Journal of Agripreneurship and Sustainable Development (JASD)
Volume 5, Number 1, March, 2022
ISSN (Print): 2651-6144; ISSN (Online): 2651-6365

COMPARATIVE SOCIO-ECONOMIC CHARACTERISTICS OF RURAL FARM HOUSEHOLDS THAT USED INSECTICIDE TREATED NETS AND NON-USERS IN AKWA IBOM STATE, NIGERIA

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ABSTRACT
The study compared the social and economic features of farm households that utilized insecticide treated nets and non-users in the rural areas of Akwa Ibom State. The cross-sectional data were collected from one hundred and eighty rural farming household heads. The descriptive tests and the bivariate t-test were used to analyze data collected. The result revealed that, about 72.22% of the rural farm households used ITNs in the study area. Moreover, the study established the fact that there were no significant differences between ITNs users and non-users in their gender, marital status, farming experience, social capital accumulation, education, access to extension agent, nature of residential building, value of household asset and non-farm income. Contrary to the above findings, a statistically significant difference was found in terms of age, household size, farm Income and farm size between the two groups. Following the findings, the study recommends a bottom-top approach that takes into consideration the social and economic matters of the rural farmers in planning the transfer of ITNs technology to the rural farmers in the region.

Keywords: Akwa Ibom State, Farmers, ITNs, Malaria, Rural, Socio-economics.

INTRODUCTION
The World Health Organization (WHO) launched a global programme to Roll Back the scourge of Malaria in the world in 1998. This programme was aimed at developing a sector-wide partnership to combat the disease at global, regional, country and local levels. The Roll Back Malaria initiative calls for a well-coordinated action that makes it an integral part of wider development processes (Roll Back Malaria, 2005). The initiative is an alliance of organizations and individuals aiming at maximizing the impact of scientific research on malaria especially in Africa, by promoting intensified and coordinated international research activities. This concerted effort reflects the fact that malaria remains the most significant public health problem in more than 90 countries and affects 40 percent of the world's population. Globally, malaria accounted for about 228 million cases and more than 405,000 deaths in 2018 (World Health Organization [WHO], 2020). The report asserted that children younger than five years are most susceptible to malaria (Biayemi, 2021) and in 2018, this category of under five years accounted for about 67% (272,000) of the global malaria deaths.

It is saddening that more than 90% of these deaths occur in sub-Saharan Africa where young children are the most affected (WHO, 2018 and 2021). Malaria directly accounts for one in five childhood deaths in Africa and contributes indirectly to illness and death from respiratory infections, diarrheal disease and malnutrition (Babalola *et al.,* 2018). Malaria's direct costs are estimated to be $12 billion per year (WHO, 2019; 2020). It is devastating in

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sub-Saharan Africa since political instability is high and resources and solid prevention programs are limited. In Nigeria, malaria has remained a major public problem and accounts for over 60% of outpatient visits and 30% of hospital admissions. Malaria is responsible for 29% of childhood death, 25% of infant mortality and 11% of maternal mortality. The disease has negatively impacted Nigeria's economy with about 132 billion Naira lost to the disease as cost of treatment and loss in man-hours. Approximately 50% of the Nigerian population experience at least one episode per year. However, an official estimate suggests as many as four bouts per person per year on average (WHO, 2019). Malaria is responsible for an average annual reduction of 1.3% in Africa's economic growth. Malaria-related absenteeism and productivity losses cost Nigeria, for example, an estimated US$ 1.1 billion every year (WHO, 2021).

The trend is rapidly increasing due to the current malaria resistance to first-line anti-malarial drugs (Rathmes *et al.,* 2020; Duffey *et al.,* 2021; Roux *et al.,* 2021). The disease carries with it two categories of costs; morbidity and mortality costs. Malaria morbidity affects households' welfare (through families' allocation to treatment and prevention of the disease), and decline in productivity, through lost time. In the case of mortality, losses to households include loss of future income and cumulative investment on the dead due to malaria. The Federal Government of Nigeria has recognized the problem and has been addressing it for years, through primary health care and other forms of interventions. For instance, in 2009, the Ministry of Health developed a 5-year National Strategic Plan for Prevention and Control of Malaria (NMSP). The vision was for a malaria-free Nigeria, with ambitious targets for these five years, including the national scale-uplong-lasting insecticide nets (LLIN) coverage, prompt diagnosis and treatment of malaria, and prevention of malaria in pregnancy. The obstacles to the success of these interventions were socio-cultural, economic and political (National Malaria Elimination Programme [NMEP], 2016).

The use of insecticide-treated nets (ITNs) is another strategy adopted by the federal government to curb the menace of malaria infection and is one of the global strategies adopted in order to decrease the burden of malaria among individuals and households especially in developing countries (Koudou *et al.,* 2010, Ajegena *et al.,* 2020). In Nigeria, the use of ITNs is currently considered one of the most cost-effective methods of malaria control. Regular use of ITNs by all those at risk of malaria infection is a key component of the National Control Programme. Despite the well-known benefits of ITNs and the efforts of the Nigerian government to promote this intervention through mass distribution campaigns, many rural families and individuals at risk in the country do not own or use ITN (Naphtali and Sani, 2014). However, access to nets has remained poor across many communities in Nigeria and other African countries (World Health Organization, 2021). This low coverage prompted the intervention by various development partners and stakeholder organizations to increase. Extended Programme to increase ITNs ownership can make a substantial reduction in malaria mortality only if the nets are used adequately by the vulnerable groups or beneficiaries. But several studies have reported that; awareness, accessibility and utilization of the ITNs have a significant bearing on the beneficiary's socio-economic features (Biayemi, 2021; Kanmiki *et al.,* 2019; Ahorlu *et al.,* 2019; Bah, 2020). The beneficiaries' socioeconomic features are useful for understanding the influences affecting well-being services and other health behaviours associated with malaria control (Manu *et al.,* 2017 and Biayemi, 2021).

The Akwa Ibom State is one of the States in Nigeria that has devoted its enormous resources towards combating malaria incidence and poverty among farming population (Akpan *et al.,* 2016; Akpan *et al.,* 2019). The state strategy health development plan (AKS-SHDP) in

2010, reported that malaria was one of the major causes of illness and death among adults; as well as the major driver of childhood illness and death in the State. The report added that only 14% of the state's population owned ITN, while 14% and 4% of children and pregnant women respectively accessed ITN. The report has far-reaching implications following the fact that; more than 60% of the State population lives and are engaged in agricultural activities in the rural areas noted for the high prevalence of malaria vectors. More than 50% of the state population lives below the poverty line, implying that affordance of efficient orthodox treatment on malaria could be an illusion, and the presence of deplorable and weak health care system in the State makes individuals and families more vulnerable to malaria attack (Nkanta, 2019). As part of the efforts to encourage individuals and families to use the ITN, the Government of Akwa Ibom State in collaboration with other stakeholders have embarked on creating awareness and free distribution of ITNs to individuals and households in the State using multiple outlets (Akwa Ibom State Ministry of Health, 2015). Following the efforts of the various tiers of governments to tackle the issue of compliance with the use of ITNs especially by the vulnerable groups; the study specifically focused on the comparative analyses of the socio-economic features of the users and non-users of ITNs among rural farm families in Akwa Ibom State, Nigeria.

There few literatures that explore the socioeconomic characteristics of farmers that adopt ITNs in the sub-Saharan African Countries. For instance, Ng'ang'a *et al.,* (2009) studied bed net use and associated factors in a rice farming community in central Kenya. The study identified the socioeconomic factors affecting the use of ITNs to include farmers' age, household head, gender and educational levels of the household head. In Nigeria, Nwosu *et al.,* (2011), studied the utilization of insecticide treated nets and its effects of health promotion intervention in selected rural communities of Abia State. Four out of 8 selected communities were assigned to the intervention group while the rest of the 4 were assigned to the control group. Two hundred (200) respondents were randomly sampled from each group for comparative analysis. The Chi-Square tests showed that; there were no significant differences in age of household head, marital status, years of formal education, primary occupation and monthly income of families under Health Promotion Intervention (HPI) which have accessed to ITNs and those outside the scheme. Obekpa *et al.,* (2015) analyzed the impact of the long-lasting insecticide-treated nets on farming households in Benue state. The findings revealed that there was no significant difference in the income of the beneficiaries and non-beneficiaries of the nets. In the southern region of Nigeria, Nlerum (2016) examined the utilization of insecticide-treated bed nets for malaria prevention by rural farmers in Ahoada East Local Government Area of Rivers State. The result revealed an ownership rate of 71.73% and a utilization rate of 28.27%. Also, the age and farm income were found to increase with an increase in ownership/utilization rate of ITNs. In another study, Kanmiki *et al.* (2019) the socio-economic and demographic disparities in ownership and the use of insecticide-treated bed nets for preventing malaria among rural reproductive-aged women in northern Ghana. They found that 79% of respondents owned ITNs. They discovered disparities in both ownership and utilization of ITNs in wealth index, occupational status, religion, and district of residence. Ahorlu *et al.* (2019) research on understanding the gap between access and use: a qualitative study on barriers and facilitators to insecticide-treated net use in Ghana. Results showed gender differences in the use of ITNs among users. Bah (2020) also observed that those with low financial status have limited access to healthcare and thus a high disease burden likewise, education help improve health status as a result of compliance with prevention strategies. The literature reviewed need to be updated to reflect the current realities in the rural

Journal of Agripreneurship and Sustainable Development (JASD)
Volume 5, Number 1, March, 2022
ISSN (Print): 2651-6144; ISSN (Online): 2651-6365

areas of the State. Again, there is need to specifically direct a study like this to focus on farm households especially now the sector is been challenge by COVID-19 pandemic.

MATERIALS AND METHODS

The Study Area

The study was conducted in Akwa Ibom State, located in the southern region of Nigeria. It is located between latitudes 4°32[1] and 5°33[1] North and longitudes 7°25[1] and 8°25[1] east. It has a total land area of areas of 7,246 km^2. The mean annual temperature of the State lies between 26°C and 29°C and average sunshine of about 1,450 hours per year. The mean annual rainfall ranges from 2,000mm to 3,000mm, depending on the area. Naturally, maximum humidity is recorded in July while the minimum occurs in January. The State is bordered on the East by Cross River State, on the West by Rivers State and Abia State, and on the South by the Atlantic Ocean. Akwa Ibom State has a population of about 3,902,051 and a population density of 634 persons per square kilometers (National Population Commission, 2006). The State is basically an agrarian society where crops like maize, okra, waterleaf, cassava, yam and rice are cultivated in large quantities. Politically and for ease of administration, the State is divided into 31 Local Government Areas; it has six distinct Agricultural Development Programme (ADP) Zones. These are: Oron, Abak, Ikot Ekpene, Etinan, Eket and Uyo zones. Uyo is the administrative head of Akwa Ibom State.

Sample Size Selection

The unit of analysis is farm households. Equation 1 provided by Anderson *et al. (*2007) was adopted to select the required farming households. Representative sample size from a large population of rural households was obtained using the equation specified as thus:

$$S_n = \frac{z^2\rho(1-\rho)}{D^2} \qquad \ldots (1)$$

where; S_n is the required sample size; Z is the 95% confidence interval (1.96); P is the expected proportion of the farming households in the rural population of the study area (about 87%); D is the absolute error or precision at 5% type 1 error. The sample size is derived as shown in equation 2.

$$S_n = \frac{(1.96)^2 0.87(1 - 0.87)}{(0.05)^2} = 174 \qquad \ldots (2)$$

In order to have sufficient data for the specified regression model, the sample size was scaled up to 180 respondents.

The population of the Study

The population for this study consisted of all farm households in the rural areas of Akwa Ibom State. A household is considered to be a farm household when at least one member or preferably household head is engaged actively in at least one form of agricultural practices. Alternatively, such households derived their livelihood from agricultural activity.

Sampling Procedure

Primary data was used in this study. Respondents consisted of the household heads of rural farm families in Akwa Ibom State. A multistage random sampling method was used to select respondents. The study adopted the working structure of Akwa Ibom State Agricultural Development Programme (AKADEP) to stratify the study area from which Simple Random Sampling was then applied. In the first stage, the six agricultural Zones in the state were grouped into three sub-zones. One of the reasons for the sub grouping of zones was to achieve

Journal of Agripreneurship and Sustainable Development (JASD)
Volume 5, Number 1, March, 2022
ISSN (Print): 2651-6144; ISSN (Online): 2651-6365

proximity and similarity in certain attributes such as cropping system, livelihood activities, present of infrastructures, weather and cultural believes among rural farm families. Hence, Oron and Eket was group into a sub zone; also, Abak and Ikot Ekpene was another sub zone, while Uyo and Etinan constituted the last sub zone. The second stage involved a simple random selection of one zone from each of the three sub-zones. A total of three zones were used in the study. From each of the sampled zone, 10% of blocks were randomly sampled. Blocks contain cells; while a cell contains a series of farm families or farming households spread across the specific locality or village(s). In the third stage, 10% of cells were randomly selected from each block. The final stage involved the random selection of 60 farm families from each zone. A grand total of 180 rural farm families were randomly sampled and used for data analysis. The breakdown of the sampling is shown in Table 1.

Table 1: The breakdown of the sampling

Zone	Users of ITN	%	Non-users of ITN	%
A	43	33.08	17	34.00
B	43	33.08	17	34.00
C	44	33.84	16	32.00
Total	130	100.00	50	100.00

Source: Provided by the authors.

Instrument for Data Collection

A structured questionnaire was used to collect cross-sectional data from farming households in the study area. The data consisted of the socio-economic features of the rural farm households and household heads. The structured questionnaire was administered to respondents and the information gotten was complemented by personal interviews and focus group discussion (FGD), to ensure consistency and accuracy of the data.

Model Specification and Analytical Techniques

Descriptive statistics consisting of percentages, tables, means and frequencies were used to analyze the objective of the study. Also, a bivariate t-test was used to test the differences in mean of some socio-economic characteristics of rural farm families in relation to the use and non-use of ITN in Akwa Ibom State. The choice of the bivariate t-test was based on the fact that most variables involved were discrete representing two independent groups with unequal populations. The bivariate t-test formula that was used to compare means from two independent frequency groups with unequal populations and equal variance is shown in equation 3.

$$t = \frac{X_1 - X_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_1}}} \qquad \ldots (3)$$

where; $X_1$and X_2 represent the means of the two samples, S_1 and S_2 are the standard deviations of the two samples, and n_1 and n_2 are the sizes of the two samples. The number of degrees of freedom for the problem is smaller of $n_1 - 1$ and $n_2 - 1$. The null hypothesis in respect of each socio-economic characteristic specified was tested using the calculated t-test value and the tabulated t-value for the difference in mean.

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RESULTS AND DISCUSSION

Socio-economic Characteristics of Rural Farmers that used ITNS and those that do not use

The social and economic characteristics of the rural households that used ITNs and those that do not use ITNs were analyzed and the results are presented and discussed in the following sub sections. The distribution of the sex composition of the rural farming household in the study area is presented in Table 2. The result revealed that the majority of farmers that used ITNs were male (56.15%), and similarly majority of farmers (58.00%) that do not use ITNs were also male.

Table 2: Comparative presentation of the sex composition of the rural farm households that used ITNs and those that do not use

Sex composition	Those that used ITN		Those that do not us ITN	
	Freq.	**%**	**Freq.**	**%**
Male	73	56.15	29	58.00
Female	57	43.85	21	42.00
Total	**130**	**100.00**	**50**	**100.00**
$t_{(value)}$ = 10.00; Prob. = 0.063*				

Source: Computed by the authors.

The result implies that female farmers are less attracted to the use of ITNs compared to their male counterparts. The result also showed that in terms of sex distribution between farmers that utilized ITNs and those who do not; the t-test value indicated a significant difference. This means that the number of male and female farmers that used ITNs in the study area is significantly different from the male and female farmers that do not use ITNs. The result further revealed that about 72.22% of the rural farm households used ITNs in the study area. This implies that about 27.78% of farming households do not use ITNs in the study area. This result corroborates the findings of Nwosu *et al.* (2011) and Ahorlu *et al.* (2019).

Table 3: Comparative presentation of the Age distribution of rural farm households that use ITNs and those that do not use

Age distribution (Years)	**Those that use ITN**		**Those that do not use ITN**	
	Freq.	**%**	**Freq.**	**%**
20 – 40	36	27.69	14	28.00
41 – 60	73	56.15	33	66.00
61 – 80	21	16.15	3	6.00
Mean	48.24		**47.90**	
Total	130		**50.00**	**100.00**
$t_{(value)}$ = 3.941; Prob. = 0.059*				

Source: Computed by the authors

The age distribution of users of ITNs as shown in Table 3 revealed that 27.69% of the respondents fell in the age range of 20 – 40 years. The majorities of them were in the age category of 41 – 60 years; while the minimum percentage of 16. 15% were described as aged. The mean age of farmers that utilized ITNs stood at 48.24 years. The age distribution among non-users of ITNs was similar to users described above. About 28.0% of non-users of ITNs were in the age range of 20 – 40 years; while the majority of non-users (farmers) belong to the

Journal of Agripreneurship and Sustainable Development (JASD)
Volume 5, Number 1, March, 2022
ISSN (Print): 2651-6144; ISSN (Online): 2651-6365

41 – 60 years, age group. This result revealed that the majority of rural farm households that used ITNs and those that do not use them fell in the age group of 41 – 60 years.

This also means that majority of users and non-users of ITNs are in their active farming age. Also, at the age range of 61 – 80 years, only 16.15% and 3.0% (Table 4) of users and non-users of ITNs, respectively were discovered in the study area. The mean age of 47.90 years was estimated for non –users of ITNs. Comparing the frequency in age distributions between the users of ITNs and non-users of ITNs, it is revealed that, the mean distribution is significantly different between the two groups. This connotes that, the frequencies spread across the age distribution for rural farming households that utilized ITNs is significantly different from that of non-users of ITNs. The finding implies that relatively older rural farm households prefer ITNs to younger farm households in the rural areas of Akwa Ibom State, Nigeria. The finding was previously substantiated by Nlerum (2016).

Table 4: Comparative presentation of the marital status of rural farm households that use ITNs and those that do not use

Marital status composition	**Those that use ITN**		**Those that do not use ITN**	
	Freq.	**%**	**Freq.**	**%**
Single	12	9.23	1	2.00
Married	84	64.62	35	70.00
Divorced	7	5.39	1	2.00
Widowed	16	12.31	5	10.00
Widower	11	8.46	8	16.00
Total	130		50	100.00
$t_{(value)}$ = 1.814; Prob. = 0.129				

Source: Computed by the authors

The marital status of the rural farming household heads indicates that, 9.23% of the rural farm household heads that used ITNs were single, whereas only 2.0% of non-users were single. About 64.62% and 70.0% of the users and non-users of ITNs, respectively, were married. None of the non-users was divorced, while only 4.62% of users were divorced. The result also showed that, 12.31%, 8.46% and 0.77% of ITNs users were widows, widowers and separated, respectively. On the other hand, about 10.0%, 16.0% and 2.0% of non-users of ITNs were documented as widows, widowers and separated, respectively. Comparing the frequency distribution of the two groups, the t-value showed that there is no significant difference in marital status distribution between the rural farm household heads that used ITNs and non-users in the study area. The finding is in consonance with the empirical work conducted by Nwosu *et al.* (2011) in Nigeria.

In terms of farming experience, the result revealed that, about 7.69% of users of ITNs and 2.0% of non-users of ITNs have farming experience of less than one year. Majority of users (63.85%) and non-users (58.0%) of ITNs had farming experience that range from 1 to 20 years, respectively. This implies that, majority of farmers that utilized ITNs and those that do used it are, well experienced farmers who have practiced farming for appreciable number of years. Only 22.31% of users and 38.0% of non-users had farming experience of 41 to 60 years each. The result also revealed that, only 6.15% of users of ITNs had farming experience greater than 40 years. The findings have shown that, older farmers are much likely to used ITNs compared to younger ones. Relatively similar average farming experience years of 15.89 and 17.32 (Table 5) were estimated for users and non-user groups respectively in the study area. Comparing the

Journal of Agripreneurship and Sustainable Development (JASD)
Volume 5, Number 1, March, 2022
ISSN (Print): 2651-6144; ISSN (Online): 2651-6365

frequency distributions of the farming experience expressed in years of the users and non-users' groups, it is shown that (t value = 1.763) there is no significant difference between the two groups. This implies that, the farming experiences of farmers' that used ITNs and those that do not are statistically the same.

Table 5: Comparative presentation of the farming experience and social capital of the rural household heads that used ITNs and those that do not use

Socio-economic characteristics	Those that use ITN		Those that do not use ITN	
	Frequency	**%**	**Frequency**	**%**
Farming experience (Years)				
>1	10	**7.69**	2	4.00
1 – 20	83	**63.85**	29	58.00
21 – 40	29	**22.31**	19	38.00
41 – 60	8	**6.15**	0	0.00
Mean	15.89		17.32	
Total	130		50	100.00
$t_{(value)}$ = 1.763; Prob. = 0.260				
Social organization (Years)	**Frequency**	**%**	**Frequency**	**%**
0	82	63.08	26	52.00
1 – 10	35	26.92	18	36.00
11 – 20	11	8.46	6	12.00
21 – 30	2	1.54	0	0.00
Mean	3.20		4.02	
Total	130		50	100.00
$t_{(value)}$ = 1.609; Prob. = 0.206				

Source: Computed by the authors.

Comparing the extent of social capital formation of farmers that utilized ITNs and those that do not; the result had revealed rather timid or self-reserved farming population in the study area. For instance, about 63.08% of users of ITNs and 52.0% of non-users did not belong to any social organizations of any sort. Only 26.92% of users group and 36.0% of non-user group had experienced some forms of social interactions for the period of 1 to 10 years. Fewer proportions representing 8.46% for users and 12.0% for non-users of ITNs were involved in social networking for the period of 11 to 20 years. Only 1.54% of users belong to social group for the period of 21 to 30 years. This finding shows that, social capital is low among users and non-users' groups in the study area. However, the mean years of involvement in social group for farmers that used ITNs and non-users stood at 3.20 and 4.02 years, respectively. The estimate of bivariate t-test revealed the t-value of 1.609 that is statistically insignificant at conventional probability levels. The result implies that, years spent in social group for farmers that utilized ITNs and non-user farmers are statistically the same. This means that both farmers' groups are similar in terms of social interaction within their farming communities.

The distribution of years of formal education among the two groups of farmers is presented in Table 6. The result shows that only 3.08% of farmers that utilized ITNs did not attend formal schools whereas all non-user farmers went through formal learning processes. Also, about 53.08% and 54.0% of users and non-users of ITNs went through primary education respectively. At the secondary school level; about 33.85% and 30.0% of the users and non-users of ITNs respectively attended this stage of education. The result indicates close and

Journal of Agripreneurship and Sustainable Development (JASD)
Volume 5, Number 1, March, 2022
ISSN (Print): 2651-6144; ISSN (Online): 2651-6365

similarity in all stages of formal education among the two groups of farmers. This further showed the homogenous nature of the rural farming communities in the State.

Table 6: Comparative presentation of the educational and household size of the rural farm households that use ITNs and those that do not use

Socio-economic characteristics	Those that use ITN		Those that do not use ITN	
	Frequency	**%**	**Frequency**	**%**
Educational attainment (years)				
No Schooling	4	3.08	0	0.00
Primary School	69	53.08	27	54.00
Secondary School	44	33.85	15	30.00
Tertiary School	13	10.00	8	16.00
Mean	13.09		14.10	
Total	130		**50**	**100.00**
$t_{(value)}$ = 2.142; Prob. = 0.122				
Household size (number)	**Frequency**	**%**	**Frequency**	**%**
1 – 5	30	23.08	16	32.00
6 – 10	45	34.62	18	36.00
> 10	55	42.30	16	32.00
Mean	10		9	
Total	**130**	**100.00**	**50**	**100.00**
$t_{(value)}$= 3.694; Prob. = 0.066*				

Source: Computed by the authors.

This result of Table 6 was also extended to the level of tertiary education among the two groups. It is revealed that about 10.0% and 16.0% of users and non-users attended higher or tertiary education. Meanwhile, the study discovered the average formal education attainment of 13.09 and 14.10 years for the users and non-users, respectively. The result implies that more educated farmers in the rural areas of the State are likely to ignore the use of ITNs compared to less educated ones. The result of the descriptive analysis of the educational attainment of the two groups of farmers was also supported by the result of the bivariate t-test conducted to test the degree of disparity in formal education attainment between the two groups of farmers. The t-test value of 2.142 was not significant at any of the conventional probability levels. This confirmed that, the educational attainment of farmers that used ITNs was not significantly different from those that do not use the ITNs. The result was in agreement with the research finding of Nwosu *et al.* (2011) in Nigeria.

Literature has provided much evidence that household size plays a key role on household utilization of insecticide treated nets in the rural areas of Nigeria. In a bit to investigate this assertion in the rural farming communities of Akwa Ibom State, the household size was categorized into 3 sub-groups for efficient analysis and presented in Table 6. The finding reveals that, about 23.08% of farmers that used ITNs and 32.0% that do not use ITNs have family size in the category of 1 to 5 members. Similarly, 34.62% and 36.00% of users and non-users' farmers respectively owned families whose size ranged from 6 to 10 members. However, majority (42.31%) of ITNs users' group have family greater than 10 members. In the similar vein, only 32.00% of non-users belong to this category. The study discovered average household size of 10 members for farmers that used ITNs and 9 members for those that do not

used ITNs. From the descriptive analysis of household size of rural farmers, it implies that, farmers that make use of ITNs have relatively larger household size than those who do not use ITNs. The result was further supported by the parametric test of the differences between these two groups of farmers using a bivariate t-test. The result of the t-test showed an estimated value of 3.694 that was statistically significant at 10% probability level. The result implies that farmers that used ITNs have a higher household size that is significantly different from those that do not use ITNs. Nwosu *et al.* (2011) has submitted similar result in Nigeria.

Farmer access to functional agricultural extension services is another identified major driver of ITNs utilization among rural dwellers in the developing countries. The active extension system is expected to act as one of the major sources of improved technology or innovation for rural farmers. But in recent times, farmers' access to agricultural extension services has suffered severe drawbacks especially in developing countries due to several factors inherent in the system and factors related to farmers themselves. The result of the descriptive analysis presented in Table 7 on farmers' access to extension services holistically supported the above assertion. The result revealed that 74.62% and 74.00% of farmers that used ITNs and those that do not use them respectively do not have access to any form of agricultural extension services for the past one year in their communities. Only 22.31% of users of ITNs and 4.00% of non-user of ITNs have access to extension services in their communities at least one to two times the previous year. Only 3.08% and 10.00% of users and non-users of ITNs respectively met extension workers 3 to 5 times in the last planting season. Surprisingly, no farmer that used ITNs had contact with an extension agent more than 5 times last season; whereas 12.00% of non-users had. This result connotes that; the technology of insecticide-treated nets might not be a component in the training programme of the extension system in the State. In other words; agricultural extension agents in the study area do not incorporate the technology of ITNs in their farms' visiting scheduled programmes. The finding also showed the mean period of 0.39 and 1.67 days per year for farmers that used ITNs and non-users respectively. This expressed the inefficiency of the agricultural extension system in the State, and the findings call for more proactive approaches by the State government to revive the system for effective and efficient service delivery. In addition, the bivariate t-test was used to test the difference in extension service accessed between the farmers that used ITNs and non-users. The result revealed t-value of 1.317 (Table 7) that was insignificantly different from zero. This implies that, number of times, farmers that used ITNs accessed agricultural extension agents is not significantly different from those that do not used ITNs. This finding further affirmed the inactive nature of agricultural extension services in the State.

The nature of residential building of respondents was also examined. The finding revealed that majority (86.92%) of farm households that used ITNs lived in concrete building, likewise majority (70.00%) of non-user households. Only 8.46% and 10.00% of users and no-user households, respectively dwell in muddy houses. Surprisingly, 20.00% of non-user households and 3.08% of user households lived in shanties.

Journal of Agripreneurship and Sustainable Development (JASD)
Volume 5, Number 1, March, 2022
ISSN (Print): 2651-6144; ISSN (Online): 2651-6365

Table 7: Comparative presentation of the access to extension services and nature of residential building of the rural farm households that use ITNs and those that do not use

Access to extension agent (Number/year)	**Those that use ITN**		**Those that do not use ITN**	
	Frequency	**%**	**Frequency**	**%**
Access to extension agent (Number/year)				
No access	97	74.62	37	74.00
1 – 2	29	22.31	2	4.00
3 – 5	4	3.08	5	10.00
> 5	0	0.00	6	12.00
Mean	0.39		1.67	
Total	130		**50**	**100.00**
$t_{(value)}$ = 1.317; Prob. = 0.279				
Farm income (Naira/year)	**Frequency**	**%**	**Frequency**	**%**
≤ 20,000	19	14.62	16	32.00
20,001 – 100,000	32	24.62	17	34.00
100,001 – 400,000	45	34.62	16	32.00
400,001 – 700,000	13	10	0	0.00
700,001 – 1,000,000	12	9.23	0	0.00
> 1,000,000	9	6.92	1	2.00
Mean	371, 961.50		128,510	100.00
Total	130		50	
$t_{(value)}$ = 3.720; Prob. = 0.014**				
Nature of residential building	**Frequency**	**%**	**Frequency**	**%**
Concrete	113	86.92	35	70.00
Mud	11	8.46	5	10.00
Shanty	4	3.08	10	20.00
Tent	2	1.54	0	0.00
Total	130	100.00	50	100.00
$t_{(value)}$ = 1.026; Prob. = 0.380				

Source: Computed by the authors.

The result (Table 7) however, is contrary to expectation given the unhygienic nature of most shanties. It was expected that those that live in shanties would utilize ITNs more because they are predisposed to mosquito compared to other categories. Reasons including high incidence of poverty among residents of shanties and lack of information could contribute to this result. It was also discovered that, 1.54% of user group lived in tent. When the mean of the frequency of the two users was compared, the result showed no statistical difference between the two groups.

Analysis of the Farm Size, Farm Income and Assets of Rural Farm Households that Used ITNS and Non-users

The analyses of farm size revealed that land holding among farm households in the study area were generally small (Table 8). The breakdown of farm sizes among respondents is presented in Table 8. Households that do not use ITNs have farm size less than one hectare. Majority (44.00%) of non-user (Table 8) farm households had farm size that range from 0.71 – 0.90 hectare. On the other hand, farm households that utilize ITNs have higher farm size compared to non-users. An average farm size of 0.63 hectares was estimated for the user

Journal of Agripreneurship and Sustainable Development (JASD)
Volume 5, Number 1, March, 2022
ISSN (Print): 2651-6144; ISSN (Online): 2651-6365

households, while 0.45 hectares was discovered for the non-user households. The t-test value of 3.243 is statistically significant at 5% probability level and this implies that, the mean farm size of households that utilized ITNs is statistically different from those households that do not use ITNs. The distribution of the respondent's farm income is shown in Table 8. The result showed significant disparity in farm income earned per annum by users and non-users' groups in the study area. For instance, about 14.62% and 32.00% of users and non-users respectively earned farm income less than or equal to ₦20, 000 per year. This result connotes that, most households that utilized ITNs are actively involved in farming activities. The findings also reveal that about 34.0% and 32.00% of non-users of ITNs realized farm income in the range of ₦20,001 – ₦100 and ₦100, 001 – ₦400, 000 per annum, respectively. In the same categories for ITNs users' group, only 32.00% and 45.00% respectively earned likewise income. This further showed that, farming households that utilized ITNs are seriously involved in farming activities and equally earned more farm income than those that do not utilized ITNs. Further examination of other income categories revealed that, no respondent in the non-user households' make farm income in the income category of ₦400, 001 – ₦700,000 and ₦700, 000 – ₦1,000, 000 whereas 10.00% and 9.23% of user households, respectively, earned income in these categories. In income category greater than ₦1, 000, 000 only 2.00% of non-user households fell in this category while 6.92% of user households were in this category. The result revealed that, farm income is skewed between households that used ITNs and those that do not use and equally tend to concentrate on user households. The finding is in agreement with the report of Nwosu *et al.* (2011). An average annual farm income of ₦371, 961.50 was estimated for user households while ₦128, 510.00 represented the non-user households in the study area. Testing for the difference in mean of farm income for the two groups, the t-test result of 3.720 was statistically significant at 5% probability level. This means that, the mean farm income of households that used ITNs is significantly different from those that do not use it. Obekpa *et al.* (2015) had submitted similar report.

The distribution of the non-farm income of the respondents is shown in Table 8. The result showed that, majority of ITNs users (53.085) and non-users (44.00%) households earned non-farm income that was either less than or equal to N20, 000 per annum. This result connotes that, majority of the farming households in the study area are actively engaged in farming as the major source of family income. For instance, about 87.70% of user households earned non-farm income in the range of ₦20, 000 – ₦400, 000 per annum, while 92.00% represents the non-user households. This result means that, agricultural concentration is high among farming households in the study area. The mean non-farm income of ₦158, 196.20 was estimated for the user households and ₦122, 380 stood for non-user households. However, the mean non-farm income of the two groups was not statistically different from each other. The value of t-test was 1.743 and was insignificant at the three conventional levels.

Journal of Agripreneurship and Sustainable Development (JASD)
Volume 5, Number 1, March, 2022
ISSN (Print): 2651-6144; ISSN (Online): 2651-6365

Table 8: Comparative presentation of the farm size, Farm income and Assets of rural farming households of rural households that used ITNs and those that do not use

Socio-economic characteristics	**Those that used ITN**		**Those that do not used ITN**	
	Frequency	**%**	**Frequency**	**%**
Farm Size (hectares)				
0.01 – 0.10	2	1.54	1	2.00
0.11 – 0.30	36	27.69	16	32.00
0.31 – 0.50	21	16.15	10	20.00
0.51 – 0.70	3	2.31	1	2.00
0.71 – 0.90	49	37.69	22	44.00
0.91 – 1.10	9	6.92	0	0.00
> 1.10	10	7.69	0	0.00
Mean	0.6269	100.00	0.4518	**100.00**
Total	**130**		**50**	
$t_{(value)}$ = 3.243; Prob. = 0.018**				
Non-Farm Income (Naira)	**Those that used ITN**		**Those that do not used ITN**	
	Frequency	**%**	**Frequency**	**%**
≤ 20,000	69	53.08	22	44.00
20,001 – 100,000	41	31.54	18	36.00
100,001 – 400,000	4	3.08	6	12.00
400,001 – 700,000	6	4.62	2	4.00
700,001 – 1,000,000	0	0.00	0	0.00
> 1,000,000	10	7.69	2	4.00
Mean	158,196.2	100.00	122,380	**100.00**
Total	130		50	
$t_{(value)}$ = 1.743; Prob. = 0.142				
	Those that used ITN		**Those that do not used ITN**	
Value of household asset (Naira)	**Frequency**	**%**	**Frequency**	**%**
< 100,000	45	34.62	9	18.00
100,000 – 300,000	5	3.85	6	12.00
300,001 – 500,000	7	5.38	3	6.00
500,001 – 700,000	6	4.62	1	2.00
700,001 – 900,000	5	3.85	0	0.00
1,000,000 – 1,200,000	2	1.54	5	10.00
> 1,200,000	60	46.15	26	52.00
Mean	4,214,047	100.00	3,827,316	100.00
Total	130		50	
$t_{(value)}$ = 1.844; Prob. = 0.115				

Source: Computed by the authors.

The respondents' asset values were unevenly distributed between the two groups of farm households. For instance, about 34.62% and 18.00% of user and non-user households possessed assets that worth less than ₦20, 000, respectively. In the range of ₦100, 000 – ₦300, 000 only 3.85% and 12.00% represent the user and non-user groups respectively; while 5.38% and 6.00% likewise stood for ₦300, 001 – ₦500, 000 category. However, majority of respondents in user and non-user groups have asset worth more than N1.2m. The average asset worth of ₦4, 214,047

and ₦3, 827, 316 were obtained for the user and non-user farm households, respectively. However, the asset worth of the two groups was similar following the insignificant value of the estimated t-test as Kanmiki *et al.* (2019) and Bah (2020) reports support the finding.

CONCLUSION AND RECOMMENDATIONS

Understanding the social and economic characteristics of the target population is critical in technology transfer and assimilation especially in the rural communities. The fight to subdue the scourge of malaria especially in the developing society is mostly done in the rural areas which are more vulnerable compared to the urban areas. The study has identified important social and economic factors that should be addressed before transferring ITNs technology to the rural farmers in the region. For instance, the need to address the family size, gender issue, farm income and the land ownership/size of the rural farmers are critical when ITNs is the major technology to be transferred to them. Given the ITNs utilization rate of 72.22% in the State, more proactive strategies should be adopted using the identified social and economic characteristics of the rural farm households to obtain the global target of 100% in the near future. Based on the findings, the study recommends a bottom-top approach that takes into consideration the social and economic matters of the rural farmers in planning the transfer of ITNs technology to the rural farmers in the region.

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