



THE FACTORS AFFECTING THE ADOPTION OF BIOGAS TECHNOLOGY IN POULTRY INDUSTRY IN SOUTHWESTERN NIGERIA

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ABSTRACT

The study investigated the factors affecting the adoption of the biogas technology in poultry farms in southwestern Nigeria. The study was carried out using both primary and secondary data sources. The primary data were obtained through the use of questionnaire, personal observations and interview sessions. A set of questionnaire was administered on one hundred and eighty poultry farmers in all the Southwestern States of Nigeria (Ekiti, Lagos, Ogun, Ondo, Osun and Oyo) using snowball sampling technique. The questionnaire was administered on poultry farmers having more than 500 birds, to elicit information based on the set objectives of the study. The secondary data were sourced from the agricultural journals, engineering journals, published and unpublished research works and international reports from bodies such as United Nations Development Project (UNDP). Data were analyzed using descriptive and inferential statistics. The study revealed that bag digesters (1.71%) were the predominant type of biodigester adopted on the farms. The major factors influencing the adoption of biogas technology in the study area were educational qualification of the respondents ($\beta = -.612$, $p < 0.05$), their specific field of study ($\beta = .192$, $p < 0.05$) and the capital cost/initial investment in the biogas technology ($\beta = 2.819$, $p < 0.05$). The study further showed that reducing the cost of maintaining environmental pollution (3.43%) was a major reason for the adoption of biodigesters on the farms.

Key words: Adoption, Biodigesters, Biogas Technology, Poultry Industry

1. INTRODUCTION

Adoption of improved agricultural technologies has been associated with: higher earnings and lower poverty; improved nutritional status; lower staple food prices; increased employment opportunities as well as earnings for landless labourers [1]. Adoption of improved technologies is believed to be a major factor in the success of the green revolution experienced by Asian countries [1-2]. On the other hand, non-adopters can hardly maintain their marginal livelihood with socio-economic stagnation leading to deprivation [3].

Adoption of technology affects not only organizational structure but it also affects organizational culture [4]. Organizational culture refers to the set beliefs and values that are shared by people within the organizational structure. It is to a large extent determined by the communication systems, training and labour-management relations. It can be instrumental in facilitating the implementation of technology and can also act as a barrier. In order to take advantage of the potential positive influence of organizational culture in technology adoption, managers and policy makers must enhance labour management relations, better the communication systems, develop effective training and selection policies as well as performance appraisal and compensation policies [4]. Most adoption studies have attempted to measure human capital through the farmer's education, age, gender, and household size [5-7]. Education of the farmer has been assumed to have a positive influence on farmers' decision to adopt new technology. Education level of a farmer increases his ability to obtain; process and use information relevant to adoption of a new technology [6, 8-9]. For instance a study by Okunlola *et al.* [10] on adoption of new technologies by fish farmers on adoption of organic fertilizers found that the level of education

had a positive and significant influence on adoption of the technology. This is because higher education influences respondents' attitudes and thoughts making them more open, rational and able to analyze the benefits of the new technology [11]. This eases the introduction of a new innovation which ultimately affects the adoption process [12]. Uematsu and Mishra [13] also reported a positive relationship between education and adoption.

Au and Enderwick [14] also carried out a study and found that the cognitive process which determined an attitude towards technology adoption was to be affected by six beliefs namely compatibility, enhance value, perceived benefits, adaptive experiences, perceived difficulty and suppliers' commitment. The study found that the individual external environmental forces did not significantly influence the formation of a behavioural intention to adopt.

Roger's Innovation Decision Process Theory (Rogers, 2003) provides an insight into technology adoption process. According to this theory, potential adopters of an innovation must learn about the innovation (Knowledge); be persuaded as to the merit of the innovation (persuasion); decision to adopt it (decision); implement the innovation (implementation) and finally, the decision must be reaffirmed or rejected (confirmation) [15].

According to Dixon and Dixon [16], technology provides benefits and requires resources. The benefits influence the perceived usefulness while the resources required determines the end-user requirements. Perceived usefulness is affected by the perceived ease of use and a number of innovation specific characteristics. These characteristics are both internal and external to the technology. Both perceived ease of use and perceived usefulness will influence the attitude towards adoption. The more technology is perceived as useful and easy to use the more the attitude towards technology becomes more favourable. With a positive attitude, an intention is formed to either adopt the technology or upgrade the sophistication or tools needed to allow the adoption of the technology. If the technology is adopted, success will be enhanced both by a good end-user fit, as well as a positive attitude. Sophistication can be increased by education; training and practical experience and increased sophistication will increase the user's capabilities and ultimately the user's success [16].

In a study, Ajayi (2009) employed the Roger's Adoption Process Theory to determine the adoption levels of the improved vegetable products introduced by the farmers as an innovation under the National Fadama Phase one Project in Anambra State of Nigeria. They categorized the adoption levels on a five-point adoption scale and weighed response categories as Awareness (1), Interest (2), Evaluation (3), Trial (4), Adoption (5). They determined the adoption level of each innovation by obtaining the weighted average value of respondent's scores and the adoption index by dividing the sum of all innovations' adoption levels with the maximum level score of 5.

2. RESEARCH METHODOLOGY

2.1 Study Area

The study covered the six states in Southwestern Nigeria, namely Ekiti, Lagos, Ogun, Ondo, Osun and Oyo States.

2.2 Study Population

According to the Poultry Association on Nigeria (PAN), registrations of poultry farms in some states are not encouraging. In 2014, Lagos State had about 100 registered poultry farms, Osun State had 45, Oyo State had 67, while Ondo, Ekiti and Ogun States do not have well formed association. During the field study, some of these registered poultry farms had closed down. They were having one problem and the other (such as financial, poultry related diseases, environmental etc.) and some poultry farms were established but have not registered. Due to the limitations of these registered poultry farms, snowball sampling technique was adopted. Thirty (30) poultry farms were purposively selected from each state for uniformity. The criteria for this selection was that each farm must have at least five hundred (500) birds in their poultry farms, therefore, a total of one hundred and eighty (180) poultry farms were purposively selected for the study.

2.3 Administration of Questionnaire

The questionnaires were hand delivered and collected. Out of one hundred and eighty (180) questionnaires, one hundred and seventy-five (175) questionnaires were retrieved. About 97% success rate was achieved.

2.4 Variables for Investigating the Factors Affecting the Adoption of Biogas Technology in Poultry Farms.

In investigating the factors affecting the adoption of the biogas technology in poultry farms, the following variables were obtained:

- i. The socio-economic factors influencing the adoption of biogas technology (measured on a six item code; age, gender, marital status, qualification, course of study and work experience).

- ii. The rate of adoption factors (measured on a eleven item code; affordability, awareness, access to loans, trialability, perceived value, complexity, compatibility, observability, relative advantage, capital cost and others).
- iii. The support(s) for the adoption of biogas technology/equipment (measured on a two item code; yes and no).
- iv. The institutional support(s) for the adoption of biogas technology was indicated on an eight item code; federal government, state government, local government, non-governmental organization (NGO), university, cooperative, bank and others. (measured on a four point Likert scale of: no support, moderate support, high support, very high support).
- v. Benefit(s) of adoption of biogas technology in poultry farm (measured on a three item code; increases profit on the farm, reduces environmental pollution and produces energy for the farm).
- vi. Organizational source for funds (measured on a two item code; yes and no (if yes, provide the name(s) of the organization)).

2.5 Data Analysis

The data gathered were edited, sorted, coded and analyzed using Statistical Package for Social Scientists (SPSS) as appropriate. The data were analysed using descriptive statistics such as percentages, frequencies, and means. The frequencies and percentages were used to analyse some of the socio-economic characteristics such as age, educational qualifications, field of study, gender and years of experience. Inferential statistics such as regression analysis was used to analyze the variables on the factors affecting the adoption of the technology and mean rating and ANOVA were also used to determine the factors that influence the support of the adoption of the biogas technology.

3. RESULTS AND DISCUSSION

3.1 Socio-economic Characteristics of the Poultry Farmers

Table 1A shows the socio-economic characteristics of the poultry farmers. The survey covered all the six southwestern states (Ekiti, Lagos, Ogun, Ondo, Osun and Oyo states) in Nigeria and the responses from the poultry farmers were very encouraging in carrying out the research. Thirty questionnaire were distributed to commercial poultry farmers in each state and 96.7% of the questionnaire were retrieved from Ekiti, while 93.3%, 93.3%, 100%, 100% and 100% of the questionnaire were retrieved from the poultry farmers in Lagos, Ogun, Ondo, Osun and Oyo States respectively.

The survey revealed that about 2.3% of the poultry farms were managed by farmers less than 18 years of age, while 5.1%, 21.1%, 33.1%, 25.7% and 12.6% were managed by farmers in the age categories of 19-25, 26-30, 31-40, 41-50 and 51 and above, respectively. This also revealed that 85% of the poultry farmers were between 19-50 years of age. This high concentration of poultry farmers in this group, which can be considered to be the most active segment of the population, may imply that younger people up to middle age are favourably disposed to poultry business.

About 76% of the poultry farmers were male while 24% were female. This implies that there are more men than women in the poultry business. This supports earlier findings by Aldrich [17] and Alsos [18] who reported that men are more likely than women to be self employed. This may also be due to the fact that there is high level of risk involved in the poultry business and according to Fogel and Nehmad [19] greater risk taking attitudes exist among men than women.

Table 1A also shows the results of the educational qualifications of the poultry farmers and Table 1B shows the state analysis of the educational qualifications of the poultry farmers. The least educational qualification the poultry farmers had was secondary school certificates. About 8% of the total average of the poultry farmers had secondary school certificates while about 13% of the total average had diploma certificates. 60% of the total average (Ekiti (75.9%), Lagos (67.9%), Ogun (64.3%), Ondo (33.3%), Osun (60%) and Oyo (60%) States) were graduates of various degrees and Ondo state (33.3%) had the highest percentage of postgraduate qualification (MSc.), while Lagos state (7.1%) and Ogun state (7.1%) had the least percentage in postgraduate qualifications. In addition, only 3.4% of the total average had professional qualifications. In poultry farming, some modicum of education may be necessary to enable the farmers to understand the day to day running (which may include administering drugs, feeding, breeding and so on) of poultry farming. Higher levels of education in business imply a larger pool of technical skills, knowledge and competence.

The poultry farmers' courses of study were also examined in Table 1A. About 40% of the poultry farmers were Agricultural scientist, 11% studied engineering/ technology, while about 26%, 10%, and 5% of the poultry farmers studied Social science, Management and Accounting and Art respectively and about 9% studied none of the above.

Table -1A Results of survey on the Socio-economic Characteristics of the Poultry Farmers in the Study Areas

| S. No. | Characteristic | Frequency | Percent |
|--------|---|-----------|---------|
| 1 | Questionnaire Retrieved from each State | | |
| | Ekiti | 29 | 96.7 |
| | Lagos | | |
| | Ogun | 28 | 93.3 |
| | Ondo | 30 | 100 |
| | Osun | 30 | 100 |
| | Oyo | 30 | 100 |
| 2 | Age | | |
| | <18 | 4 | 2.3 |
| | 19-25 | 9 | 5.1 |
| | 26-30 | 37 | 21.1 |
| | 31-40 | 58 | 33.1 |
| | 41-50 | 45 | 25.7 |
| | >50 | 22 | 12.6 |
| 3 | Sex | | |
| | Male | 133 | 76 |
| | Female | 42 | 24 |
| 4 | Educational Qualification | | |
| | No Formal Education | 0 | 0 |
| | Primary | 0 | 0 |
| | Secondary | 14 | 8 |
| | Diploma | 22 | 12.6 |
| | Graduate (BSc/BA/HND) | 105 | 60 |
| | Post Graduate | 28 | 16 |
| | Professional Qualification | 6 | 3.4 |
| 5 | Field of Study | | |
| | Agricultural science | 69 | 39.5 |
| | Engineering/technology | 20 | 11.4 |
| | Social science | 45 | 25.7 |
| | Management and Accounting | 18 | 10.3 |
| | Art | 8 | 4.6 |
| | None | 15 | 8.5 |

Table 1B State Analysis of the Socio-economic Characteristics of Educational Qualifications of the Poultry Farmers in the Study Area

| Parameters | State | | | | | | Total _{average} (%) |
|----------------------------|-----------|-----------|----------|----------|----------|---------|------------------------------|
| | Ekiti (%) | Lagos (%) | Ogun (%) | Ondo (%) | Osun (%) | Oyo (%) | |
| No Formal Education | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Primary Education | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Secondary Education | 3.4 | 7.1 | 3.6 | 13.4 | 3.3 | 16.7 | 8 |
| Diploma | 6.9 | 14.3 | 21.4 | 10 | 10 | 13.3 | 12.6 |
| Graduate (BSc/BA/HND) | 75.9 | 67.9 | 64.3 | 33.3 | 60 | 60 | 60 |
| Post Graduate(MSc) | 13.8 | 7.1 | 7.1 | 33.3 | 23.4 | 10 | 16 |
| Professional qualification | 0 | 3.6 | 3.6 | 10 | 3.3 | 0 | 3.4 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

3.2 Result of Regression Analysis of the Factors Influencing the Adoption of Biogas Technology in Southwestern Nigeria

Tables 2 and 3 show the results of the binary logistic regression analysis of the factors influencing the adoption of biogas technology in Southwestern Nigeria. The results revealed that educational qualification ($\beta = -.612$, $p < 0.05$), field of study ($\beta = .192$, $p < 0.05$) and capital cost/initial investment ($\beta = 2.819$, $p < 0.05$) were the main factors that significantly influenced biogas technology adoption among the selected poultry farms in Southwestern Nigeria. This implied that the above factors greatly influenced the poultry farmers in their choice of technology adoption.

This is expected because one's level of education has the potential to influence his/her decision on such aspect of life including business. This was also supported by Mignouna *et al.*, 2011; Lavison 2013; Namara *et al.*, 2013 [6, 8-9] and however, it is not surprising to observe from the analysis that a good number of the poultry farmers' decision on the choice of technology adoption was based on the background field of study.

Table -2 Results of Regression Analysis of the Socio-economic Factors Influencing the Adoption of Biogas Technology in Southwestern Nigeria

| Variables | B | S.E. | df | Sig. | Exp(B) |
|--------------------|--------|-------|----|-------|--------|
| Age | -0.038 | 0.192 | 1 | 0.842 | 0.963 |
| Gender | -0.14 | 0.445 | 1 | 0.754 | 0.87 |
| Marital status | 0.351 | 0.311 | 1 | 0.258 | 1.421 |
| Qualification | -0.612 | 0.221 | 1 | 0.006 | 0.542 |
| Field of study | 0.192 | 0.095 | 1 | 0.044 | 1.211 |
| Working experience | 0.052 | 0.038 | 1 | 0.171 | 1.053 |
| Constant | 1.429 | 1.495 | 1 | 0.339 | 4.175 |

B = Constant, Df = Degree of freedom, Sig. = Level of significance, S.E = Standard Error
Exp B. = Exponential of constant

The model of the relationship is given as:

Biogas Technology Adoption = 1.429 – 0.038 age – 0.140 gender + .351 marital status – .612 qualification + .192 field of study + .052 working experience.

Table -3 Results of Regression Analysis of the Factors Influencing the Adoption of Biogas Technology in Southwestern Nigeria

| Variables | B | Df | Sig. | Exp(B) |
|--------------------|---------|----|-------|--------|
| Affordability | 0.285 | 1 | 0.842 | 1.330 |
| Awareness | -2.165 | 1 | 0.186 | 0.115 |
| Access to loan | 2.808 | 1 | 0.175 | 16.572 |
| Trialability | 0.681 | 1 | 1.000 | 1.976 |
| Perceived value | -20.605 | 1 | 0.996 | 0.000 |
| Complexity | -2.284 | 1 | 0.177 | 0.102 |
| Compatibility | 17.345 | 1 | 0.996 | 0.499 |
| Observability | 45.023 | 1 | 0.999 | 0.000 |
| Relative advantage | -17.142 | 1 | 0.996 | 0.000 |
| Capital cost | 2.819 | 1 | 0.059 | 16.755 |
| Constant | -52.124 | 1 | 0.998 | 0.000 |

The model of the relationship is given as:

Biogas Technology Adoption = -52.12 + 0.29 affordability – 2.17 awareness + 2.81 Access to loan – .68 trialability – 20.61 perceived value – 2.28 complexity + 17.35 compatibility + 45.02 observability – 17.14 Relative advantage + 2.82 capital cost.

For example, one will expect that poultry farmers who have background in Agricultural related fields such as (Agricultural engineering, animal sciences to mention a few) will be affected by their choice of technology adoption as farmers. Additionally, the capital cost of installing the biogas technology on the farm was shown to significantly influence the choice of technology as well. This is not unexpected because to a large extent, the investment cost should influence the biogas installation the most. It is however surprising to note that other factors such as affordability, awareness, access to loans, trialability among others did not have any significant influence on the choice of biogas technology adoption among the sampled farms. In the developing world, beyond concerns about biodigester being used for sanitation, successful adoption of biogas is highly dependent on political, economic, logistical, and social factors. Again, a key to successful adoption of biogas technology appears to be direct observation and experience. Though, it is seen as complicated, it is regarded as hard and expensive, but many thousands of rural units worldwide show that this can still be used [20].

A high rate of literacy observed among the existing biogas users indicates that more educated poultry farmers are more likely to adopt the technology than the less educated ones. Therefore, the rate of adoption is expected to be higher in the future because (a) the literacy rate in poultry industries is on the rise and poultry farmers are becoming more aware of environmental concerns, (b) more areas are becoming accessible with the expansion of road and communication network, and (c) the availability of firewood is on the decline in most parts of the country. Since, the poultry farmers are generally characterized by scattering farms, low literacy rate, low investment capacity, low access to infrastructure for communication and transport. Therefore, some special

efforts are necessary to influence these poultry farmers to adopting the biogas technology. Such efforts are categorically termed as extension activities. Biogas extension refers to activities and procedures for motivating people to adopt biogas technology. Extension activities aim to take an individual through the mental stages of being aware of the technology, getting interested in it, assessing the relevance of the technology in resolving problems faced or for getting additional benefits, and finally taking decision to adopt the technology.

3.3 Reasons for the Adoption of Biodigester in Some Poultry Farms

Tables 4 and 5 show the reasons and the intended reasons for the adoption of biodigester in some poultry farms. About 3.43% of the poultry farmers adopted biodigester to reduce environmental pollution while 0.57% each of the poultry farmers adopted biodigester to produce energy and to increase farm profits. About 36.57% of the poultry farms have the intention of adopting biodigester to reduce environmental pollution, while 37.14% and 38.29% of the poultry farmers have the intention of adopting biodigester to produce energy for the farm and to increase profit on the farm respectively and based on the factors of adoption above, the level of awareness ($\beta=2.165$, $p > 0.05$) and the access to loan ($\beta=2.808$, $p > 0.05$) though greater than 0.05 significance level but less than 0.2 when compared to other factors.

Table -4 Reasons for the Adoption of Biodigester in Sampled Poultry Farms

| Reason | Frequency | Percent (%) |
|---|-----------|-------------|
| Reduces cost of maintaining environmental pollution | 6 | 3.43 |
| Increase profit on the farm | 1 | 0.57 |
| Produces energy for the farm | 1 | 0.57 |

Table -5 Intended Reason for the Adoption of Biodigester by Sampled Poultry Farms

| Reason | Frequency | Percent (%) |
|---|-----------|-------------|
| Reduces cost of maintaining environmental pollution | 64 | 36.57 |
| Increase profit on the farm | 65 | 37.14 |
| Produces energy for the farm | 67 | 38.29 |

3.4 The Types of Biodigester Adopted by the Poultry Farmers

Table 6 showed the types of biodigester adopted by the poultry farmers. Though the number of poultry farms engaging in biogas technology is now increasing based on the level awareness during the course of study. About 2% of all the poultry farms visited were using bag biodigester, while 1.14% and 0.57% of the poultry farmers were using floating and fixed dome biodigester respectively. Majority of the poultry farms that were using these biodigester were because of the cost of purchasing them. As shown in Table 4.8 the cost of materials and installation of a fixed type bio-digester made the poultry farmers to opt for the bag biodigester and the floating biodigester. A farm visited using a bag biodigester cost about \$1,250. This cost will affect the number of years of use and the level of maintenance.

Table -6 Types of Biodigester Adopted by Sampled Poultry Farmers

| Types of Biogas | Frequency | Percent (%) |
|---|-----------|-------------|
| Bag Digester | 3 | 1.71 |
| Filter | 0 | 0 |
| Deenbandhu Model | 0 | 0 |
| Khahi and Village Industries Commission | 0 | 0 |
| Floating | 2 | 1.14 |
| Fixed Dome | 1 | 0.57 |

4. CONCLUSION

Adoption of biogas technology in poultry industry in Southwestern Nigeria was insignificant. The factors influencing the adoption of biogas technology in Southwestern Nigeria revealed that educational qualification, field of study and capital cost/initial investment were the major factors that significantly influenced biogas technology adoption among the selected poultry farms in Southwestern Nigeria. The level of awareness, access to loan and complexity of the biogas technology among the poultry farmers can help to increase the rate of adoption of the technology.

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