Journal of Education, Society and Behavioural Science

33(1): 33-45, 2020; Article no.JESBS.54662
ISSN: 2456-981X
(Past name: British Journal of Education, Society & Behavioural Science, Past ISSN: 2278-0998)

Predicting Public Acceptance of Genetically Modified Crops in Ghana Using the Decomposed Theory of Planned Behaviour

R. Ampadu-Ameyaw[1*] and J. Owusu-Arthur[1]

[1]CSIR-Science and Technology Policy Research Institute, Accra, Ghana.

Authors' contributions

This work was carried out in collaboration between both authors. Author RAA designed the study. Both authors performed the statistical analysis and wrote the protocol. Author RAA wrote the first draft of the manuscript. Authors JOA and RAA managed the analyses of the study. Authors JOA and RAA managed the literature searches. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JESBS/2020/v33i130193
Editor(s):
(1) Dr. Shao-I Chiu, Associate Professor, Professional Development in Education, Dayeh University, Taiwan.
Reviewers:
(1) Hanuman Singh Jatav, Sri Karan Narendra Agriculture University, India.
(2) Ariel M. Alcones, Apayao State College, Philippines.
Complete Peer review History: http://www.sdiarticle4.com/review-history/54662

Original Research Article

Received 10 December 2019
Accepted 15 February 2020
Published 27 February 2020

ABSTRACT

Public behaviour is a critical in determining factors influencing technology adoption and use. This study employs the Decomposed theory of planned behaviour to ascertain the factors influencing public behaviour, attitude and perception toward genetically modified crops in Ghana. This paper employs the views of 563 respondents from the media, agricultural extension and farmer groups in various regions of Ghana. The results of the study suggest there are significantly positive correlations between constructs of perceived usefulness, perceived ease of use and subjective norms leading to possible intention to accept GM technologies in the country. The study revealed that while the public holds a positive view of the technology, some important concerns that could limit the acceptance rate were listed. These include perceived high costs of GM seeds, monopoly of technological rights, health and other environmental risks. In many cases it was found that the understanding of the technology among the respondents was not encouraging. Many perceive the biologically oriented technology to be chemically oriented because the initial development of the product is laboratory oriented. The result, therefore begs for an immediate education and awareness creation on the merits and demerits of the technology in order to allay the fears of the pessimists.

**Corresponding author: E-mail: r.ampadu@csir-stepri.org, r.ampadu@yahoo.com;*

Keywords: Behaviour; technology; Ghana; decomposed; modified; public.

1. INTRODUCTION

In the wake of the emerging negative impacts of climate change and increased use of chemicals in food production, Scientists are developing new and improved seeds using various techniques of genetic engineering including biotechnology (commonly referred to as genetically modified (GM) technologies). The product of such bioengineering activity, the transgenic, commonly referred to as genetically modified organism (GMO) has been available on the market since the 1990s and yet controversies over its acceptance by the public still continue. In most cases, these new seeds are engineered to respond to the specific needs of the resource poor farmer as well as consumers. These improvements include engineering the crop or seed to build resistance against disease and pest attacks, increase yield, income. Others include engineering crops to adapt to changing conditions of the weather and climate such as drought, salinity and water stresses. Unfortunately, these new technologies and their products have been received with mixed feelings from a section of the public. As a result of this, governments confused as to what to do with the technology. The whole debate surrounding the acceptance or otherwise of the new technology has created a dilemma for policy makers and other decision makers about the way forward with this new technology.

In most part of Africa, particularly the sub Saharan Region, local agriculture is heavily relied on to feed the growing population as well as industries, the majority of which are not in the position to import raw materials. Alarmingly, this region has the largest proportion of people living below the poverty line [1]. The agriculture sector provides a chunk of the foreign exchange for developments and therefore contributes greatly to infrastructural improvements of the countries. It employs majority of the labour force and therefore provides livelihood for a considerable portion of the population, yet agriculture in these countries is mainly rain-fed and therefore climate dependent. This suggests a massive repercussion on the economies in the event of a crop failure. While yield potential are higher in some areas, generally water and nutrient inadequacies are becoming major challenges [2]. Most farmers are resulting to replenish soil strength through use of chemicals, which is becoming expensive to farmers. All these suggest the vulnerability of sub Saharan Africa agriculture (which accounts for approximately 96% of overall crop production) to emerging impacts of climate change [1].

In the absence of the seeds on the ground as well as the phobia surrounding the consumption of the new grains, the fear of the unknown especially in the context of climate stresses, it is important to measure public acceptance of the new technology before rolling out the commercialization process. Understanding the factors influencing behavior of the public towards acceptance and intention to use the new technology is essential for policy. In view of this, this study adopts the decomposed theory of planned behavior (DTPB) with certain core constructs such as perceived ease of use, perceived usefulness, and control behavior as well as attitude toward adoption and use and other to predict the acceptance the new seeds being developed in Ghana. Although, data employed in this paper does not cover the whole of Ghana, the result provides an excellent context for understanding public knowledge, attitudes, and perception of GM Food in Ghana. The evidence of this study will be used to educate the public, particularly policy makers and agricultural decision makers.

1.1 Background

In Ghana, like some developing countries the agricultural sector forms the backbone of the economy, employing majority of the active labour force, providing livelihoods for a considerable number of households and accounting for a large proportion of the country's foreign exchange. This makes the agriculture sector a critical sector for which policy makers and other stakeholders need to focus more attention if significant development is to be expected in the country. Unfortunately, this sector has been bedeviled with several challenges spanning from low productivity, poor soils, crop and animal disease and pest conditions, poor markets, bad roads among others. In spite of these realities, acceptance and adoption of some of these technologies, particularly genetically modified technologies and its associated products, have met some oppositions for varied reasons.

Against this background, population increase, youth unemployment and emerging impacts of climate change are making it necessary for the

introduction and employment of modern scientific techniques to help reducing the challenges in the country [3]. Studies show that user acceptance or perception of risks and benefits to end users and other value chain actors are crucial elements for determining whether or not investment in developing a technology should be a priority for developing nations as Ghana. A look at the Ghanaian media space shows heated arguments over genetically modified technologies and their products, although the genetically modified crops or technologies have not yet been commercialized in the country. Responding to these issues, require a careful introduction, proper guidance and user acceptance based on evidence gained through a better understanding of what appeals to people through a systematic research.

1.2 The Debate

While the GM technology is applied in several sectors including health and the environment, the agriculture and food sectors face enormous debates when it comes to introducing the technology to increase food and agriculture production. This is not a surprise since food forms a central element of daily life, and therefore an important subject for the general public. In view of this many new food technologies face serious checks, and are often met with various forms of suspicion. Genetic modification of plants and their use as food or feed in animal diet is an example of this contentious debate in the 21st century. This and others are reasons for the many studies on determining factors contributing to public perception and attitudes towards the new technologies and especially GM foods using different approaches.

The arguments for and against the introduction of the seeds or technology have mainly centered on environmentalisms, human health and safety as well as biodiversity and other risks, perceived by a section of the population to be associated with the cultivation and consumption of genetically modified crops and for that matter food. It has been observed that these risk concerns arguably stems from (i) the level of trust in government regulators on food supply safety; (ii) attitudes of people toward science and technology; and (iii) influence of media coverage and sensationalism. While these concerns may not have strong scientific evidences, it is important to understand the perceived risk concerns of the society. Since the technology is new in Ghana, it is important to assess peoples' reactions, attitudes, interests as well as intentions to accept and use GM seeds or otherwise. This knowledge will enable the policy makers and other decision makers the opportunity to strategize based on informed decisions about the development, promotion and commercialization of the technology and its products.

As has been pointed out earlier in this paper, this work comes on the wheels of the growing debate in Ghana on the subject of GMOs. This paper is therefore designed to explore and provide a better understanding of the elements of acceptance behavior of the public in relation to the introduction of genetically modified crops in Ghana. Given that perceptions of a technology, especially new technologies, play key and integral role in the technology's introduction, acceptance and integration into the market, this paper considers the subject as significant as any development issue in the country. It approaches the issue within the context of public dissimilarities in perceptions, ethics, and values as well as attitudes and behaviours towards the newly developed GM technologies and their products.

1.3 Theoretical Framework

According to Fishbien [4], a "well designed, intervention based on theory to change bahviours is more effective'. This suggests that any such behavioral disease or activity involving decisions making about whether to perform an action or not can be explored using any of the behavioral theories such as the decomposed theory of planned behavior (DTPB). In addition to the DTPB this study is located at the crossroads of literature on consumer behavior, technology adoption and innovation diffusion. The literature show that several authors have employed different models to determine, explore and explain the behaviour of individuals towards the acceptance of otherwise of new technologies aimed at responding to needs of the public. The present study utilizes the above literature focusing on the decomposed theory of planned behavior (DTPB) to explore, predict and understand the acceptance behaviour of the public towards commercialization of genetically modified organism and their associated products in Ghana.

The decomposed theory of planned behavior (DTPB) is a variation of the theory of planned behavior. In the DTPB the constructs of

attitudinal, normative and control beliefs into a set of more measurable variables. The DTPB was developed by Taylor and Todd (1995) and has been used by several authors to explain the relationship between behavioral intention and other factors that influence people's intention to perform a bahviour. As an extension of the theory of reasoned action (TRA), the theory of planned behavior (TPB) which is the antecedent of decomposed theory of planned behavior (DTPB) was developed to include a predictor of behavioral intention called perceived behavioral control" as a way of using it to achieve the deficiency of the TRA [5].

The introduction of the DTPB as a successor of the TPB was conceived to correct the idea that the original elements of the TPB constructs were not the only factors that determined behvaiour and that other factors external to those original constructs also contributes and therefore must be considered. This led Taylor and co to develop the DTPB which allows the inclusion of other factors perceived to help the three main constructs of TPB. According to the theory of planned behaviour, human behaviour is guided by three kinds of considerations:

(1) Attitude to the behaviour or behavioral beliefs (Beliefs about the likely consequences of the behavior).
(2) Subjective norms or normative beliefs (Beliefs about the normative expectations of others) and
(3) Perceived behavioural control or control beliefs (Beliefs about the presence of factors that may facilitate or impede performance of the behaviour).

This study included the factor of trust in the model since many producers and consumers alike depend on people, they consider trustworthy to make informed decisions. Trust therefore becomes an important factor in defining the position of consumers and producers regarding assessment of GM food and therefore making decision of choice or acceptance.

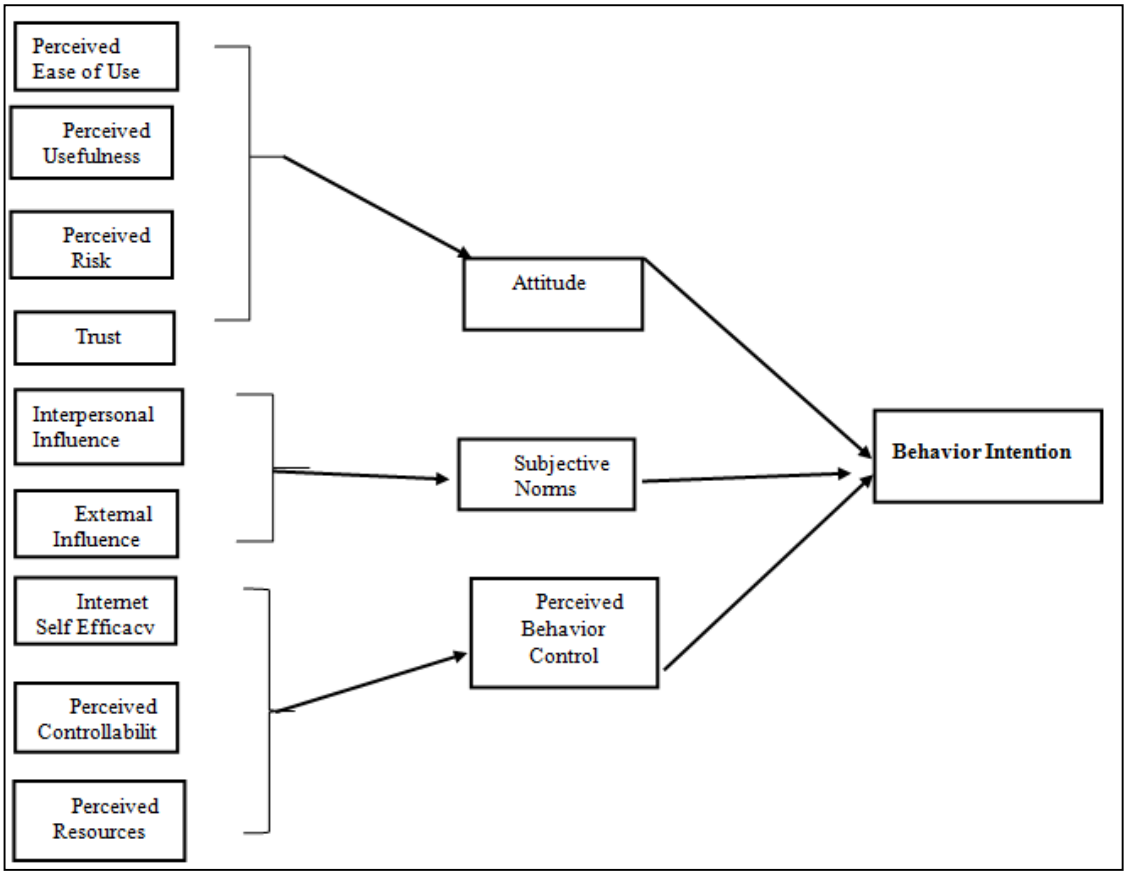

Chart 1. Diagram of DTPB used in the study

The TPB essentially, aims at explaining the behavior of users based on the relationship among the belief elements. This model employs constructs of attitudes, subjective norms and perceived behavioral control to understand the conditions or factors explaining individual actions or intentions [6]. The DTPB on the other hand focuses on the identification of beliefs and other factors that influence the three determinants of behavior, namely attitudes, subjective norms, and perceived behavioral control. This model decomposes attitude into three variables, namely perceived usefulness, perceived ease of use, and compatibility, a variable arising out of Rogers's diffusion of innovation theory [7]. According to Rogers [8], complexity as employed in the DTPB represents the extent to which an innovation is perceived to be difficult to understand, learn or operate. It is therefore argued that innovative technologies that are perceived to be easier to use and less complex have a higher possibility of acceptance and use by potential users. In this case complexity would be expected to have a negative relationship with attitude (defined as the extent to which a person has a favourable or unfavourable appraisal of a given behaviour toward for example a technology). According Davis [9] ease of use or complexity should be an important factor in determining factors influencing technology adoption decision.

Another important element in this model of acceptance is compatibility which refers to the degree to which the innovation fits with existing values, previous experience and current needs [9] of adopters. The literature suggests that during the 1990s, studies on acceptance and use of technologies mainly focused on variables related to the expectations, individual and environmental influences [9,10]. Other studies conducted in the past indicates that an innovation which is more compatible with the job responsibilities and value system of an individual is more likely to be adopted than one which looks completely new and in contrasts with ones values and beliefs systems. In this case, a priori, it may be expected that compatibility relates positively to the adoption of a new technology or innovation, when the innovation it requires less or no effort to use or operate. That is an innovation that is likely to be adopted by farmers for example should be such that its use does not infringe on the cultural or social norms or values or previous experience of the farmer. This implies that the more one is exposed to a technology or an innovation, the more likely it is going to be perceived as less difficult to use or understand and therefore c with way of life.

On normative belief, studies have found that the decomposition of normative belief structures is a better option of understanding peoples' acceptance behavior in the context of controlled belief. Generally subjective norm is a function of normative beliefs, which represent perceptions of specific salient others' preferences about whether one should or should not engage in a behavior. Usually people who are higher than us in specified areas of life are able to influence us by their actions or what they want us to do and we do them because we believe that by that we will be accepted by societies and not receive any negative sanctions. For example, Fisher and Fisher [11] in a study found out that an individual with positive attitudes about always using condoms during vaginal or anal intercourse, who perceives social support for these behaviours from key referent others and who has the conviction that he or she can carry out these behaviours effectively, will likely take consistent HIV preventive actions.

With the inclusion of the above-mentioned constructs in the TPB [5] showed that the decomposed model of the TPB had better explanatory power than the pure TPB, especially in the case of measuring the acceptability or intentions of people in relations to new technologies. Genetically modified organisms (GMOs) are considered as new innovation, for whose acceptance could be influenced by external as well as internal factors beyond what the TPB suggests. This study argues that the decomposed TPB could be a better model to employ since it is likely to give a better explanatory power of the factors that influence people to accept or otherwise a new technology. The decomposed model of the TPB unlike its predecessor TPB, allows for the integration of other factors such as economic benefits, image, enhancement, convenience and satisfaction [8], which the TPB did not consider. The decomposed theory of technology model is employed in this study to explain how acceptance of GM technology is formed, adapted and used by the society of study. The decomposed theory of planned behavior has been used in this study because it has more predictive power than the pure theory of planned behavior [5]. This model provides flexibility in finding a stable set of beliefs that can be applied across a variety of settings [5].

A typical study on consumer behaviour dates back to the 1960s, when Howard and Sheth [12] explained consumer behaviour as a factor of rationality and other external impacts that motivates the individual to purchase a product. The authors argued that the stimuli, characterized by the expectations generated by the markets, such as performance, ease of use, pricing, quality, among others, encourages consumers to collect and process information about the goods, perceive risks and costs. It is after this that the individual looks at alternatives available and stimulated by favorable or unfavorable conditions and attitude, an intention of adoption is made. According to Solomon [13] the decision to purchase an item is determined by feelings linked to environmental (social influence) and individual (motivation, value). And the degree of personal involvement in the decision-making process is a reflection of the perceived risk and the importance given to the object of the decision, considering the needs, interests, and personal values of individuals [14].

1.4 Research Questions

The foregoing background discussion suggests the critical importance to address some pertinent questions related to the new technology. This study, therefore, sets itself to address the question 'why in the face of factors such as climate change and other food and agriculture threatening factors, technologies like the biotechnology which promises to reduce the threats should be criminalized'. This seeks to help the authors understand the factors that influence perception and acceptance behavior of the public towards new technologies in Ghana. Specifically, the new technologies or crops being developed in Ghana now include the Bt Cowpea and NUE Rice. These technologies are being developed by local scientists of the CSIR who are using local varieties like the *Songotra* for the bt Cowpea and Jasmine 87 for the NUE rice. These are common varieties on the local market and already been consumed by the public.

1.5 Objectives of Studies

This question was set in order to achieve the purpose of this study. The objective of the study was to predict the acceptance behavior of the public in relation to GM products in Ghana. It also sought to determine the extent to which the constructs of the Decomposed Theory of Planned Behavior (DTPB) explain the variability of GM crops acceptance behaviors among the survey participants. The specific objectives of the study were; at achieving include;

1. To ascertain the relative importance of factors that influence people's acceptance behavior in relation to accepting and using GM seeds and products.
2. To ascertain relationships between constructs of the model employed using structural analysis.
3. To employ results in policy advocacy towards development of the GM crops in Ghana.

1.6 Significance of Study

While a considerable number of studies have looked at the choice of the public of technologies in several fields, including farming, a search of the burgeoning literature suggests that no such study has focused on the GM technologies and the products in Ghana, using the behavioural theories. The novelty of this is the fact that no previous work has been cited to investigate public behavioural intention to accept and use GM seeds. The significance of the current study stems from several considerations including the need to explore the possibility of using an acceptance model to determine the significance of acceptance behaviour of the public to commercially released GM technologies and their associated genetically modified organisms.

Again, the findings of this study will provide Ghana's policy makers, agricultural planners as well as scientists with more insight into public perception of the GM seeds. It provides opportunity to spur discussions on the future research on GM technologies and other agriculturally related technologies and practices in Ghana. In addition to this, the study's results will further spur discussion on GM seeds in the public. Implicitly, this paper aims at measuring how and the extent to which the behaviour of the public can be changed based on the factors that may seem to have shown lower responses in terms of acceptability of the GM technology and seeds.

2. METHODOLOGY

According to Kanaan [15], the decision to use qualitative or quantitative approach rests with the researcher and the question to be investigated. For this reason and based on the research questions, both quantitative and qualitative data were used in a mixed-method approach to

explore public perceptions and attitudes of the selected participants for the study. The main criterion adopted for the study was that the participant's acceptance to participate in the study. Data was collected in two phases. The first phase comprised a focus group interview (qualitative) and the second phase was a cross sectional survey involving quantitative data collection. Data used in this study was collected at a particular period implying that recommendations can be done based on the selected population or sample, which means that generalizing the results may not be accurately correct unless reference is made to the study population. This limitation notwithstanding, the study provides an insight into what is likely to happen to the adoption of the new crop, given that the selected participants covers of cross section of those who are likely to educate and or use the technology.

On one hand, the use of quantitative data analysis in this paper helps provide a description of the relationships among variables [16] employed in the study. The quantitative approach also enables both quantitative scale and qualitative data from a large research sample to be obtained on the other hand, the qualitative part allowed an in-depth analysis of the participants' experiences and perceptions, the quantitative study focused on the variables used to determine the relationships [17].

Participation in this study was voluntary and data was collected anonymously from people who were willing to provide information about their acceptability or otherwise of the technology. All the participants in the survey were at the capacity building section and these include those who have heard and or had knowledge about biotechnology/GMO or did not have any knowledge or heard of the technology. Prior to the start of the survey, all participants were made aware of the significance of the research and the type of information we were going to collect from them for our analyses and conclusions.

The participants of this study were mainly farmers, the majority of who could speak and understand English. Using a non-probabilistic technique, specifically convenience sampling, a total of 603 farmer participants were selected from all the six regions of Ghana, where the awareness creation workshops on GM technologies and products were organized. Study participants were sampled for purposes of convinces [18] since not every one of the farmers at the workshop understood the technology. Out of the 603 participants interviewed with the questionnaire, 560 questionnaires were validated as complete and used in the analyses of the data collected.

2.1 Data Instrument Design

Questionnaires used in data collection were designed for the study based on the theoretical framework that guided the study as well as review of other questionnaire used previously by other authors. The first part of the questionnaire was used to gather data on the socio-demographics of the respondents, while the other sections captured information on the technology using a five point Likert scale. The first part of the questionnaire was used to gather data such as respondents' age, gender, educational background, farming experience, position, or role in their communities, family or household information, previous knowledge on the technology among others. The Likert Scale was applied to most questions in the questionnaires since the study intended to gather more information on the technology. The likert scale was designed to examine how strongly subjects agree or disagree with statements on a five-point scale with the following anchors: (1) Strongly disagree, (2) Disagree, (3) Nature, (4) Agree, (5) Strongly agree.

The questionnaire carried a total of 49 questions divided into four parts. The first part of the questionnaire carried questions (8), focusing on the socio-demographic characteristics of participants while the second part of the questionnaire contained questions (5) knowledge and beliefs about GMOs. The third section has a number of questions (12) related to experiences and 27 behaviors of participants towards GMOs. The fourth section of the questionnaire measured a range of questions (24) on a 5-point Likert scale). The last part of the questionnaire included questions ranging from perceptions of the participants, perceived usefulness and perceived ease. Other questions focused on participants' attitude towards biotechnology and participants' behavioural intentions. In the qualitative part of the study, six focus groups were conducted with selected members of the general public in the various locations of study or data collection therefore making the study purposive.

Data analysis was carried out by running descriptive statistics on the socio-demographic data of the respondents using SPSS statistical

software (version 23) for the quantitative study. Since qualitative studies or analysis do not require a representation, the qualitative study employed a focus group interview approach and data collected in the process were analyzed based on thematic areas from which the questions came. The analysis was therefore considered case by case. A structural equation model was used to estimate the rest of the data. This actually involved an estimate of how the constructs related and influenced intentions to accept or not to accept biotechnologically developed food crops and products otherwise called genetically modified organisms or products. The Structural Equation Model (SEM) technique enables the authors to test the relationship between independent and dependent variables used in the model simultaneously. The phase in testing the model is as follows: data normality test, evaluate outliers, test the validity and reliability and test of relations causality and evaluation of the model.

3. RESULTS AND DISCUSSION

3.1 Participants' Socio-demographic Characteristics

The study result indicates that majority (73.6%) of respondents in the survey were men. This could be attributed to the reality of the hard work involved in farm work as opposed to marketing and processing nodes of the food production value chain where the women mostly occupy. On education the study results showed that most (42.0%) of the respondents had minimum education of Junior High Secondary (JHS) or Middle School Leaving Certificate (MLSC) and therefore were able to read and write. The disaggregated data of those with JHS education showed that (68.0%) of the respondents had education to the JHS level, while the remaining (32.0%) attempted the MSLC. The survey result shows that about (15.2%) of respondents had SSSCE (SHS) education. The data show that as the level of education category rises, the numbers fall. This is attributed to the high rate of dropouts with increasing number of years or level of education, particularly in rural farming communities.

The age distribution of respondents showed that a greater number of the farmers interviewed, were mainly between the ages of 36 and 45 years old. This age group was followed by those within the age bracket of 46 and 55 years in terms of numbers. Together, these last two age groups form the middle age who surprisingly, were more than those who could be classified as a youth (between 18 and 35 years old) in Ghana. This distribution clearly shows that the farming population interviewed was more of middle level aged men and women but were still looking strong. By the standards in Ghana, practically these age groups could be described as youth. This explains why Ghana's farming population may be described as youthful even though some of the people classified as youthful are middle-aged people.

On experience in farming, it was realized that among the farmers interviewed only a handful of them did not have enough experience (working on their own farms for 5 years). The majority of them have been working on their farms, owned through self-acquisition of land, land renting or hereditary. This is a break from the past where the majority of farmers worked as farm hands on their parents or relatives' farms. The data showed that the least experienced among the interviewers had 2 years' experience tilling their own farms. On the average it was computed that farmer experience on working on own farm in the community was about 25 years.

As a prelude to the inferential analyses, a few questions on the knowledgeability and willingness to accept GMO products as well as the use of other agriculture technologies were asked to the farmers participating in the study. The results show that as many as 55.4% claimed that they had knowledge of the technology while about 37.9% said they did not know anything about the technology. There was this other group of respondents who said they were not sure whether or not they have any knowledge about the new technology. This last group constituted about 6.8% of the total respondents. Information and knowledgeability about a subject is critical in forming a positive or negative attitude toward the subject. In the same way, the absence or lack of information creates opportunities for uncertainty to thrive. This explains the myriad of concerns about the risks of consuming GM crops and foods. Education helps the public to weigh the risks and benefits of the new technology in a more rational way, and thereby are able to form a positive attitude toward the technology.

On the willingness to accept the technology, about half of the population of participants in the study responded in the affirmative with about 6.6% saying they were not sure whether or not they were ready to accept the technology.

Table 1. Socio-demographic data of respondents

Gender	**Frequency**	**Percent**
Male	412	73.6
Female	148	26.4
Total	560	100.0
Age	**Frequency**	**Percent**
15-25	25	4.5
26-35	90	16.1
36-45	180	33.2
46-55	122	21.8
65 and above	45	8.0
Total	560	100.0
Knowledge of GMOs		
Response	**Frequency**	**Percent**
Yes	310	55.4
No	212	37.9
I don't know	38	6.8
Total	560	100.0
Willingness to accept		
Response	**Frequency**	**Percent**
Yes	281	50.2
No	242	43.2
I don't Know	37	6.6
Total	560	100.0
Education	**Frequency**	**Percent**
No School	21	8.8
Primary	124	22.1
JHS	235	42.2
SHS	85	15.2
Diploma	45	8.0
Post Diploma	10	1.8
Others (informal)	40	7.1
Total	560	100.0
Married		
Response	**Frequency**	**Percent**
Yes	345	61.6
No	215	38.4
Total	560	100.0
Use of other agri. technologies		
Response	**Frequency**	**Percent**
Yes	465	83.0
No	95	17.0
Total	560	100.0
Experience in farming		
Response	**Frequency**	**Percent**
Less than 6 years	69	12.3
6 to 10 years	145	25.9
11 to 20 years	251	44.8
More than 20 years	95	17.0
Total	560	100.0

Source: Authors survey data 2019

Table 2. Distribution of range, mean and standard deviation of attitude, subjective norm and perceived control behaviour towards acceptance of GMOs

Variable	N	Possible range	Observed range	Mean	Std.
Behavioural Intention	560	3-21.00	3 - 21.00	10.75	6.58
Attitude Toward Acceptance	560	-6 – 63.00	0 – 63.00	49.82	14.02
Subjective Norm	560	6 – 63.00	31 – 52.00	6.55	23.62
Perceived Behavioral Control	560	-6 – 63.00	-51 – 63.00	9.55	33.05

Table 3. Test of causality

	Regression weights		
Factor	**UStd Est.**	**Std**	**Prob**
Attitude towards Behaviour	1.218	-0.231	.006
Subjective Norm	1.817	0.421	0.001
Perceived Behaviour Control	4.932	0.802	0.001

Significance level <_ 0.05

Table 4. Parameter estimates from final regression for behavioral intention as dependent variable predicted by perceived by behavioral control and subjective norm

	B	Std error	Std coef (β)	t
Constant	10.21	0.54	-	16.92
Perceived Behavioral Control	0.21	0.01	0.51	5.07
Subjective Norm	0.56	0.02	0.31	3.87

Significance level = 0.001; R^2 = 43%

The pre-existing structure of attitude toward the technology could be key in explaining this form of response to the technology. Since many people have not experienced the technology or the products thereof, the mindset is not easily released from what has previously been formed. On the use of other agriculture technologies, it was not a surprise to realize that as many as 83.0 % of survey participants were already using technologies in their farms. This is commendable as it could form the basis for education on the new technology among the farming population.

3.2 Usefulness of the Technology

One of the important variables considered in this study was the extent of usefulness of the new technology (GM crop) to the respondents. In view of this, the questionnaire asked the question: in your view can the GM crop or technology be beneficial to the environment? In response, the results show that about 62.5% of the sample responded in the affirmative. This suggests that more than three-fifth of the sampled population believed that the GM technology holds some environmental benefits for Ghana. The remaining two-fifth of the sample who did agree on the environmental benefits of the technology consisted of those who disagreed (13.2%) and those who were not sure (24.3%) of the new technology's influence on the environment.

3.3 Awareness of the Technology

In the focus group discussions, a considerable number of respondents said yes to the questions on awareness of GMOs in the country but not the physical cultivation of any GM crop. This results show that while debates and discussions about the new technology continue in the country, not many of Ghanaians have ever seen the crop. It is believed that their discussions are based on mere hear says or from the literature.

Table 2 provides results of the distribution of means, range and standard deviations of intentions, attitude and subjective norms as well as perceived behavioural control towards acceptance and possible utilization of the new technology. Table 1 indicates depicts a score range of 3 – 21 sub-scale for the construct behavioural intention, which provides an actual mean score of 10.75 (SD = 6.68). This implies that the participants had moderate intention to accept GM technologies and their products. In the case of people's attitude towards the acceptance of GM technologies Table 1 shows a mean score of 49.82 (SD = 14.12) for a subscale ranging from -6.00 to 63.00. More importantly,

with a score range of -6.00 to 6.00 in each case and a mean score of 6.53 and 9.55 respectively, Table 1 shows the extent to which subjective norm (SD = 23.62)) and perceived behavioural control (SD=33.05) construct influence participants moderate response to accepting the new technology and its products. This statistic shows that role of the significant others' in the decisions about choice of participants in relation to acceptance of the new technology on the basis of participants' view of subjective norms and perceived control behaviours.

Table 3 shows the test of causality or the relationship between the construct selected for the estimation model. It provides information on the extent of direct influence as observed from the regression standard coefficient. The test results indicate that attitude to accepting the technology, subjective norms, and perceived behaviour control clearly shaped behavioural intention to accept the new technology with probability value of 0.007; 0.001 and 0.001 respectively. These probability values are all less than 0.05, which implies that the results are statistically significant. This indicates that the null hypothesis that attitude, subjective norms and perceived behaviour control can be accepted. This shows that the results are not due to chance and that they represent the reality and thus can be used to predict the future. Based on these it will be right to say that the decomposed theory of planned behaviour as modelled in this study will increase the predictive power in predicting acceptance behavior or intentions to use the technology. The results (Table 3) indicate that all three variables and their decomposition variables or constructs in the model influenced the intention to accept the new technology. The results confirm other studies that have used similar or same constructs and decomposition variables to predict adoption and use (ref).

The results show that the attitude towards accepting the new technology and its decomposed variables- perceived ease of use, perceived usefulness, perceptive risk and trust significantly shape the behaviour of the participants towards the intention to accept and use the technology. This seems to confirm other study results in the area of information technology acceptance [19,20]. In summary, these studies show that attitude has a direct link in terms of behaviour toward intention to perform an activity and therefore should be taken seriously in matters of behavioural changes or studies.

Table 3 indicates that perceived ease of use is another important factor used in adoption studies, particularly in reference to information technology studies. Studies have shown that so long as respondents know that a particular technology can improve their performance, especially by reducing costs and getting the job done on time, they will adopt. Suryaningrum et al. [21], have confirmed this result in a study conducted in Vietnam on e-learning. The current study shows that while respondents are eager or showed some high level of interest in the technology it is not available for people to use it and hence it was clear that the negative news heard about the technology still lingered in the minds of many. The interviews show that people are now building their understanding of the technology with the few advocacies on going.

The study results (Table 3) indicate that subjective norms construct which was decomposed into inter-personal and external influences was significant. The result of this study indicates the essence of subjective norm in predicting the behavioural intention of people toward a new technology and in this case genetically modified foods. Hsu et al. [22] have confirmed this result by asserting that subjective norms influence behaviour intention of people in using new technology. Bhattacherjee [23], who found out that subjective norms could be decomposed into interpersonal and external influences, has corroborated this result. Generally, the results show that friends and colleague are a critical mass of support when it comes to technology adoption. Many farmers have learnt to do things or accept technologies and used them on their fields, as a result of their relationship and closeness to other farmers. Exposure to new technologies through advocacies, workshops, farmer field school and media among others, are critical if technology introduction can be effective.

The statistics on the construct, perceived behaviour controls that consist of the internet self-efficacy, perceived control, and perceived resources in the model used for this study, affect the behaviour intention to accept and possibly use the new technology. According to Ajzen [24], self-efficacy is the ease or the difficulty to do a certain behaviour, or to belief in individual to do these behaviours, while perceived control is a control against behavior or belief about how far do a certain behaviour. Bandura [25] pointed out that in addition to self-efficacy, people will be

ready to do a behavior if they feel confident that with resources provided.

Table 4 shows the results from the final regression model for behavioural intention towards acceptance of the new technology in Ghana. It shows that the variables used as predictors in the model designed were all significant at ($p<0.001$). The R^2 value was estimated at 43% indicating that the constructs are able to explain 43% of the variation in the acceptance behaviour of the people toward the new technology.

4. CONCLUSION

Generally, the introduction of new technologies is often accompanied by an objective for workplace change or development. In agriculture, new technologies are deployed with the intention that the material features of those technologies will change farmers existing practices and thereby help them to be more productive. Paying close attention to the reasons people resist a new technology, is extremely important for both theory and practice [26]. In this study attempts have been made to investigate and identify the factors that influences the acceptance behaviour of the survey participants using the various constructs of the decomposed theory of planned behaviour. It tested the extent of relationships among selected factors or constructs in order to understand and explain how they influence each other to form the intention to accept genetically modified seeds or crops. The results showed that acceptance of GM seed among the survey participants is influenced by the attitude towards the technology, perception of risk or safety, trust, control of perception. The study shows that subjective norms, resource control and ease of use and behavioural intentions are positive and significant, influence acceptance, programmes and initiatives to educate and create awareness among various stakeholders and should be designed based on such constructs. This indicates that the proposed model of behavioural acceptance is good and able to explain the variables identified. The result indicated that survey participants' intention to accept and possibly use the GM seeds or accept crops is depended upon their attitudes and controls on the environment.

The results indicate that although the survey participants have shown some level of willingness to accept and use the new technology and its products, there are clear indications of inadequate understanding of the technology. That is, the understanding of the GM technology and therefore GM crops is not well understood because of poor advocacy and awareness creation. This is to the extent that not many of the respondents have a better understanding of the technology. This implies that more effort in terms of policy advocacy is needed to educate and create awareness about the technology. Through constant awareness creation and education, the acceptance behavior among end users of the technology is likely to increase. It is therefore imperative for the Government of Ghana through its Departments and Agencies whose activities impinge on technology development and dissemination to make conscious efforts to educate end users of the technology on the importance of the technology and its products.

Given that the technology developed in the country is yet to be released for commercial cultivation, this will be the appropriate time for an intervention programme to educate the public before the actual commercialization. In this case, people will be more informed in taking any decision to accept or otherwise the technology. Policy makers will also be debating on related bills and regulations based on evidence and better understanding.

CONSENT

As per international standard or university standard, Respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. World Development Report. Mind, Society and Behavior; 2015.
2. Mueller N, Gerber J, Johnston M, et al. Closing yield gaps through nutrient and water management. Nature. 2012;490: 254–257.
3. Medium Term Agriculture Sector Investment Plan. Ministry of Food and Agriculture, Ghana. 2011-15.
4. Fisbein M, Ajzen I. Belief, attitude, intention and behavior: An introduction to theory and research. Addison Wesley, Reading, MA; 1975.
5. Taylor S, Todd PA. Understanding information technology usage: A test of

competing models. Information System Research. 195;6:144-176.
6. Herrero-Crespo, Ángel, Rodríguez-del-Bosque Ignacio. The effect of innovativeness on the adoption of B2C e-commerce: A model based on the Theory of Planned Behaviour. Computers in Human Behavior. 2008;24: 2830-2847.
DOI: 10.1016/j.chb.2008.04.008
7. Rogers EM. Diffusion of Innovations. 4th ed., New York: The Free Press; 1995.
8. Rogers Everett M. Diffusion of innovations (3rd ed.). New York: Free Press of Glencoe; 1983.
9. Davis, Fred, Bagozzi Richard, Warshaw Paul. User acceptance of computer technology: A Comparison of two Theoretical models. Management Science. 1989;35:982-1003.
10. Agarwal R, Prasad J. The role of innovation characteristics and perceived voluntariness in the acceptance of information technologies. Decision Sciences. 1997;28:557-582.
11. Fisher JD, Fisher WA. Theoretical approaches to individual-level change in HIV risk behavior. In: Peterson JL, DiClemente RJ, editors. Handbook of HIV prevention. New York: Kluwer Academic/Plenum Press. 2000;3–55.
12. Howard JA, Sheth JN. Theory of Buyer Behaviour, New York, Wiley. 1969;12-15.
13. Solomon, Michael. Consumer behavior: Buying, having and being; 2002.
14. Engel JF, Blackwell RD, Miniard PW. Consumer behaviour' London: Dryden Press; 1990.
15. Kanaan RK. Making sense of E-government implementation in Jordan: A qualitative investigation. PhD Thesis, Center of Computing and Social Responsibility. De Montfort University, Leicester; 2009.
16. Creswell JW. Controversies in mixed methods research. In N Denzin, YS Lincoln (Eds.). The sage handbook of qualitative research (4th ed). Thousand Oaks, CA: Sage Publications. 2011;269-283.
17. Creswell JW. Research design: Qualitative, quantitative and mixed methods approaches (4th ed.). Thousand Oaks, CA: Sage; 2014.
18. Malhotra N, Reay T. Hybridity and power in the micro-foundations of professional work, Research in the Sociology of Organizations; 2001.
[ISSN: 0733-558X]
19. Ajzen I. From intention to actions: A theory of planned behavior, in springer series in Social Psychology, edited by Kuhl J, Bechmann J, Berlin, Springer; 1985.
20. Sheikhshoaei, Fatemeh, Oloumi, Tahereh. Applying the technology acceptance model to Iranian engineering faculty libraries. The Electronic Library. 2011;29:367-378.
21. Suryaningrum DH, Harymami, Sulistyowati E. Arti penting perceived of use dalam pengadopsian sistem informasi: Suatu studi terhadap penguunaan E-Learning Seminar Nasional V Call for Paper UniversitasTeknologi Yogyakarta; 2009.
[ISBN: 978-979-1334-25-9]
22. Hsu, Meng-Hsiang, Chiu, Chao-Min. Predicting electronic service continuance with a decomposed theory of planned behavior. Behaviour & IT. 2004;23:359-373.
DOI: 10.1080/01449290410001669969
23. Bhattacherjee A. Acceptance of E-commerce services: The case of electronic brokerages. IEEE Transactions on Systems, Man and Cybernetics: Part A. Systems and Humans. 2000;30(4): 411–420.
24. Ajzen I. Perceived behavior control, self-efficacy, locus of control and the theory of planned behavior. Journal of Applied Social Psychology. 2002;32(4):665-683.
25. Bandura A. Self-efficacy: The exercise of control. New York: Freeman; 1997.
26. Davidson E. A technological frames perspective on information technology and organizational change. Journal of Applied Behavioral Science. 2006;42(1):23–39.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/54662