where human health implications are only but one element.

We shall now compare the results obtained through the price-organic experiment with those obtained through the choice-organic one. Looking at the choice data (figure 3), we have a very clear picture: 36.84 percent of the subjects always chose the organic product, while 26.32 percent always preferred the non-organic product. Slightly more than one fifth of all subjects (21.05 percent) first expressed their preference for the organic product and subsequently, once the number of non-organic bananas was sufficiently high (i.e. when the  $i$  value was sufficiently high), switched to the non-organic product. Three subjects seem to be inconsistent since they do not respect transitivity (e.g. after having first stated their preference for 2 non-organic bananas over 1 organic banana, they switched their preferences to 1 organic banana over 3 non-organic bananas).



**Figure 3:** Subjects' categorisation in the choice data experiment (choice-organic)

Overall, the choice-organic results confirm our findings for the price-organic sessions: almost 58 percent of the experimental subjects<sup>25</sup> displayed a preference for organic products, out of which 36.84 percent showed a persistent preference for organic products (i.e. regardless of the number of extra non-organic bananas offered during the experiment).<sup>26</sup>

<sup>25</sup> This percentage goes up to 68.74 if we exclude those three agents who showed an inconsistent behaviour. Interestingly enough, this percentage is exactly the same as the one obtained with price data.

<sup>26</sup> Note that typically, Ghanaians prefer the small non-organic bananas that, they claim, are sweeter. This preference is also explainable by the fact that the bigger, organic bananas are normally exported, so as to satisfy preferences of developed countries consumers and not local. Assuming that also the participants in the experiment tend to prefer the non-organic bananas for their sweetness, we can conclude that our results - where a clear preference towards organic bananas has been observed - are even more significant.

All in all, we can conclude that also by looking at choice data we get a confirmation to our second hypothesis. Moreover, as noted earlier, only few subjects provided inconsistent answers (3 out of 38 if we consider both experimental sessions). This suggests that students involved in the experiment have clearly understood the type of experiment they took part in and that the incentive scheme was appropriate. This fact suggests that the standard preferences elicitation techniques in an incentive-compatible experiment turned out to be an adequate tool to elicit Ghanaians preferences towards the environment.

Subjects	Threshold of substitution
1	confused
2	$a > 11$
3	$3 < a < 4$
4	$a > 11$
5	$a > 11$
6	$a = 2$
7	confused
8	$a > 11$
9	$4 < a < 5$
10	$a < 2$
11	$a < 2$
12	$a < 2$
13	$a < 2$
14	$a > 11$
15	$a > 11$
16	$6 < a < 7$
17	confused
18	$a < 2$
19	$a > 11$

**Table 5:** Organic-non organic substitution thresholds (choice-organic)

As discussed earlier, choice experiments, though simpler to understand, provide less information if compared to price experiments. In fact, with choice data we cannot calculate the exact substitution rate of the two goods. We can, however, calculate the threshold value above which agents are willing to opt for one good or the other. In table 5 we report these threshold values calculated for each subject.<sup>27</sup> First, we observe that such threshold is not calculable for those players who were earlier classified as inconsistent as they move back and forth from such threshold. Second, we can see that for seven subjects all we can say is that the substitution threshold lies somewhere above the ratio one to eleven; in fact, we are

<sup>27</sup> Note that comparing the substitution rate reported in table 4 and the substitution thresholds reported in table 5, we can observe significant differences. This is, of course, due to the different elicitation methods used in the two sessions.

unable to identify this threshold in our experiment (if existing), where the highest substitution rate proposed to players was as high as one to eleven. Third, four players are either indifferent (with a ratio of one) between the two goods or prefer non-organic bananas. Forth, for three agents we can define an interval of substitution included among two adjacent integers. Finally, for one player we can pinpoint the exact substitution rate, under the assumption that random answers within the same  $i$ -group of questions imply indifference.<sup>28</sup>

## 6. Conclusions

The aim of this study was to investigate Ghanaians preferences towards the environment; we did so by means of a laboratory experiment conducted at the University of Legon in Accra. Specifically, we set the objective of addressing the following two research hypotheses:

H<sub>1</sub>: *It is possible to estimate Ghanaians preferences using a lottery incentive scheme and such estimates would produce results unaffected by cultural bias*

H<sub>2</sub>: *Ghanaians display a preference for green products (organic bananas) when compared to non-green products*

Our experimental results suggest that both hypotheses have proved to be true in the case of Ghana. Bearing in mind that our experiment has been conducted among University students, whose economic conditions are likely to be above the average Ghanaian, we believe this result is a first step towards a much needed direct elicitation of local preferences towards the environment in LDCs. This idea counters what Brechin and Kempton have dubbed ‘the conventional wisdom’, according to which “citizens of developing countries do not or cannot care about the environment” (1994: 247) or that they are ‘too poor to be green’.

In terms of implications of our study, we feel that our results should stimulate further research, aiming, eventually, at suggesting an environmental policy based on the direct involvement of local stakeholders in the definition of local policies.

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<sup>28</sup> Recall that in the choice-organic session subjects were asked to choose between  $q$  organic bananas and  $(q + i)$  non-organic bananas, where  $q \in [1, 10] \subset N$ , and  $i \in [1, 10] \subset N$ .

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## Annex

### I. Socio-demographic and environmental awareness questionnaire

<p><b>Please answer the following questions, by circling the answer that most suits you or by ticking the box. The information you will provide us with will remain anonymous and is only used to for statistical purposes.</b></p>	
<p>1. How would you define your concern for the environment?</p>	<p>1 - very concerned  2 - quite concerned  3 - concerned, but only to a certain extent  4 - not very concerned  5 - it doesn't concern me at all</p>
<p>2. How important do you think environmental issues are?</p>	<p>1 - Very important  2 - Quite important  3 - Important, but only to a certain extent  4 - Not very important  5 - Not important</p>
<p>3. Are you a member of any associated involved in environmental protection?</p>	<p>1- Yes*  2- No  * If yes, which one? _____</p>
<p>4. How important do you consider to be each of the following attributes of an ecological product?  <i>Please express the level of importance by writing into the boxes one of the following numbers.</i>  1 - Very important  2 - Quite important  3 - Important, but only to a certain extent  4 - Not very important  5 - Not important</p>	<p><input type="checkbox"/> Recyclable  <input type="checkbox"/> Use of ecological production (for instance, lower energy consumption, waste disposal minimisation, organic methods)  <input type="checkbox"/> Production using renewable resources  <input type="checkbox"/> Production using toxic/dangerous materials  <input type="checkbox"/> Other (please specify) _____</p>
<p>5. How much do you know about Ghana's environmental situation?</p>	<p>1 - I am very updated as far as environmental issues in Ghana are concerned (through newspapers, leaflets of NGOs, reports of international organisations, local activism)  2 - I follow, occasionally, reports/news about environmental issues in Ghana and</p>

	try to keep myself updated <b>3</b> - I follow environmentally-related news in Ghana only if I accidentally come across them <b>4</b> - I know very little about the environmental situation of Ghana (only big events that reach the TV news editions) <b>5</b> - I know nothing about Ghana's environment
6. As far as you know, Ghana's environmental situation is...	<b>1</b> - Very good <b>2</b> - Quite good, considering its economic situation, and likely to improve <b>3</b> - Deteriorating but with a positive outlook <b>4</b> - Not so good <b>5</b> - Deteriorating with no encouraging outlook
7. How much are you aware to the dangers of pesticide residues in fruit and vegetable?	<b>1</b> - very aware <b>2</b> - quite aware <b>3</b> - aware, but only to a certain extent <b>4</b> - not very aware <b>5</b> - I don't know anything about it
<b>Other questions*</b>	
1. How old are you?	
2. How old is your father?	
3. Do you have a telephone?	<input type="checkbox"/> Yes <input type="checkbox"/> No
4. Do you a TV set?	<input type="checkbox"/> Yes <input type="checkbox"/> No
5. Do you have a computer?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Do you use the internet?	<input type="checkbox"/> Yes <input type="checkbox"/> No

## II. Questionnaires' results

Results of the socio-demographic and the environmental awareness questionnaire (Agricultural Economics students session)																		
	Question 1	Question 2	Question 3	Question 4						Question 5	Question 6	Question 7	Age	Father's age	Telephone	TV	PC	Internet
Subject	How would you define your concern for the env.?	How important do you think env. issues are?	Are you a member of an assoc involved in env protection?	How important do you consider each of the following attributes of an eco product?	Recyclable	Use of ecological production	Prod. using renewable resources	Prod. using toxic/dangerous materials	Other	How much do you know about Ghana's env. situation?	As far as you know, Ghana's env. situation is...	How much R U aware to dangers of pesticide residues in fresh produce?						
	1 3	1 1	2 2		2 1	2 1	1 1	4 1		3 3	2 3	2 1	21 21	56 51	1 1	1 1	1 1	1 0
	2 1	1 1	2 2		1 1	1 1	1 1	1 1		3 2	4 1	1 1	21 25	57 95	1 1	1 1	1 1	1 1
	4 2	1 1	2 1		1 2	1 2	2 3	5 4		4 1	2 4	1 1	25 23	95 63	1 1	1 1	1 1	1 1
	5 1	1 1	1 - FoE		1 2	1 2	3 1	4 5		1 3	4 3	1 1	23 28	63 55	1 1	1 1	1 0	1 1
	6 1	1 1	2 1		2 4	2 4	1 1	5 5		1 3	3 1	1 1	28 21	55 51	1 1	1 0	1 1	1 1
	7 1	1 1	1 - Wild Life		1 2	1 2	1 1	5 5		2 3	5 3	3 3	21 22	51 43	1 1	0 1	1 1	1 1
	8 1	1 1	2 2				2 1			2 1	5 1	3 1					0 0	1 1
	9 2	2 2	2 2		1 1	1 1	2 1	5 5		1 5	1 2	1 1	22 23	43 61	1 0	1 1	1 0	1 1
	10 1	1 1	2 2		1 1	1 1	1 1	5 1		4 2	2 3	1 1	23 23	61 50	0 1	1 1	1 1	1 1
	11 1	1 1	2 2		1 1	1 1				1 3	1 3	1 1	23 22	50 47	1 1	1 1	1 1	1 1
	12 3	1 1	2 2		1 1	1 1	1 1	4 3		4 3	1 2	1 1	22 22	47 67	1 1	0 1	0 1	1 1
	13 1	1 1	2 2		2 1	2 1	1 1	3 5	Use or products that are biodegradable	4 2	2 3	1 2	22 22	67 67	1 1	1 1	1 1	1 1
	14 2	1 1	2 2		1 1	1 1	1 1	5 5		2 3	3 4	2 1	23 23		1 1	1 1	0 0	1 1
	15 1	1 1	1 - Green Earth		1 1					2 4	1 3	1 3	23 23		1 1	1 0	1 0	1 1
	16 3	2 2	2 2		2 2	2 2	1 1	2 2	Labour cost	4 4	2 3	4 3	23 21	50 58	0 0	0 1	0 1	1 1
	17 1	1 1	2 2		1 1	1 1	1 1	5 5		2 3	2 5	3 3	21 22	58 63	0 0	0 0	0 0	1 1
	18 1	1 1	2 2		1 1	1 2	1 1	5 1		3 2	5 2	3 1	22 25	63 68	0 1	0 0	0 0	1 1
	19 2	1 1	2 2					1 1		2 2	2 2	2 2	1 1	25 25	68 68	1 1	0 0	0 1
Average	1.58	1.11			1.27	1.50	1.27	4.14		2.42	3.21	1.63						

Results of the socio-demographic and the environmental awareness questionnaire (Geology students session)																	
	Question 1	Question 2	Question 3	Question 4					Question 5	Question 6	Question 7	Age	Father's age	Telephon	TV	PC	Internet
Subject	How would you define your concern for the env.?	How important do you think env. issues are?	Are you a member of an assoc involved in env protection?	How important do you consider each of the following attributes of an eco product?	Recyclable	Use of ecological production	Prod. using renewable resources	Prod. using toxic/dangerous materials	How much do you know about Ghana's environmental situation?	As far as you know, Ghana's environmental situation is...	How much R U aware to dangers of pesticide residues in fresh produce?						
1	1	1	2		1	1	1	5	3	2	3	27	65	1	1	1	1
2	1	1	2		1	1	1	5	2	3	2	22	61	1	1	1	1
3	3	2	2		3	3	2	5	4	4	3	23	62	1	0	1	1
4	1	1	2		1	1	1	4	3	3	3	28	68	1	1	0	1
5	1	1	2		1	1	1	1	3	4	4	33		1	1	1	1
6	3	1	2					1	4	4		36	56	1	1	0	0
7	2	2	2		1	2	1	5	2	3	3	21	50	1	1	1	1
8	1	1	2		1	1	1	5	2	2	1	34		1	0	1	1
9	1	1	1 - FoE		3	1	2	5	1	3	3	25	58	1	0	0	1
10	1	1	2			1			2	3	1	24		1	1	1	1
11	1	2	2			1			2	4	3	23	48	1	1	1	1
12	1	1	2		2	1	3	5	4	3	1	22	79	1	1	1	1
13	1	1	2		2	1	2	5	2	4	1	25		1	1	1	1
14	1	1	1 - Ged Stud Associ		1	1	1	4	2	3	1	23	72	1	1	0	1
15	2	1	2			1	1	1	3	3	1	18	40	1	1	1	1
16	1	1	2		1	1	1	5	2	3	1	23	53	1	1	1	1
17	1	1	2		1	1	1	5	2	3	1	23	53	1	1	1	1
18	2	1	2		2	1	2	5	5	2	3	21		1	1	1	1
19	2	1	2		1	1	1	2	2	3	2	22	62	1	1	1	1
Average	1.42	1.16			1.47	1.18	1.38	4.40	2.63	3.11	2.06						

### III. Organic bananas production - scenario provided to participants in the experiment

Banana cultivation is an important source of foreign exchange in tropical countries in Latin America, the Caribbean and Africa<sup>29</sup>. The economic gains are immediate and seemingly constant as it is a plant which grows quickly and can be harvested all year round. But these advantages are not priceless. According to Yamileth Astorga<sup>30</sup>, bananas cultivation – a perennial crop which has established itself as intensive and mono-cultural – requires the following inputs: large amounts of land, tight control over the amount of water, shallow systems of canals and drainage ditches, high levels of fertilisers and pesticide application, careful attention to de-leafing, de-suckering and maintenance and a substantial labour-force.

The environmental and human consequences are, thus, not marginal. One of these concerns arises from the issue of genetic uniformity. In fact, there are more than 300 varieties of bananas in the world; yet, as the most popular ones in the North are the Cavendish-type bananas, most producers shift to this plant (47% of production)<sup>31</sup>, creating a genetically homogenous banana market which is, by definition, a more vulnerable and less resilient eco-system. Other, more straightforward, environmental impacts include deforestation (due to continuously expanding plantations), soil depletion (due to intense cultivation without rotation) and water and soil pollution (due to intensive use of pesticides). Indirect consequences include intensification – quality and quantity wise – of floods (due to deforestation processes), and the creation of huge amounts of wastes (e.g. plastic bags to protect the bananas from disease, the remains of trees)<sup>32</sup>.

Although traditional banana growing in West Africa has originally given a lot of attention to environmental and social concerns, with the rise of industrial agriculture and mainly with the competition with big multinationals, such traditional, greener, methods were abandoned to accommodate more chemical-intensive growing techniques. In Ghana, a relatively small

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<sup>29</sup> FAO, (2003), *The World Banana Economy 1985-2002*. Rome: Food and Agricultural Organisation.

<sup>30</sup> Astorga, Y. (1998), *The Environmental Impact of the Banana Industry: A Case Study of Costa Rica. International Banana Conference*, Brussels 4-6 May.

<sup>31</sup> FAO, (2003).

<sup>32</sup> Astorga, Y. (1998).

exporter (though not producer) of bananas - though not comparable to the mining or cocoa sectors - the bananas sector is in constant growth<sup>33</sup>.

Volta River Estates Ltd. (VREL) Organic is an organic-fair-trade banana plantation on the banks of the Volta River, near Akosombo. In 2003, after three years of intensive research, planning and development, the company started producing bananas which were not only fair-trade but also organic (with the brand name eko-oké). They employ 720 people which are constantly involved in management decisions. They receive support from the Ghanaian government, a Dutch fair-trade company. Their bananas are mainly destined to export, but some of the fruit reaches also local markets in Accra, Tema and Aflao<sup>34</sup>.

In a typical cost-benefit-analysis framework, a shift to more sustainable organic techniques would entail the following costs and benefits. Please consider these factors when answering the survey:

Costs	Benefits
<ul style="list-style-type: none"> <li>• Involves high initial costs of R&amp;D</li> </ul>	<ul style="list-style-type: none"> <li>• Diversifies the economy, reducing its dependence on gold and cocoa exports</li> </ul>
<ul style="list-style-type: none"> <li>• Often requires assistance from public authorities or external bodies (as in the VREL case, the Dutch NGO)</li> </ul>	<ul style="list-style-type: none"> <li>• Saves money on chemical pesticides and fertilisers</li> </ul>
<ul style="list-style-type: none"> <li>• Involves costs of education and training to local framers</li> </ul>	<ul style="list-style-type: none"> <li>• Guarantees a smaller negative impact on the environmental and natural resources (e.g. no use of chemicals and fertilisers, reduced waste; protection of flora and fauna)</li> </ul>
<ul style="list-style-type: none"> <li>• Bananas export - in general - depends to a large extent on the European Community banana import regime, which implies some uncertainty for suppliers</li> </ul>	<ul style="list-style-type: none"> <li>• Guarantees long term environmental and economic sustainability</li> </ul>
<ul style="list-style-type: none"> <li>• Takes long time to convert the land into organic</li> </ul>	<ul style="list-style-type: none"> <li>• Safer in terms of workers' health</li> </ul>
	Beneficial in term of human capital creation and R&D output

<sup>33</sup> FAO, (2001). *Contribution of Bananas to Income, Employment and Food Security in Ghana and Ecuador*. Committee on Commodity Problems, Intergovernmental Group on Bananas and on Tropical Fruits, Second Session. San José, Costa Rica, 4-8 December.

<sup>34</sup> Information obtained from <http://www.vrelorganic.com/>.

#### IV. List of the pairwise choice lotteries

\$0	\$1	\$3	\$4	\$0	\$1	\$3	\$4
0	0	1	0	0.2	0	0	0.8
0.75	0	0.25	0	0.8	0	0	0.2
0.3	0.6	0.1	0	0.32	0.6	0	0.08
0	0.6	0.1	0.3	0.02	0.6	0	0.38
0	1	0	0	0.7	0	0	0.3
0	0.5	0.5	0	0.35	0	0.5	0.15
0.5	0.5	0	0	0.85	0	0	0.15
0	0	0.7	0.3	0.15	0	0	0.85
0.8	0	0.14	0.06	0.83	0	0	0.17
0.2	0	0.74	0.06	0.23	0	0.6	0.17
0	0.2	0.8	0	0	0.5	0	0.5
0.5	0.1	0.4	0	0.5	0.25	0	0.25
0	0.2	0.6	0.2	0.2	0	0.4	0.4
0	0.1	0.3	0.6	0.1	0	0.2	0.7
0.2	0.8	0	0	0.8	0	0	0.2
0.1	0.4	0.5	0	0.4	0	0.5	0.1
0	0.4	0.6	0	0.4	0	0	0.6
0.5	0.2	0.3	0	0.7	0	0	0.3
0	0.2	0.3	0.5	0.2	0	0	0.8
0	0.2	0.7	0.1	0.2	0	0.4	0.4
0	0	0.5	0.5	0.1	0	0	0.9
0.5	0	0.5	0	0.6	0	0	0.4
0.25	0.5	0.25	0	0.3	0.5	0	0.2
0	0.5	0	0.5	0.2	0.2	0	0.6
0.5	0.25	0	0.25	0.6	0.1	0	0.3
0	0.25	0.5	0.25	0	0.35	0	0.65
0	0	0.75	0.25	0	0.1	0.25	0.65
0.25	0.25	0.5	0	0.25	0.35	0	0.4

### V. List of lotteries in the price session

Lottery	\$0	\$1	\$3	\$4	Lottery	\$0	\$1	\$3	\$4
1	0	0	1	0	29	0.2	0	0	0.8
2	0.75	0	0.25	0	30	0.8	0	0	0.2
3	0.3	0.6	0.1	0	31	0.32	0.6	0	0.08
4	0	0.6	0.1	0.3	32	0.02	0.6	0	0.38
5	0	1	0	0	33	0.7	0	0	0.3
6	0	0.5	0.5	0	34	0.35	0	0.5	0.15
7	0.5	0.5	0	0	35	0.85	0	0	0.15
8	0	0	0.7	0.3	36	0.15	0	0	0.85
9	0.8	0	0.14	0.06	37	0.83	0	0	0.17
10	0.2	0	0.74	0.06	38	0.23	0	0.6	0.17
11	0	0.2	0.8	0	39	0	0.5	0	0.5
12	0.5	0.1	0.4	0	40	0.5	0.25	0	0.25
13	0	0.2	0.6	0.2	41	0.2	0	0.4	0.4
14	0	0.1	0.3	0.6	42	0.1	0	0.2	0.7
15	0.2	0.8	0	0	43	0.8	0	0	0.2
16	0.1	0.4	0.5	0	44	0.4	0	0.5	0.1
17	0	0.4	0.6	0	45	0.4	0	0	0.6
18	0.5	0.2	0.3	0	46	0.7	0	0	0.3
19	0	0.2	0.3	0.5	47	0.2	0	0	0.8
20	0	0.2	0.7	0.1	48	0.2	0	0.4	0.4
21	0	0	0.5	0.5	49	0.1	0	0	0.9
22	0.5	0	0.5	0	50	0.6	0	0	0.4
23	0.25	0.5	0.25	0	51	0.3	0.5	0	0.2
24	0	0.5	0	0.5	52	0.2	0.2	0	0.6
25	0.5	0.25	0	0.25	53	0.6	0.1	0	0.3
26	0	0.25	0.5	0.25	54	0	0.35	0	0.65
27	0	0	0.75	0.25	55	0	0.1	0.25	0.65
28	0.25	0.25	0.5	0	56	0.25	0.35	0	0.4



## VI. Comparing hypothetical questions results with incentive-based results

	Average price	S.D.	Average price	S.D.
	Organic Bananas		Non Organic Bananas	
CV	415.39	230.78	316.83	131.48
Experiment	613.85	205.31	475.29	122.02
Calibration facor	0.6767		0.6666	
Market Price*	~ 600		~ 600	

\* Market price is not precise as it depends on the size of the banana as well as on the quantity of the bananas bought

Note that the average price obtained in the incentive compatible experiment is higher than the CV average price in both organic and non-organic sessions. Comparison of simple averages yields calibration factors of 0.674 and 0.668 for organic and non-organic treatments, respectively. Note, moreover, that S.D. is always higher in the CV surveys. Finally, it is worth pointing out that the price elicited through the incentive compatible experiment is closer to market price. More precisely, the experimental price is higher than the market price for organic bananas (hence displaying the willingness to pay an environmental premium) and lower for non-organic bananas. In the CV surveys the average price is always lower than market price.

Results of the socio-demographic and the environmental awareness questionnaire (Contingent Valuation session)																		
	Question 1	Question 2	Question 3	Question 4					Question 5	Question 6	Question 7	Age	Father's age	Telephon	TV	PC	Internet	
Subject	How would you define your concern for the env.?	How important do you think env. issues rea?	Are you a member of an assoc involved in env protection?	How important do you consider each of the following attributes of an eco product?	Recyclable	Use of ecological production	Prod. using renewable resources	Prod. using toxic/dangerous materials	How much do you know about Ghana's environmental situation?	As far as you know, Ghana's environmental situation is ...	How much R U aware to dangers of pesticide residues in fresh produce?							
	1	1	3	1-GEOLSA	1	1	3	5	1	2	1	22	49	1	1	1	1	
	2	1	1	2	1	1	1	5	2	3	3	20	50	1	1	1	1	
	3	1	1	2	3	1	1	4	2	3	3	21	59	1	1	1	1	
	4	1	1	2	5	4	5	3	1	5	2	24	not alive	1	0	0	1	
	5	1	1	2	2	1	4	5	2	4	2	24	51	1	1	1	1	
	6	1	1	1	1	1	1	5	2	2	5	24	60	1	1	1	0	
	7	2	1	1-GEOLSA	2	2	1	3	2	3	4	23	55	1	1	1	1	
	8	1	1	2	1	3	1	5	4	1	5	3	22	54	1	1	1	1
	9	1	1	2	1	1	2	5	4	1	4	23	50	1	1	1	1	
	10	1	1	1-GEOLSA	1	2	3	4	2	3	1	22	54	1	0	0	1	
	11	1	1	2					1	2	2	21	60	1	1	1	1	
	12	2	2	2		2	2	2	3	2	3	24	52	1	0	1	1	
	13	1	1	2		1	2	1	5	2	3	28	56	1	1	0	1	
	14	2	1	2		1	1	1	4	3	3	22	54	1	1	0	1	
	15	1	1	2		3	1	2	5	2	2	1	23	64	1	1	1	1
	16	1	1	2		1	2	2	5	1	3	1	24	55	1	1	1	1
	17	1	1	2		3	1	2	5	2	2	1	21	79	1	1	1	1
	18	1	1	2		2	1	3	4	2	4	3	23	59	1	1	1	1
	19	1	1	2		1	1	2	5	3	3	5	25	57	1	1	0	1
20	1	1	2		1	2	1	5	2	5	1			1	1	0	1	
Average	1.15	1.15			1.74	1.58	2.00	4.47	2.15	3.00	2.60							