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An Empirical Review of the Effect of Climate Change on Agriculture: A contingent valuation Method

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Abstract

This study is an empirical review of the effect of climate change on agriculture: a contingent valuation method. The paper relied on content analysis of extant literature. The paper viewed contingency valuation or the Contingent Valuation Method (CVM) is an economic, non-market based valuation method especially used to infer individual's preferences for public goods, notably environmental quality and more precisely it is used to place a monetary value on nonmarket goods. Available of the literature investigated suggest that there is a paucity of empirical literature in this area of study. However, findings from the empirical literature showed that climate impact negatively on agricultural production which suggests the need for proactive a mitigation and adaptation policy measures to help address the consequences of extreme events of climate change.

Keywords: Climate Change, Agriculture, Contingent Valuation Method.

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1. Introduction

In economic parlance, contingency valuation or the Contingent Valuation Method (CVM) is an economic, non-market based valuation method especially used to infer individual's preferences for public goods, notably environmental quality. It is also used to refer to the method of valuation used in cost—benefit analysis and environmental accounting. It is conditional (contingent) on the construction of hypothetical markets, reflected in expressions of the willingness to pay for potential environmental benefits or for the avoidance of their loss. In other words, it is an economic tool used for estimating the value that a person places on environmental goods and services. [1] Ekstrand and Draper [2] stated that contingent valuation uses a hypothetical market for estimating how much individuals would be willing to pay for environmental or natural resource amenities. They further stated that these elicited values are contingent on the described market and quality of the good. Because these amenities are nonmarket goods, the economic value of these amenities are difficult to determine. Economists call these goods "nonmarket goods" because these goods are not sold in the normal manner as a priced good in a market, but they still provide economic benefits to individuals. In a nutshell, contingency valuation is referred to as a "stated preference" method of valuation because it involves the survey of personal opinions of value regarding hypothesized, but unrealized, environmental changes (Duberstein & de Steiguer, undated). Carson [3] noted that the central problem in the application of standard economic tools to the provision of environmental goods, whether indirectly through regulation or directly through public provision, is placing a monetary value on them and because these goods are not routinely bought and sold in the market, actual cost/sales information is seldom available. Economists have developed a variety of techniques to value nonmarket amenities consistent with the valuation of marketed goods. These techniques are based upon either observed behavior (revealed preferences) toward some marketed good with a connection to the nonmarketed good of interest or stated preferences in surveys with respect to the nonmarket good. The stated preference approach the economist uses to place a monetary value on nonmarket goods is frequently referred to as contingent valuation especially when it is used in the context of environmental amenities.

2. History of contingent valuation

The concept of contingent valuation was dated back to about six decades ago. Bowen [4] and Ciriacy-Wantrup [5] were the first to propose the use of a public opinion survey as a valid instrument to value public goods, based on the idea that voting could be the closest substitute for consumer choice. [6] Ciriacy-Wantrup (1947) proposed the concept in theory as a method of obtaining market valuation of a non-market good. [7] The Harvard dissertation of Davis in 1963 further popularized contingent valuation as the first empirical application of the technique. Davis used surveys to estimate the value hunters and tourists placed on a particular wilderness area. He compared the survey results to an estimation of value based on travel costs and found good correlation with his results (Agrawal, 2001). Hoyos and Mariel (2010) stated that the history of the contingent valuation method (CVM) can be broadly divided into three

periods. In the first period (1943-1989), covering the origins of the method up to the Exxon Valdez accident, the CVM conforms as an alternative to revealed preference methods, such as the travel cost method (TCM), especially in the field of outdoor recreation. In the second period (1989-1992), the extensive debate following the Exxon Valdez oil spill stimulated further research on the theory and empirics of stated preferences for non-market valuation techniques. Finally, from 1992 onwards, the CVM has been consolidated as a non-market valuation method, being accepted at both an academic and a political level.

As earlier stated the concept is based on placing a monetary value on non-market goods. According to Giudedice and Paola [8] , the method proposes to evaluate nonmarket assets through the simulation of a hypothetical market in which users are asked to declare their "willingness to pay" (WTP) or "Willingness to Accept" (WTA) for particular goods granted in use. The choice between the two options (WTP) or WTA) derives from their potentiality in solving specific cases of assessment, and to the ability that have to support the decision making processes. Giudedice and Paola (2016) posit that contingent valuation method is the only method that can explain both the non-user values (option value, bequest value, existence value) the user values for amenities, the amount of which can't be ascertained by examining subjective behoviours).

3. Climate Change

Climate change is a global threat that extends into the future for decades or even centuries and thus it is an externality that requires a clear cut global commitment and agreement for the reduction in the emission of greenhouse gases. However, the lack of such global arrangement and commitment in mitigating the global warming and the grievous economic consequences of mitigation presents Africa the possible option of adaptation, that is, to increase resilience to the severity and consequences of extreme events of global warming. [9] The success of adaptation option is subject to the presence of a number of indicators like skills, education, infrastructure, access to resources, information, management capabilities, wealth and technology. These indicators are scarce in developing countries like Africa, thus making them vulnerable to global warming. However, for the developing countries to cope with the adaption option, early planning is imperative as preventive adaptation is more valuable and less expensive than compulsory or urgent situation adaptation. [10]

4. Agriculture

The agricultural sector is an important component of Nigerian economy with over 70% of the population engaged in agriculture and agricultural related activities. [11] The sector is almost entirely dominated by small-scale resource, poor farmers living in rural areas. Agriculture is the main pillar of any economy because of the many significant roles it plays. It is a major source of food for the population, provides employment opportunities, earns foreign exchange as well as serves as sources of raw materials for the nation's industries. Increasing agricultural production can increase food availability and enhance access to rural incomes and rural welfare. Rural areas are home to 75 percent of Africa's population, most of who count agriculture as their major source of income. Fortunately, Africa has experienced continuous agricultural growth during the last few years. Rahman and Rahman [12] noted that the principal solution to increased food production lies in raising the productivity of land given the existing varietal mix. In most countries, future sustainable agricultural growth will require a greater emphasis on productivity growth, as suitable area for new cultivation declines, particularly given growing concerns about deforestation and climate change. Agriculture still retains its position as the bulk walk upon whose solid foundation the economy of Nigeria is based. [13] Growth in agriculture has been linked to development in other sectors which invariably contributes to poverty alleviation. [14] Thirtle, Lin and Piesse [15] observed that development in agricultural sector has a powerful impact on poverty because it helps majority of poor people, compared with other development sectors of the economy. It is paramount, therefore, that the enterprises in the agricultural sector in Nigeria keep up with the current developments in the world.

5. Empirical Literature Review

Osuafor and Ude [16] carried out a valuation of rice farmers' preferences and willingness to pay for climate-smart agricultural technologies in Southeast, Nigeria. The study revealed greater proportion of the respondents to be strongly not willing to pay for over 77.8% of the CSA technologies while barely 7.4% were mildly willing to pay. Rice farmers were strongly not willing to pay for the following CSA technologies: rainwater harvesting, cover crops method, directed seeded rice, systems of rice intensification, use of solar pumps, etc, while the CSA technologies they were mildly willing to pay for are drip irrigation and drainage management. The major reason for respondent's unwillingness to pay was: poverty (2.0%) and CSA technologies as the responsibility of the Government to farmers within the state (5.0%). For the estimated willingness to pay value, the mean monthly minimum WTP in South-East was estimated at ₦5176.7123 while the mean monthly maximum WTP for rice farmers was estimated as ₦10,926.95. Water-smart technologies (76.8%) were mostly preferred CSA technology. Based on the ordered probit regression analysis of factors influencing willingness to pay for CSA technology, primary occupation (X5), access to credit (X8) and distance to market (X12) were found to be significant.

Contingent Valuation Method (CVM) was used by Kehinde, Shittu and Osunsina [17] to examine the willingness to accept incentives for a shift to climate-smart agriculture among lowland rice farmers in Nigeria. The study used choice experiment data collected from 462 farmers in five geopolitical zones in Nigeria. Result revealed that farmers significantly ($p<0.01$) showed strong preference for rice varieties that have early and medium maturing as against that of late maturing varieties. Findings also revealed that preference was given to farmers that practiced intermittently flooding and rain-fed relative to continuously flooding the rice farm. Likewise, exporting straw from the farm to feed livestock was significantly ($p<0.01$) preferred to incorporating the straw into the soil for more than 30 days before cultivation as against straw incorporation less than 30 days.

Using the contingent valuation method, Fonta, Kedir, Bossa, Greenough, Sylla and Ayuk [18] estimated a net farm revenue per hectare for a sample of 280 cocoa farmers sampled across seven Nigerian states. This was regressed on climate, household socio-economic characteristics and other control variables by using a Ricardian analytical framework. Marginal calculations were used to isolate the effects of climate change (CC) on cocoa farm revenues under supplementary irrigated and rainfed conditions. The objective was to examine the relative importance of climate normals (average long term temperature and precipitation) in explaining net farm revenue per hectare (NRh) for supplementary irrigated and rain fed cocoa farms in Nigeria. Results indicated high sensitivity of net farm revenue per hectare to Nigerian climate normals depending on whether farms use supplementary irrigation. Average annual temperature increases and precipitation decreases are associated with net farm revenue per hectare losses for rain fed farms and gains for supplementary irrigated cocoa farms.

Ouédraogo, Barry, Zougmoré, Partey, Somé and Baki (2018) investigated farmers' willingness to pay for climate information services: evidence from cowpea and sesame producers in Northern Burkina Faso. The study used the contingent valuation method for a monetary valuation of farmers' preferences for climate information. Data were collected using a structured questionnaire from 170 farmers. The study found that 63% of respondents were willing to pay for climate information services (CIS) such as seasonal climate forecast (SCF), decadal climate information (10-DCI), daily climate information (1-DCI) and agro-advisories. The predicted value for the WTP was XOF 3496 for SCF, XOF 1066 for 10-DCI, XOF 1985 for 1-DCI and XOF 1628 for agro-advisories. The study also showed that several socioeconomic and motivation factors have greater influence on farmers' WTP for CIS. These included the gender, age, education of the farm head and the awareness of farm head to climate information.

Using an econometric Autoregressive Distributed Lag (ARDL) Bound test approach to co-integration, Akomolafe, Awoyemi and Babatunde (2018) examined climate change and its effects on agricultural outputs in Nigeria. The result shows that climate change is insignificant in influencing agricultural productivity in the short run.

Amegnaglo, Anaman, Mensah-Bonsu, Onumah and Gero [19] examined contingent valuation study of the benefits of seasonal climate forecasts for maize farmers in the Republic of Benin, West Africa based on a random survey of 354 maize farmers and to use the contingent valuation method. Results indicate that farmers need accurate seasonal climate forecasts between 1 and 2 months before the onset of rains. The most desirable dissemination channels are radio, local elders, local farmer meetings and extension agents. The most likely used farming strategies are change of: planting date, crop acreage, crop variety, and production intensification. The vast majority of farmers are willing to pay for seasonal climate forecasts, and the average annual economic value of seasonal climate forecasts are about USD 5492 for the 354 sampled farmers and USD 66.5 million dollar at the national level. Furthermore, benefits of seasonal climate forecasts are likely to increase with better access to farmer based organisation, to extension services, to financial services, to modern communication tools, intensity of use of fertilizer and with larger farm sizes.

Banna, Afroz, Masud, Rana, Koh and Ahma [20] assessed farmers' willingness to pay for an efficient adaptation programme to climate change for Malaysian agriculture using the contingent valuation method to determine the monetary assessment of farmers' preferences for an adaptation programme. Based on the survey, 74% of respondents are willing to pay for the adaptation programme with several factors such as socio-economic and motivational factors exerting greater influences over their willingness to pay. However, a significant number of respondents are not willing to pay for the adaptation programme.

Tolunay and Başsüllü [21] examined the willingness to pay for carbon sequestration and co-benefits of forests in Turkey. The data for the estimation of maximum willingness to pay, total economic value and co-benefits of forests were collected with a questionnaire form prepared according to the contingent valuation method. Analyses have been conducted by correlation analysis and regression analysis. According to the analyses, per capita consumer/equivalent surplus or maximum willingness to pay to establish a new forest was estimated at US$ 23.52 on average, while total economic value was estimated at US$ 270,443,962.68.

Markantonis and Bithas [22] investigated the application of the contingent valuation method in estimating the climate change mitigation and adaptation policies in Greece. An expert-based approach. Findings that the mean WTP, as an annual household payment, was stated by the experts to stand at 229.58 euro, an amount mostly allocated to mitigation measures. Additionally, provided the policy framework remains as is, the experts stated that the national GDP's present 1.71% and future 2.75% should go towards mitigation and application measures. Similarly to the WTP, on the present-time scale, the experts slated the largest part of this GDP percentage for mitigation measures, a preference greatly influenced by the international debate on and efforts for reduction of greenhouse emissions.

6. Conclusion

In conclusion, a number of literature on contingent valuation have been reviewed from various standpoints and varying literary perspectives. All the literature reviewed are in congruity in stating that contingency valuation or the Contingent Valuation Method (CVM) is an economic, non-market based valuation method especially used to infer individual's preferences for public goods, notably environmental quality and more precisely it is used to place a monetary value on nonmarket goods. Available of the literature investigated suggest that there is a paucity of empirical literature in this area of study. However, findings from the empirical literature showed that climate impact negatively on agricultural production which suggests the need for proactive a mitigation and adaptation policy measures to help address the consequences of extreme events of climate change.

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