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Full Length Research Paper

The effect of olive mill effluent and organic compost on evaporation and temperature in medium and coarse textured pot soils

Bagheri, M. R.* and Movahedi Naeini, S. A. R.

Department of Pedology, Gorgan University of Agricultural Sciences and Natural Resources, Iran.

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The effects of olive mill effluent on evaporation assessed from the surface of two kinds of soil sandy loam and loam textures with two different temperatures. In the other hand five treatments for each texture were prepared in three replicates, including wastewater treatment stained with olives in a value and two percent, compost mixture treatments, mulch amount equal to 50 tons/h, control and water. Eleven treatments were used. Treatments only to a depth of 5.0 cm of soil were applied. 0.0 to 5.0 cm depth of soil particles passed through the eight millimeters sieve and the remaining depth to bottom pot (13 cm) were full by a particle passed through 2.0 mm sieve. By measuring weight loss pots completely "wet every day of the evaporating three months for each period temperature were assessed. Soil temperature in depths of 2.0 and 10.0 cm twice each day, once at 8 a.m. (temperature achieved during the night) and the other at 19 p.m. (temperature gained during the day) were recorded. Stored soil moisture in different potential (zero, 0.05, 0.1, 0.3, 1.5 and 15 bar) in the olive mill effluent for both texture by pressure plates and tempi cells were measured. Statistical analysis of data from completely randomized design (CRD). These results indicate that the rate of the hydrophobic material used in both textures had indirect relation with evaporation from the soil surface.

Key words: Olive mill effluent, mulch, compost mixture, evaporation.

INTRODUCTION

Nowadays using the artificial and natural mulch is one of the operations that maintain soil moisture and decrease evaporation rates. Hydrophobic materials such as (OME) seem useful (Melloli et al., 1998). Evaporation reduction methods using hydrophobic materials modifications and changes based on hydrodynamic upper soil is firm. Below in the water volume in the unsaturated soil hydraulic conductivity and water level rise in capillary tubes decreased and thus decrease the rate of evaporation (Mansell, 1970). In addition, soil moisture cause soil mechanical strength reduces and root growth increase than the available soil water is extracted.

Melloli et al. (1998) also studies the effect of olive mill effluent form with a completely mixed with the soil

*Corresponding author. E-mail: mohammad_bagheri2003@yahoo.com.

Abbreviations: OME, olive mill effluent; **CE,** Cumulative evaporation; **CER,** Cumulative evaporation reduction material in the form of reduced evaporation compared to spraying the soil surface were significantly higher announcement. Cumulative evaporation and wastewater treatment aggregate mixture after forty-six days compared to the control of 27.9% indicated that the reason there was aggregate stability in soil, reducing and changing the angle of unsaturated hydraulic conductivity in a capillary tube was declared.

Studies of soil amendment concept stages of soil evaporation from the descriptive to the quantitative form developed. Usually three main evaporation steps when dry soil is wet can be used (Hillel, 1980). Merely the first stage controls the rate of energy intake and continues until the water level in the soil surface is not limited. Air drying of soil surface area begins second phase evaporation. At this stage evaporation rate gradually decreases and is controlled by the soil profile. In the third stage of evaporation rate is very low and constant. During the third phase of water movement in soil as a vapor is greater and may take several months. First stage ends when the curve of (CE) to separate free water from the soil. Pot a long intermediate phase is observed because the energy levels and aspects of the pot is supplied (Movahedi and Cook, 2000). Daily changes in demand for farm atmosphere for evaporation and vapor transport to the soil surface at night and distillation, the evaporation process of converting first to the second stage and the image may occur. This phase is called the intermediate phase and is very short compared to the pot. Coupled method for measuring and controlling the rate of evaporation from soil and effectiveness of amendments in pot measured by CER graph. Difference between cumulative water loss from each treatments and control called CER. Maximum evaporation reduction (MER) in the CER curve is highest.

The purpose of this study compared evaporation rates, soil temperature, water holding capacity and soil bulk density in the control treatments,1 and 2% hydrophobic waste water, mulch and mixed compost with soil.

MATERIALS AND METHODS

Two-pot experiment at intervals from November 2002 until August 2004 to investigate the effect of hydrophobic substances from olive waste on soil temperature, reducing evaporation and increasing cumulative moisture storage was done. First experiment in normal room temperature and uncontrolled conditions (period 2613 h) and second experiment in a growth chamber with controlled temperature (during the time 1111 h) was performed. Experiments in a completely randomized design with five treatments and three replications into plastic pots 20.5 cm diameter and 18 cm in height were performed. First and second experiment treatments consisted of pure water (to determine the free water surface evaporation compared phase evaporation), bare soil (control), compost mix (equivalent to fifty tons per hectare) mulch, (equivalent to fifty tons per hectare) two percent of hydrophobic material and a percentage of hydrophobic material. For this study, two types of light and heavy soil textures of the two points around the city were collected. The first sample (loam soil) of the Jahan - abad village (Inceptisols) and the other from the same city in southern (sandy loam soil) Entisols (fluvent) was collected. Both of samples got from Gorgan city – Golestan province. After transferring the samples to the laboratory some were sieved by 2 and 8 mm mesh.

Control treatment in both textures (sandy loam and loam) with filling pots of 0 to 2 mm aggregates up to 6 cm pot and put the edge of the texture particles 0 to 8 mm to the height of 5 cm until on the edge 1 cm pots were prepared. Mulch treatment for surface preparation for both textures, similar to control treatment in lower pots, soil, 0 to 2 mm and 0 to 8 mm in the top soil was poured on the amount of 405 g of soil with compost rotten wet moisture content 53.04%, which was equivalent to 30 tons of straw on the field. Mixed compost consist compost with the soil pots (both texture) mixed. Prepare for an active percent with 100 g soil, mixing 6.7 ml of (*OME*) with 11.3 ml distilled water, volume reached 18 ml. Soil moisture contents between 11 to 29% caused uniform coating aggregate with wastewater is sprayed. Low moisture content in effluent infiltration into the pores is less in higher moisture contents of the material inside the pores and cover large accumulations are not uniform. Spraying operation very carefully and slowly and regularly done. Soil particles 0 to 8 mm are impregnated with this substance for several days and then stained with the aggregate exposed to air again left to dry air. Drying soil to create irreversible bonds or ability between the components back slower hydrophobic materials and soil is essential.

Treatment for the preparation of 2% for each 100 g of soil 13.4 ml of olive waste with 4.6 ml of pure distilled water volume was 18 ml and sprayed on the aggregate was 0 to 8 mm. After air-drying treatments, like the previous treatments were applied (Melloli et al., 1998). Evaporation rate and soil temperature were measured twice every day, first at 8 am and second at 19 pm.

RESULTS

Table 1 show analysis of physical and chemical concentration and some salts in two soil textures. Acidity, electrical conductivity (mmho /cm), density (mg/m^3) and organic material in (OME) were respectively 5.5, 19.8, 1.3 and 14.9. Saturated moisture percentage in loam and sandy loam, respectively, 40.68 and 52.75 and moisture percentage in compost was 53.04. Duration first stage of evaporation under high evaporation potential in comparison to the low evaporation potential in soil textures was decreased (Table 2). Movahedi and Cook (2000) and Pryhar et al. (1996) also pointed to this and were told that the first stage of dry phase decreases in higher potential evaporation. Bond and Willis (1971) also reported that the duration of dry phase with slow evaporation increased. In this experiment the high evaporation potential cause first stage evaporation time has fallen.

Cumulative evaporation reduction in the different treatments on upper and lower atmosphere potentials in the forms 1 to 4 is seen. Maximum cumulative evaporation reduction (MER) on the top curve is happen (Movahedi Naeini and Cook, 2000). Maximum cumulative evaporation reduction (MER) value and duration that treatments achieve to maximum cumulative evaporation reduction is given in Table 3. Evaporation rate and soil temperature, twice daily, 8 am (during the night) and 7 pm (during the day) was measured (Tables 4 and 5). The

Table 1. Loam and sandy loam soil chemical properties.

Tissue	Acidity	Lime percent	Organic matter percent	Cation exchange capacity (meq/100 g soil)	Saturation extract electrical conductivity (mmho/cm)
Loam	7.6	12	3.53	22.28	2.85
Sandy loam	7.4	25.75	3.8	8.152	1.53

Solute concentration in soil based on meq/lit						
Tissue	Moisture volume percent	Sodium	Potassium	Calcium	Magnesium	Chalk
Loam	52.75	8.89	1.5	14.8	17.6	0
Sandy loam	40.68	6.06	2.6	2.8	15.6	0

Table 2. First stage time in treatments (hour).

Treatment	Low evaporation potential		High evaporation potential	
	Sandy loam texture	Loam texture	Sandy loam texture	Loam texture
Mix compost	364	352	51	29
2% Hydrophobic	184	292	51	27
Mulch	232	244	51	27
1% Hydrophobic	232	340	29	25
Control	352	292	28	27

Table 3. Evaporation (mm) and duration (hours) Maximum cumulative evaporation.

Textures	Treatments	Low atmospheric potential		High atmospheric potential	
		MER	Time	MER	Time
Sandy loam	Mix compost	0.2	268	3	181
	2% Hydrophobic	18.7	995	9.4	303
	Mulch	14.9	969	14.1	327
	1% Hydrophobic	13.3	969	7.2	318
Loam	Mix compost	0	--	0.88	85
	2% Hydrophobic	5.8	1061	1	327
	Mulch	14	1061	13.6	366
	1% Hydrophobic	0.56*	2613	0.95	157

*Last time measured MER has not happened. Therefore, some MER is more than this number.

Table 4. Comparison of mean soil temperature in low atmospheric conditions.

Change resources	Daily soil temperature(8 am)				Soil temperature at night (19 pm)			
Treatments	A2	A10	B2	B10	A2	A10	B2	B10
Mix compost	18.3^a	18.8^a	18.1^a	18.7^a	18.4^a	18.8^a	18.3^a	18.7^a
2% Hydrophobic	18.6^a	19^a	18.3^a	18.7^a	18.6^a	18.9^a	18.4^a	18.8^a
Mulch	18.5^a	18.9^a	18.8^a	18.3^a	18.5^a	19^a	18.5^a	18.9^a
1% Hydrophobic	18.5^a	19^a	18.2^a	18.7^a	18.6^a	18.9^a	18.3^a	18.8^a
Control	18.4^a	18.9^a	18.1^a	18.6^a	18.4^a	20^a	18.4^a	18.7^a
Water	18.27^a	18.28^a	18.27^a	18.28^a	18.3^a	18.33^a	18.3^a	18.33^a
Mean treatments	18.42	18.81	18.29	18.54	18.46	18.98	18.36	18.7

Table 5. Comparison of mean soil temperature in high atmospheric conditions.

Change resources	Daily soil temperature				Soil temperature at night			
Treatments	A2	A10	B2	B10	A2	A10	B2	B10
Mix compost	27.1[a]	28.3[ab]	27[ac]	28.1[a]	27.7[ab]	28.7[ac]	27.1[a]	28.3[a]
2% Hydrophobic	27[a]	28.3[ab]	27.3[ab]	28.4[ab]	27.5[ab]	28.7[bc]	27.4[ab]	28.6[ab]
Mulch	27.6[b]	28.6[a]	27.6[b]	28.7[b]	27.8[a]	28.9[b]	27.8[b]	29[b]
1% Hydrophobic	27.3[a]	28.5[a]	27.2[c]	28.4[ab]	27.6[ab]	28.8[bc]	27.4[a]	28.5[ab]
Control	27[a]	28[b]	27.1[abc]	28.3[ab]	27.2[bc]	28.4[c]	27.4[a]	28.6[ab]
Water	26.5[c]	26.7[c]	26.5d	26.7[c]	26.8[c]	27[d]	26.8[c]	27[c]
Mean treatments	27	28	27.1	28.1	27.4	28.4	27.3	28.3

A= sandy loam soil, B= loam soil, * Numbers 2 and 10 deep soil* temperature is to (cm) ,The letters indicate the lack of significant difference is the 5% levels.

Table 6. Correlation between evaporation rate (mm/hours) and soil temperature (°C) at depths of 2 and 10 cm in the day and night.

Potential evaporation	Each day or night	Sandy loam texture		Loam texture	
		Depth of 2 cm	Depth of 10 cm	Depth of 2 cm	Depth of 10 cm
Low	Day	0.179	0.165	0.430	0.424
	(Night)	0.001	0.001	0.001	0.001
	Night	0.422	0.134	0.499	0.537
	(Day)	0.001	0.001	0.001	0.001
Top	Day	-0.501	-0.480	-0.554	-0.519
	(Night)	0.09	0.42	0.14	0.38
	Night	-.0547	-0.529	-0.574	-0.486
	(Day)	0.08	0.31	0.06	0.62

Table 7. Comparison of mean volumetric soil moisture in suction potentials for hydrophobic treatments 1 and 2% in both sandy loam and loam (tukey test).

Soil texture	Change in resources	$S_{0.0}$	$S_{0.05}$	$S_{0.1}$	$S_{0.3}$	$S_{1.0}$	$S_{5.0}$	$S_{15.0}$
Sandy loam soil	2% Hydrophobic	51.4[a]	36.1[a]	31.7[a]	29.3[a]	24[a]	27.4 [a]	14 [a]
	1% Hydrophobic	46.5[b]	39.5[a]	35.6[a]	33.7[a]	26.1[a]	27.5 [a]	13 [a]
Loam soil	2% Hydrophobic	48.3[a]	45.2[a]	43.9[a]	41.1[a]	37.2 [a]	42.2 [a]	30.2 [a]
	1% Hydrophobic	47.7[a]	45.3[a]	43.1[a]	39.5[a]	34.4 [a]	40.4 [a]	31.6 [a]

correlation between the soil surface evaporation rate (mm/hours) and soil temperature at depths of 2 and 10 cm in all treatments was calculated. The correlation coefficients and significance levels for the morning and afternoon measurements in atmospheric potential evaporation ware calculated. The results are presented in Table 6. There is more correlation between the intensity of evaporation and soil heat in 2 and 10 cm deep.

Volumetric soil moisture content in different potential for hydrophobic treatments only one and two percent in both the sandy loam and loam soil in suction potential zero, 0.05, 0.1, 0.3, 1, 5 and 15 bars were measured. The only significant difference in suction between zero and two percent of a hydrophobic treatments in sandy loam soil is found (Table 7) that the exact cause is unknown. Between these treatments and there was no significant difference in loam soil. May cause an increase in total soil pores with zero suction and 2% hydrophobic treatment and soil aggregate stability by this treatment.

DISCUSSION

Fairbourn and Gardner (1975) in soil were tested to see that the entire hydrophobic treatments Arquad R20 and aggregate stability were increased. This study may also

Table 8. Comparison of bulk density (g/cm^3) means in sandy loam and loam soil texture in the end of the experiment lasting.

Soil texture	Treatments	Average
Sandy loam soil	Compost mix	1.31^b
	2%Hydrophobic	1.44^a
	1%Hydrophobic	1.38 ^{a}
	Control	1.42 ^{a}
Loam soil	Compost mix	1.3^b
	2%Hydrophobic	1.34^{ab}
	1%Hydrophobic	1.45^a
	Control	1.37^a

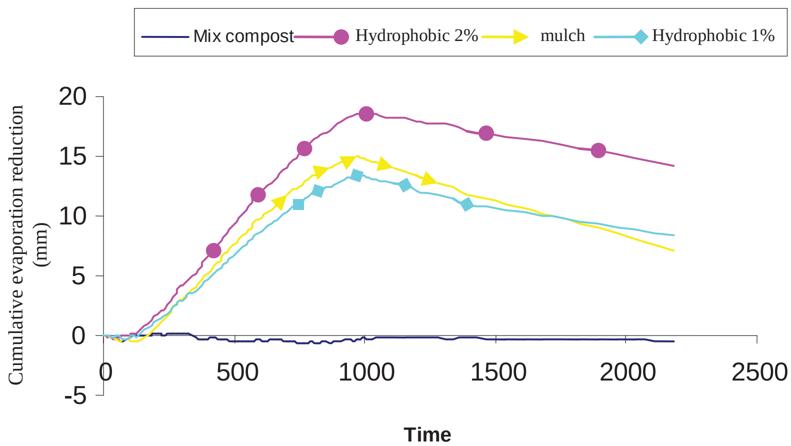

Figure 1. Cumulative evaporation reduction in sandy loam soil with low atmospheric potential.

aggregate with a two percent hydrophobic treatment to the end of the experiment lasting the control treatment is outstanding. This increases the total volume of pores in the sandy loam soil (percentage of total pores in the zero suction (Table 7) should be reduced bulk density compared to the control (Table 8) is cost-effective results that do not match. Hydrophobic treatment may increase aggregate stability of two percent in the sandy loam soil and thus prevent their density decreased unsaturated soil hydraulic conductivity is compared with the controls. The hydraulic transport water to the surface can reduce soil evaporation be reduced. The additional effects through increased contact angle with water wall tubes by hairy hydrophobic treatments are applied. Receive test results more clearly with different percentages of hydrophobic treatments in both heavy and light texture is required to repeat. In sandy loam soil in the lower atmosphere potential CER decreased for two percent hydrophobic treatment 18.7 mm, which was occurred after 995 h (Table 3 and Figure 1). But at high temperatures with high evaporation rate of the demand to reduce evaporation 9.49 after 303 h had been occurred (Table 3 and Figure 2). Cumulative evaporation loss for the loam texture in low-temperature 5.8 and 1.0 mm at high temperatures was respectively 1061 and 327 h now occurred. Therefore, increase the evaporation vulnerability and fine texture reduce the amount of the MER in two percent hydrophobic (OME). Therefore, because with increasing air evaporation vulnerability all moisture evaporates into the fluid transfer is not possible, more than the form of moisture vapor is transferred and the hydrophobic material such as fluid flow humidity affect the results over time reduce its impact on evaporation rate decreases. Finer texture soil increased soil unsaturated hydraulic conductivity and thus increase the transfer rate of liquid water below the surface of the pot, regardless of ambient temperature is. Because 5.0 cm above the soil surface layer of between 0.0 to 8.0 mm aggregates formed under this section the 0.0 to 2.0 mm aggregate, thus unsaturated hydraulic conductivity slow in the upper section and water flow in this layer is mostly water vapor. Thus finer soil texture and more abundant moisture in lower layers of security caused more water vapor to transfer through the upper air layer, the

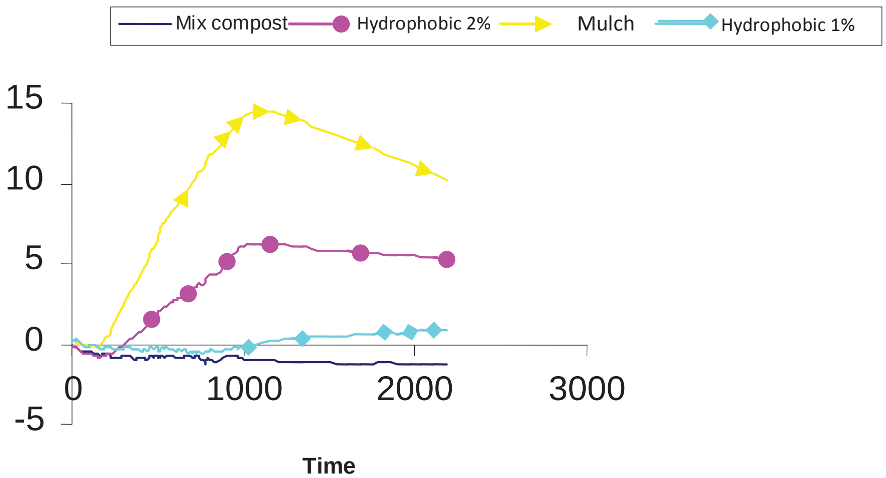

Figure 2. Cumulative evaporation reduction in loam soil with low atmospheric potential.

atmosphere is large and hydrophobic materials such as found in the upper layers of water move only on the basis of fluid effective, their impact on loam soil The sandy loam soil moisture content than the form of transfer is more fluid in it was decreased. Because moisture in sandy loam soil is less than the lower layer fluid flow of water to steam mode is higher. Because in farm the soil surface heat transfer takes place only, so the use hydrophobic materials and drying temperature on the soil surface may be concentrated at the soil surface and thus the cooling effect of soil depth than flow evaporation velocity fluid is slower than the pot. Therefore, the influence of these materials on evaporation in the field may be completely different pots. Reduce the amount of cumulative evaporation for the hydrophobic (1%) treatment of sandy loam soil in low and high potential evaporation atmosphere respectively 13.3 and 7.2 mm, respectively 969 and 318 h after it happened. According to Table 2, Figures 3 and 4 reduce the amount of cumulative evaporation in loamy soil at high and low potential evaporation was negligible atmosphere. MER rate at low temperature for mulch in the sandy loam 14.9 and 14 mm in the loam was 969 and 1061 h, respectively after the test occurred.

High evaporation potential in the atmosphere, sandy loam to reduce the amount of cumulative evaporation for the mulch treatment 14.1 and loam 13.5 mm was respectively 327 and 366 h in the time it happened. Thus reducing the amount of cumulative evaporation for mulch low atmospheric evaporation potential in sandy loam and loam soils of less than 2.0% of hydrophobic treatments but its value was higher than other treatments. Comparison of hydrophobic material and the mulch evaporated under field conditions should be tested in the same conditions. So can you download all treatments (except mix compost that is in both soil and hydrophobic one percent in loam soils effect on evaporation have not) in low temperature environment compared with the high temperature environment much more moisture in both soil storage and reduced speed evaporation from the soil surface have been occurred. These findings contrast Movahedi and Cook (2000). Their experiments conducted in black pots that unlike much of the energy achieve in high temperature and low temperature around the pot was entered. Therefore, potential evaporation increased with soil drying was not considered a barrier to evaporation. In this regard Movahedi and Cook (2000) expressed that mulch municipal compost residues in high temperature environments than the low temperature decreasing the cumulative evaporation increase in the clay loam soil.

In this study, both the soil for all treatments regardless of treatment with both mixed compost a percentage of hydrophobic soil and loam soil that have had no effect on evaporation in high temperature environment, time to reach the MER in low temperature decreased due to the faster dry and high soil temperatures earlier entry phase is evaporated. The MER value for all soil treatments at higher temperatures than these amounts in low temperature environments and the other was obtained in less time. Movahedi and Cook (2000) and Taban and Movahedi Naeini (2006) also showed that the effect for mulch in high evaporation potential conditions, is shorter.

The results of the treated compost mixture evaporated at low evaporation potential similar results Movahedi and Cook (2000) monitoring expression ends at the low potential evaporation, atmospheric conditions, evaporation of the treated compost mixture similar to the control treatment and more treatment is mulch. Results for MER values (Table 3) shows that increasing hydrophobic consumption evaporation from soil surface is also lower. However, higher intake of hydrophobic substances other comprehensive (in terms of increased risk of erosion) require that the plans recommended in

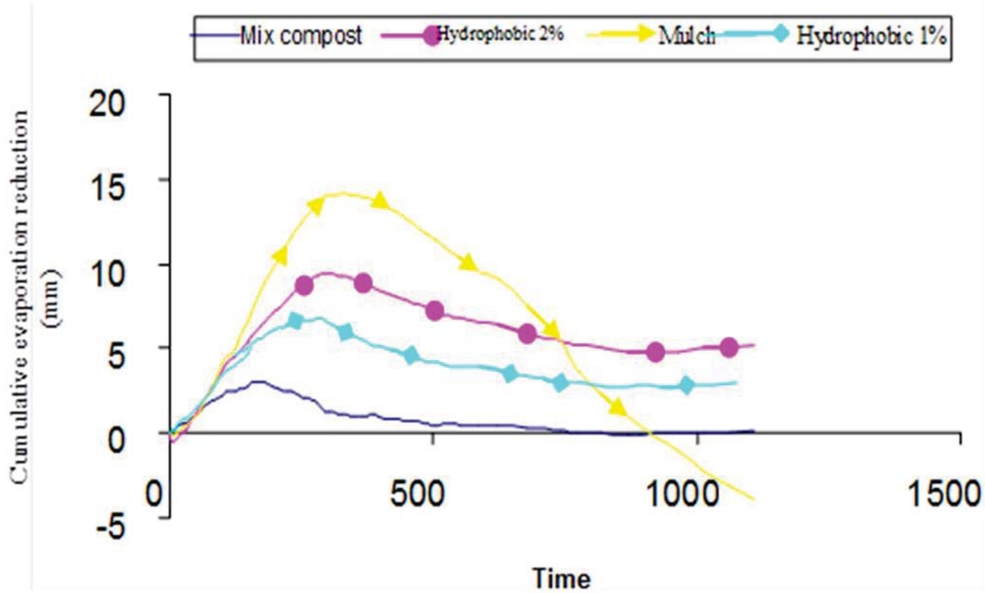

Figure 3. Cumulative evaporation reduction in sandy loam soil with high atmospheric potential.

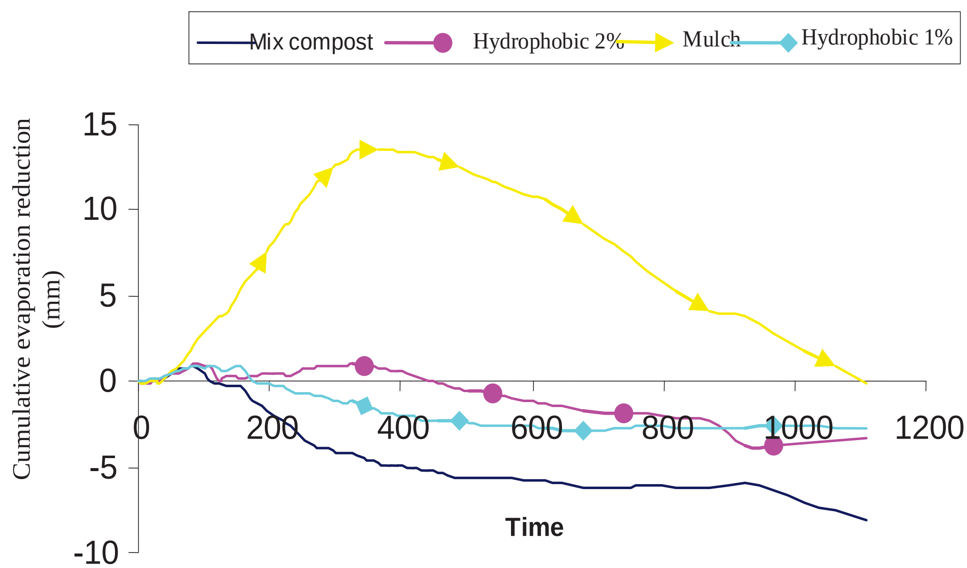

Figure 4. Cumulative evaporation reduction in loam soil with high atmospheric potential.

order to determine the maximum allowable consumption of hydrophobic material form field should be done in light soils.

Results of mean soil temperature for different treatments and atmosphere conditions, high evaporation and low for both sandy loam and loam soils at depths of 2.0 and 10.0 cm were studied (Tables 4 and 5). In both test and histological grade in both hydrophobic potential evaporation treatments had no significant effect on soil temperature. The transfer of hydrophobic materials such as mulch evaporation not effective and therefore have no effect on temperature, evaporation latent. These materials form liquid water on the effective hydraulic conductivity. High potential evaporation conditions mean temperature in 10.0 cm depth in both sandy loam and loam to 2.0 cm deep in the night and the day was more than that for treatments; this difference in temperature is significant depths. Thus evaporation during the night and day under the influence of energy absorption cross wall pots and latent heat transfer is performed. Unlike in pots under field conditions due to a temperature inversion and evaporation pressure inversion at night there is no evaporation (Movahedi and Cook, 2000). High potential evaporation in the soil surface drying faster and faster reduction of diffusion temperature, the temperature at the soil surface and thus focuses strongly correlation between evaporation and soil temperature and disappears (Table 6). Because of low soil moisture, that is, the intensity of evaporation drying temperature decreases and vice versa in the depths of the soil surface 2.0 and 10.0 cm increased the lead to evaporation and lack of correlation between the intensity and soil surface temperature is negative. Thus in high evaporation potential for atmospheric, highest energy factor came from below and around the pot. In low evaporation potential for atmospheric correlations greater between evaporation intensity and temperature of soil in 2.0 and 10.0 cm. Therefore, by using the (Table 6) heat transfer and how to supply energy for evaporation in conditions of low evaporation potential for recent experimental pots and farm conditions have the most similarities. In intense evaporation condition, increasing heat transfer around the inside of the pot, similar to how heat transfer is reduced with the farm. Movahedi and Cook (2000) in similar research, placing pots into another pot without painting, (white pots), which were attempted entry into the pots of energy loss can produce around them. But the absence of a significant negative correlation between soil temperature and evaporation rate indicates that this was not enough action for the above purpose and energy also came from around the pot. In the present study stained positive effect of white pots on the wall to prevent entry of energy we have created conditions of low evaporation potential.

The experiments at high temperatures mulch with slow evaporation during the night and day, reduced waste latent heat soil and increase soil temperature at depths of 2.0 and 10 cm evaporation vulnerability layer than controls were, in most cases the difference in potential evaporation over the environment was significant. Temperature had little guidance organic mulch is in contrast to field, pot condition reduced heat transfer mulch below the surface of the soil and this is causing soil cool during the day. Also on the night of the heat transfer from soil air and atmosphere, thus preventing an increase in comparison with control heat transfer is during the night. Although under field conditions with slow evaporation and day latent heat transfer is reduced by mulch, but increased soil temperature in this way very little from soil temperature decreased by entering the soil surface. In short, the overall results suggest the following:

(i) The use of hydrophobic material sprayed pot for hot areas of evaporation control is not suitable. Potential evaporation increases, its effect is reduced.
(ii) Because the soil treatments as determined aggregate sized devices require that special conditions are everywhere and always is not possible for the farmers therefore recommended that the application instead of spraying the liquid solution is needed determined aggregate level is specified in the form fields mulch (olive mill effluent), compost be used after the process.

Conflict of Interest

The authors have not declared any conflict of interest.

REFERENCES

Bond JJ, Willis WO (1971). Soil water evaporation: long term drying as influenced by surface residue and evaporation potential. Soil Sci. Soc. Am. Proc. 35:984-987.

Fairbourn ML, Gardner HR (1975). Water-repellent soil clods and pellets as mulch. Agron. J. 67:377-380.

Hillel D (1980). Application of soil physics. Academic Press. Newyork 109:55-60.

Mansell RS (1970). Infiltration of water into soil columns which have a water-repellent layer: Proc. Soil Crop Sci. Soc. Florida 29:92-102.

Melloli HJ, Hartmann R, Gabriels D, Cornelis WM (1998). The use of olive mill effluents ("margines") as soil conditioner mulch to reduce evaporation losses. Soil Till. Res. 49:85-91.

Movahedi NSAR, Cook HF (2000). Influence of municipal waste compost amendment on soil water and evaporation. Soil Sci, Plant Anal. 31:3147-3161.

Pryhar SS, Jalota SK, Steiner JL (1996). Residue management for reducing evaporation in relation to soil type and evaporate potential. Soil Use Manage. 12:50-157.

Taban M, Movahedi Naeini SAR (2006). Effect of Aqua Sorbent and Organic Compost Amendments on Soil Water Retention and Evaporation with Different Evaporation Potential and Soil Texture. Commun. Soil Sci. Plant Anal. 37(13-14):2031-2055.

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Full Length Research Paper

Determinants of technical efficiency in smallholder soybean production in Bomet District, Kenya

Patrick K. Yegon[1], Lawrence K. Kibet[2]* and Job K. Lagat[3]

[1]Kenya Agricultural Research Institute, Njoro Centre, Kenya.
[2]Department of Economics, Egerton University, Kenya.
[3]Department of Agricultural Economics and Agribusiness Management, Egerton University, Kenya.

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Increased soybean productivity has great potential for alleviating the perpetual problems of food and nutrition insecurity, poverty and unemployment among the rural households in Kenya. This study analyses the determinants of technical efficiency in smallholder soybean production in a rural farm setting in Bomet District, Kenya. Technical efficiency in this case is the ability of the smallholder farmer to maximize soybean output from a given level of inputs including seed, fertilizer, crop protection chemicals and labour. The primary data used was collected from a field survey using a multistage random sampling design, with the sampling being done at division, location, sub-location and household levels. A structured questionnaire administered in a face to face interview on a proportionate sample of hundred soybean farmers was used. Stochastic Cobb- Douglas frontier model was used to estimate technical efficiency levels while an inefficiency model was used to examine inefficiency variables. Education level, occupation, age and gender affected technical inefficiency. Education level and occupation had negative effects while age and gender had positive effects on inefficiency. Hence, policies targeting promotion of farmer education and farming professionalism would lead to significant increase in the level of technical efficiency in smallholder soybean production.

Key words: Determinants, Stochastic Cobb-Douglas frontier model, technical efficiency, small-holder, soybean, Kenya.

INTRODUCTION

Soybean was introduced as a commercial oilseed crop to Kenya around 1904 (GoK). It was however not until early sixties when the cultivation started in earnest on small-scale in Nyanza and Western provinces and by large scale farmers in Trans-Nzoia, Uasin Gishu, Laikipia, and Nakuru Districts (GoK, 2009) and is now concentrated in Western, Nyanza, Rift Valley, Eastern, and Central, where it is produced for food and nutrition security, and as a source of income. Western province is the leading producer, accounting for over 50% of total national smallholder planted area and production followed by Nyanza and Central provinces (GoK, 2009). However production and yield have stagnated since 1990 at 2000 metric tons year^{-1} and 800 kg ha^{-1} respectively (FAO, 2008) while demand for soybean and its products is currently over 150,000 MT year^{-1} (Thagana and Riungu,

*Corresponding author. E-mail: kibetlawrence@gmail.com

2000; Jagwe and Nyapendi, 2004). The resultant widening deficit is met by importation with vegetable oil and fat imports alone totalling Ksh 23.3 billion in 2007 (GoK, 2009).

The unexploited national annual production potential of about 300,000 MT (GoK, 1985) and the productivity potential of about 2600 kg ha^{-1} (KARI, 2005; Ministry of Agriculture, 2007; Thagana and Riungu, 2000) reveal the existence of enormous potential. The production can be enhanced through vertical (productivity) and horizontal (area) growth. But considering the limiting land resource which is becoming exhausted, emphasis is placed on increased productivity through use of improved production technologies which efficiently utilise the available productive resources. Several soybean production technologies including improved varieties, crop management and protection techniques have been continuously generated by agricultural research system and disseminated to the farmers for enhancing productivity and profitability. However, the benefit associated with such technological advancement has not been fully enjoyed by the smallholders. The escalation of inputs costs especially fertilizers, diesel, crop protection chemicals and land rent in Kenya has become prohibitive to realization of the benefits. It is therefore important to make serious economic consideration when evaluating production technologies before being recommended for use by the farmers, rather than just evaluating for technical potential. Any technological recommendation must therefore be targeted at specific socio-economic circumstances of the farmers. Farmers usually choose and use technologies that are within their technical and economic capacities.

Resource-use efficiency measures are important indicators of the viability of any agricultural activity and hence the economic performance of any technology and producer. The efficiency levels can be used to select the most cost-effective input use options and to determine the magnitude of gains that could be obtained by improving efficiency of the existing production technologies. This can provide the farmers with criteria for adjusting the levels of inputs use for maximizing benefits. This study tried to address the factors explaining the huge mismatch between the production (supply) and demand for soybean and its products among smallholders in Bomet District, Kenya. The general objective of the study was to establish technological sources of inefficiency in smallholder soybean production in a rural farm setting in Kenya so as to find feasible ways for increased productivity and farm income. The specific objectives were to determine the efficiency levels of resource use in smallholder soybean production and establish factors that influence efficiency levels in smallholder soybean production. This would help isolate those factors that are constraints to technological efficiency in smallholder soybean production in the study area.

METHODS AND MATERIALS

The study was carried out in Bomet district, Bomet County, Kenya. The District was chosen for this study because soybean cultivation has been promoted, by various stakeholders which include KESA, KARI and Ministry of Agriculture (Extension service), over the last decade to assist the smallholder farmers in the District to alleviate perpetual food and nutrition insecurity and poverty. Bomet District is one of the forty-two districts of Rift Valley Province and centred at latitude 0° 29' and 1° 03' South and longitudes 35° 05' and 0° 35' East with an area of about 1450 km^{-2} and 443,640 residents with 419 persons km^{-2} increasing at 2.6% $year^{-1}$ (GoK, 2002). Most farmers are small-scale with an average farm size of 2 ha (GoK, 2008).

Primary data was used in the study and was collected from a field survey conducted in the District. A multistage simple random sampling technique was used to select the sub-locations, the primary units from which a sample of 100 farmers were drawn. The data was obtained from the sample farmers using a structured questionnaire that was administered to the sample soybean farmers in face-to-face interviews by the researcher and the locally selected and trained enumerators.

Empirical model

Stochastic Cobb-Douglas function model was chosen because of the variability nature of agricultural production and smallholder farmers. The stochastic frontier method makes it possible to estimate a frontier function that simultaneously takes into account the random error term and the inefficiency component to every farmer. The stochastic Cobb-Douglas production (CD) function used was of the following form:

$$Y = a_0 X_1^{a1} X_2^{a2} X_3^{a3} X_4^{a4} X_5^{a5} e^E \quad (1)$$

Where: Y is soybeans yield($kgha^{-1}$), a_o = an efficiency parameter, and; X_1, X_2, X_3, X_4, X_5, are farm-level soybean production related attributes including land ($hayear^{-1}$), labour ($m.dsha^{-1}$), seed ($kgha^{-1}$), fertilizer ($kgha^{-1}$) and crop protection chemicals ($kgha^{-1}$) invested, $a_{1...}$ a_5= regression co-efficient (unknown parameters for the respective inputs – X_1, X_2, X_3, X_4 and X_5)

E = random disturbance term (error term) – accounts for the unpredictable variation in output due to such variables as the weather, but also include v and u, or the stochastic and inefficiency components of the error term respectively).

All the variables were examined, prior to estimation of the function (model), for multicollinearity by using Klein's Test (Debertin, 2002; Sankhayan, 1988). The Stochastic Cobb-Douglas production frontier was estimated using the maximum likelihood (ML) estimation techniques (Sankhayan, 1988; Kiresur et al., 1993). Variables that affected the smallholder soybean farmers' technical efficiency were assessed using the inefficiency model specified by Battese (1992), and Coelli (1995), as shown in Equation 2:

$$u_i = \alpha_o + \sum_{i=1}^{n} \alpha_i z_i + w_i \quad (2)$$

Where u_i is the inefficiency measure, Z_i is a vector of socio-economic factors affecting inefficiency which include: age (yr) and education level (yr in school) of the household head; adults per household (15 years and above); household head experience in farming (yr); farm size (ha); farm income ((Ksh)); extension contact (visits yr^{-1} paid by extension agents); gender of the household head (1 if male; 2 otherwise); access to credit (1 if access; 0 otherwise);

Table 1. Estimates for stochastic frontier production function of parameters of soybean per unit of inputs in Bomet District, Kenya.

Production factors	Coefficient of regression	Standard error	P-value
Constant	7.6856	0.4433	0.0000
Soybean farm area	0.1031	0.0494	0.037**
Labour	-0.1815	0.0925	0.050**
Seed	-0.0225	0.0561	0.689
Fertilizer	0.0167	0.0076	0.029**
Agrochemicals	-0.0165	0.0362	0.649

** (p<0.5), Summarized from computer output (STATA).

occupation of household head (1 if farming is major occupation; 0 otherwise); organization membership of household head (1 if member of a cooperative or farmer group, 0 otherwise.

RESULTS AND DISCUSSION

In the stochastic production frontier model, inputs used for soybean production were land, labour, seed, fertilizer and agrochemicals. Soybean land area, labour and fertilizer affected technical efficiency (Table 1) and soybean area and fertilizer quantity were positively related to soybean yield.

The findings about farm size concurs with those of Umoh (2006) which indicated a positive relationship between soybean area and technical efficiency and that farm size would not only have a direct effect on production but also an indirect effect on output through the marginal productivity of non-farm inputs. This was supported by recent studies by other researchers like Otitoju and Arene (2010) who found land to have a positive and significant association with soybean output under medium-scale production in Benue State, Nigeria.

The significant positive coefficient of fertilizer shows that application of optimum level of fertilizer increases the output by enhancing the productivity of soybean. This concurs with Huyuh et al. (2008)'s findings which found that a 1% increase in fertilizer rate could cause nearly 36% increase in soybean output. Increased use of chemical fertilizers would therefore assist the smallholders compensate for the limiting land resource. However, this requires judicious and optimal usage for increased productivity and profitability.

The estimated coefficient of household labour was negative. This implies that any additional use of labour by the soybean farmers would decrease the technical efficiency by increasing the cost of production thus affecting profitability. Though not expected on priori ground, the results concur with those of Kiresur et al. (1993) which found a significant negative coefficient in India's oil crop production. The negative effect of the household labour variable could have been due to the fact that smallholder soybean production in the area is labour-intensive right from land preparation to harvesting, and therefore for optimum yield to be realized, high cost of labour is required (Ajibefun and Aderinola, 2003). These were further supported by Otitoju and Arene (2010) who found labour variable to be significant with a negative coefficient and that any additional use would result in a decline in marginal productivity.

The estimated coefficients of both seed and agrochemicals were not statistically significant hence soybean productivity was independent of seed and agrochemicals rates. This was contrary to the *a priori* expectation and some past studies by Oyewo et al. (2009) and Huyuh et al. (2008). In Bomet District, the insignificant effect of seed on the productivity of soybean could be attributed to the type of seed the farmers were using.

Determinants of technical inefficiency

The sources of inefficiency were examined using the estimated coefficients associated with the inefficiency variables specified in the inefficiency model (Equation 2). The variable considered included farm size, age, gender, occupation, number of adults, credit access, membership to organization, level of education and extension contact (Table 2).

Older compared with younger household heads were more inefficient in soybean production agreeing with Owuor and Ouma (2009) who found that younger farmers were more efficient than the older because they were more adaptive to modern farming technologies but contradicting other findings (Onu et al., 2000; Amaza and Olayemi, 2000; Faturoti et al., 2006) which found older farmers to be more efficient due to more farming experience which enabled them to acquire knowledge and skills necessary for choosing appropriate new and improved production technologies. The age disadvantage is of concern as only 26% of the soybean farmers were of 21 to 40 years.

Male compared with female headed households were more inefficient in soybean production (Table 2). This is

Table 2. Regression results of factors explaining soybean production inefficiency.

Inefficiency factors	Parameters	Coefficient of regression	Standard error	P-value
Soybean farm area (Ha.)	∂_1	-0.2430	0.1661	0.144
Occupation of H/H(0,1)	∂_2	-3.1347	0.6042	0.001*
Gender of the H/H (0,1)	∂_3	0.0603	0.4455	0.049**
Education level of h/h (0,1,2,3,4)	∂_4	-0.5000	0.2881	0.038**
Number of adults (No.)	∂_5	-0.2983	0.1725	0.065
Age of household head (years)	∂_6	0.0534	0.0242	0.027**
Extension contact (0,1)	∂_9	-0.0628	0.2750	0.819
Credit access (0,1)	∂_{10}	-0.7994	0.7587	0.460
Membership to organization(0,1)	∂_{11}	-0.7192	0.6797	0.290
Diagnostic statistics				
Log likelihood	1.5014			
Sigma v		0.0008	0.0026	
Sample size = Population	100			
Wald chi2 (6)	205787			
Prob > chi2	0.0000			

** (p<0.05) * (p<0.1), Summarized from computer output (STATA).

of concern as 70% of the households in Bomet District were headed by the males. These results contradict Otitoju and Arene (2010) who showed that male- compared with female-headed households were less technically inefficient

When the main or only occupation of the household head was farming, technical inefficiency of soybean production was less compared with otherwise. This implies that more time for management improves technical efficiency confirming Ojo's (2003) conclusion that farmers should be encouraged to use more time to supervise their farms so as to improve their technical efficiency.

Increased education reduced technical inefficiency among the farmers. The findings conform to *a priori* expectations and concur with Oyewo et al. (2009) that farmers with more formal education tended to be more technically efficient in maize production in Oyo State of Nigeria.

The coefficient of the number of adults in the household had negative sign but insignificant. This indicates that the variable had no influence on technical inefficiency or efficiency meaning that households with larger number of adults were no more efficient or inefficient than households with smaller numbers. The reason may be that the available family labour was not being used or utilized wholly in the production of soybeans. The results were inconsistent with Onyenweaku et al. (2005), which identified a positive relationship between household size and technical efficiency among crop farmers. Villano and Fleming (2004) also found a significant positive coefficient for number of adult persons in a household and indicated the more they were, the more quality labour would be available for carrying out farming activities in timely fashion, thus making the production process more efficient.

Credit access, membership to organization, extension service and farm area did not affect technical inefficiency. These findings did not conform to *a priori* expectation of negative and significant effects on technical inefficiency. Earlier studies gave varied results. Huyuh et al. (2008) found no effect of credit access but available land area was negatively related to technical inefficiency. Ogundari and Ojo (2007) found that credit access reduced technical inefficiency for small scale food production in Nigeria.

CONCLUSIONS AND RECOMMENDATIONS

The study revealed that the smallholder soybean farmers in Bomet District of Kenya have a wide scope for improvement just with the existing production technologies. Land (farm area) and fertilizer were the main direct input of production that had significant positive influence on technical efficiency while labour had significant negative effect making it the single main input contributing to low efficiency in smallholder soybean production in Bomet District. Occupation and education level of the household head tended to reduce technical inefficiency or invariably increase technical efficiency level among soybean farmers. On the other hand, age and gender tended to increase technical inefficiency effectively reducing the farmers' level of technical efficiency.

Improvement in productivity among the smallholder soybean farmers in Bomet District could be achieved by addressing some of the important policy variables that negatively and positively influenced the farmer' levels of technical efficiency. Since education level and occupation of the household head negatively influenced inefficiency, policies targeting improvement of farmer education and farming professionalism are recommended. These would include engaging young educated people in farming, training relatively old people through informal education like in Agricultural Training Colleges (ATCs) where they would be trained specifically on crop husbandry aspects like choice of seed and varieties, and crop management and protection.

The farmers should be encouraged and trained on some aspects of farming economics like proper allocation of available resources and judicious use of farm inputs given their rising prices. The government needs to formulate policies that are favourable to smallholder farmers especially in regards to accessibility of affordable farm inputs and appropriate labour-saving technologies such as soybean threshers and herbicides considering that soybean production is labour intensive. The farmers should also be encouraged and facilitated to form and join organizations like self-help groups and cooperative societies. Since age and gender tended to increase technical inefficiency, strategies should be developed that will not discriminate farmers on the basis of these variables in soybean production. Older farmers should be encouraged to involve female and youth in the handling of productive resources.

Conflict of Interest

The authors have not declared any conflict of interest.

REFERENCES

Ajibefun IA, Aderinola EA (2003). Determinants of Technical Efficiency and Policy Implication in Traditional Agricultural Production: Empirical Study of Nigerian Crop Farmers Work in Process. Report presented at the Bi-annual Research Workshop of AERC, Nairobi, Kenya, May 24th - 29th.

Amaza PS, Olayemi JK (2000). The Influence of Education and Extension Contact on Food Crop Production in Gombe State, Nigeria. Nig. J. Agribus. Rural Dev. 1:80–92.

Battese GE (1992). Frontier production function and technical efficiency: a survey of empirical applications in Agricultural Economics. Austr. J. Agric. Econ. 41:185-208.

Coelli T (1995). Estimators and Hypothesis Tests for a Stochastic Frontier Function: A Monte Carlo Analysis. J. Prod. Anal. 6:247-268.

Debertin DL (2002). Agricultural Production Economics. McMillan Publishing Company. New York, America, 2nd edition.

FAO (2008). Production Statistics. FAOSTAT. FAO, Rome, Italy.

Faturoti BO, Emah GN, Isife BI, Tenkouano A, Lemchi J (2006). Prospects and Determinants of Adoption of IITA Plantain and Banana based Technologies in three Niger Delta States of Nigeria. Afr. J. Biotechnol. 5(14):1319-1323.

Government of Kenya (GoK) (1985). Soyabean Production: Programme Report. Government Printer, Nairobi, Kenya. MoA

GoK (2002). Bomet District Development Plan, 2002-2008. Ministry of Planning and National Development. Government Printers, Nairobi. Kenya.

GoK (2008). *The Vision 2030*. Ministry of Planning. Government Printers, Nairobi.

GoK (2009). Strategy for Soybean Production and Marketing in Kenya. Crops Management Directorate. MoA, Government Printer, Nairobi, Kenya.

Huynh VK, Mitsuyasu Y, Hiroshi Y, Goshi S (2008). Analysis of Productive Efficiency of Soybean Production in Mekony River Delta, Vietnam. J. Fac. Agric. Kyushu Univ. Japan 53(2):607-614.

Jagwe J, Nyapendi R (2004). Evaluating the Marketing Opportunities for Soybean and its Products in the East African Countries of ASARECA. Ugandan Report. International Institute of Tropical Agriculture (IITA) - FOODNET.

KARI (2005). Crop Production Handbook for Wheat, Oil Crops and Horticulture, revised edition, KARI-Njoro. KARI Publications Unit, Nairobi, Kenya.

Kiresur V, Reddy BN, Prasad MVR (1993). Low Cost Technologies for Sustainable Oil Seed production. Indian Society of Oilseeds Research, Pradesh National Seminar on Oilseeds Research and Development in India: Status and Strategies. Aug 2-5 1993. Extended Summaries: 225-227, Hyderabad, India.

Ministry of Agriculture (2007). Economic Review of Agriculture. Central and Planning Unit. Government Printer, Nairobi, Kenya.

Ogundari LO, Ojo SO (2007). An Examination of Technical, Economic and Allocative Efficiency of Small Farms: The Case Study of Cassava Farmers in Osun State of Nigeria. J. Central Eur. Agric. 7(3):423-432.

Ojo SO (2003). Productivity and Technical Efficiency of Poultry Egg Production in Nigeria. Int. J. Poult. Sci. 2(6):459-464

Onu JK, Amaza PS, Okunmadewa FY (2000). Determinants of cotton production and economic efficiency. Afr. J. Bus. Econ. Res. 1:34-40.

Onyenweaku CE, Igwe KC, Mbanasor JA (2005). Application of a Stochastic Frontier Production Functions to the Measurement of Technical Efficiency in Yam Production in Nasarawa State. Nig. J. Sustain. Trop. Agric. Res. 13:20–25

Otitoju MA, Arene CJ (2010). Constraints and Determinants of Technical Efficiency in Medium-Scale Soybean Production in Benue State, Nigeria. Afr. J. Agric. Res. 5(17):2276-228.

Owuor G, Ouma AS (2009). What are the Key Constraints in Technical Efficiency of Smallholder Farmers in Africa? Empirical Evidence from Kenya paper presented at 111 EAAE-IAAE Seminar 'Small Farms: decline or persistence' University of Kent, Canterbury, UK 26th- 27th June 2009.

Oyewo IO, Raul MO, Ogunwole F, Balogun SO (2009). Determinants of Maize Production among Farmers in Ogbomoso South Local Government in Oyo State. Agric. J. 4(3):144-149.

Sankhayan PL (1988). Introduction to the Economics of Agricultural Production. Punjab Agricultural University, Ludhiana.

Thagana WM, Ruingu TC (2000). The Status of Kenya in Global Production and Supply of Oil Crops and Oilseed Products. Proceedings of 7th KARI Biennial Scientific Conference. KARI Publications Unit, Nairobi, Kenya pp. 197-201

Umoh GS (2006). Resource Use Efficiency in Urban Farming: An Application of Stochastic Frontier Production Function. Int. J. Agric. Biotechnol. 8:38-44.

Villano R, Fleming E (2004). Analysis of Technical Efficiency in a Rain-fed Lowland Rice Environment in Central Luzon Philippines using a Stochastic Frontier Production Function with Heteroskedastic Error Structure. Working Paper Series in Agricultural and Resource Economics No. 2004-15, University of New England, Armidale, Australia.

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Health-care access and utilization among rural households in Nigeria

Omonona Bolarin Titus[1], Obisesan Adekemi Adebisola[2]* and Aromolaran Oluwatosin Adeniji[1]

[1]Department of Agricultural Economics, University of Ibadan, Nigeria.
[2]Department of Agricultural and Resource Economics, Federal University of Technology, Akure, Nigeria.

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This study examined healthcare access and utilization among rural households in Ogun state, Southwestern Nigeria. Primary data were collected through the use of structured questionnaires. Multistage sampling technique was employed for the selection of 200 rural households. The data were analyzed using descriptive statistics and health care accessibility index. The results show that the mean age of the respondents was 46 years with an average household size of 8 members. Majority of the respondents (43.5%) had no formal education and farming is the main occupation of respondents. Fifty-eight percent of the respondents have access to health care services while only 42.50% utilized these services. Most of the respondents (40.5%) travel a distance of 5-9 km before accessing health care facilities. Accessibility indices reveal unequal access to modern health facilities in the study area. Therefore this study recommends that rural development policies should promote the creation of enabling environment to enhance participation and equitable accessibility in modern health care delivery across the rural areas in the country.

Key words: Healthcare, utilization, rural households, Nigeria.

INTRODUCTION

Sound health is a fundamental requirement for living a socially and economically productive life. Poor health inflicts great hardships on households, including debilitation, substantial monetary expenditures, loss of labour and sometimes death. The health status of adults affects their ability to work, and thus underpins the welfare of the household, including the children's development (Asenso-Okyere et al., 2011). Poor health affects agricultural production. Treatable conditions often go untreated because of lack of access to healthcare. Development in all its forms is only possible when there is access to healthcare service and in turn its effective utilization by individuals.

Access to healthcare services is a multidimensional process involving the quality of care, geographical accessibility, availability of the right type of care for those in need, financial accessibility, and acceptability of service (Peters et al., 2008). The utilization of healthcare services is related to the availability, quality and cost of services, as well as to social-economic structure, and

*Corresponding Author. Email: kemi_triumph@yahoo.com

personal characteristics of the users (Chakraborty et al., 2003; Manzoor et al., 2009; Onah et al., 2009).

In developing countries, the under-utilization of the health services in public sector has been a universal phenomenon (Zwi, 2001). The state of the Nigerian health system is dysfunctional and grossly under-funded with a per capita expenditure of US$ 9.44 (World Bank, 2010). As a result, Nigeria still has one of the worst health indices in the world and sadly accounts for 10 percent of the world's maternal deaths. The National health management information system is weak, without an integrated system for disease surveillance, prevention and management. Research also indicates that there are high rates of absenteeism (about 40%) among medical doctors, especially in rural areas (Hamid et al., 2005). The high level of mortality, and morbidity which accounts for 157 deaths per 1000 live births (NDHS, 2008), non-attainment of international goals for health and survival, and the inequalities in access to health facilities are the challenges of rural populace.

According to the Federal Ministry of Health (2008), the total shares of public ownership in 2004 on health facilities were 14,607 while the private sector accounted for 9,029 in Nigeria. Consequently, various Nigerian governments have made numerous great efforts toward the provision of healthcare facilities to its populace. Notable among these efforts were the expansion of medical education, improvement of public health care systems, provision of primary health care (PHC) in many rural areas. However, overt attention has not been paid to equity in the planning and distribution of health care facilities over the years in the country. Public and private health care facilities are sparsely provided in many rural areas within the country. Such regions with difficult terrain and physical environment are often neglected (Onokerhoraye 1999). This makes the distance between the rural dwellers and the healthcare center far apart, given the transportation problems experienced in these areas, and its attendant cost. Many rural areas do not have clinics; the sick must be carried on the backs of young men or on bicycles to the nearest clinic. Moreover, clinics in rural areas often lack adequate equipment or trained health personnel, and they require payment before providing services. In the absence of health insurance, rural people are often unable to afford healthcare of any kind.

Healthcare access and utilization are of major interest to rural development, because they are vital elements of wellbeing and components of human capital (Aghion et al*.,* 2010). In rural areas, where physical jobs tend to be more abundant, healthcare access and utilization stand to be more important than education in determining labour productivity. Furthermore, every individual sees good health as a need; this makes healthcare utilization an economic good. Good health is a need for all and the choice of a particular healthcare system respond to the laws of demand and supply, the demand for health care is a derived demand. Health care is not demanded for itself but for the advantages that can be derived from being healthy.

Many low-income countries, Nigeria inclusive, have not been able to meet the basic healthcare needs of their people, especially those in the rural areas. In Nigeria, there has been a growing recognition of the challenge of rural people's health issues and the need for it to be addressed (Hamid et al., 2005). There is a huge shortage of qualified practitioners in the rural areas. Accessing health care in rural areas is confounded by problems such as insufficient health infrastructure, the presence of chronic diseases and disabilities, socioeconomic and physical barriers (Ricketts, 2009).

Over the years, Ogun State healthcare services and facilities have not achieved all its objectives of ensuring that everybody has access to adequate health care services at affordable costs. This study will extend prior literature such as: Sanusi and Awe (2009) who studied the level of awareness of National Health Insurance Scheme (NHIS) by health care consumers in the south west of Nigeria using chi-square and descriptive statistics. Ibiwoye and Adeleke (2009) examined the extent to which income of household heads, occupation of household heads, sex of household heads, age group, marital status and family size plays an explanatory role in the slow pace of usage of healthcare service in Lagos State; while Olugbenga-Bello and Adebimpe (2010) examined the knowledge and attitude of civil servants in Osun State towards its healthcare usage. However, this research work fills the huge knowledge gap examining the access and utilization of health care services among rural households in Ogun State. Specifically, this study intends:

(1) To identify rural household access and use of health care services in relation to their socio-economic characteristics.
(2) To determine the level of accessibility of rural households to healthcare facilities.

METHODOLOGY

The study area is Ogun State, Southwest of Nigeria. The total land area is 16,409.26 km². It is bounded by Benin Republic to the West, Lagos State and the Atlantic Ocean to the south, Ondo State to the East, and on the North by Oyo and Osun States. It is situated between Latitude 6.2°N and 7.8°N and Longitude 3.0°E and 5.0°E. The main cash crops produced in the State are cocoa, cashew, kola nut, oil palm and palm kernels, rubber and coffee.

Primary data employed in this study were obtained with the aid of well-structured questionnaires. A multi-stage sampling technique was employed in the selection of respondents. The first stage involved the selection of the entire four Agricultural zones while the second stage involved the random selection of two Blocks (LGA) from the zones. In the third stage, five cells (Villages) each were randomly selected from the blocks (LGA) amounting to 10 cells across the zones. The fourth stage was the random selection of

Table 1. Distribution of respondents by gender.

Gender	Total		Healthcare access		Healthcare utilization	
	Frequency	%	Frequency	%	Frequency	%
Male	142	71.00	82	41.00	64	78.05
Female	58	29.00	34	17.00	21	61.76
Total	200	100.00	116	58.00	85	42.50

Source: Field Survey (2013).

210 households proportionate to size of the selected cells. However, a total of 200 questionnaires with consistent reports were used for analysis.

The analytical techniques used in this study include descriptive statistics and Healthcare Accessibility Index. Descriptive statistics such as frequencies, means, percentages and standard deviation were used to describe the sources and uses of healthcare facilities in relation to socio-economic characteristics as well as the level of utilization of health care services.

Healthcare Accessibility Index was used to analyze the second objective which is to determine the level of accessibility of the rural households to healthcare facilities. The data set was segregated based on the wards in the selected local government areas in the state. The segregation of the data generated the pattern of distribution of the health care facilities in the study area. The pattern evolved revealed the extent of inequality among the local government in terms of the provision of the health care facility by both government and private sector in the area. The index of accessibility to health care services was computed using three variables from the data set. The variables used are population ratio to bed space in each LGA: population ratio to medical doctor and population ratio to nurses/ mid-wife. The choice of these three variables is because doctors and nurses are directly involved in providing health care services to the people and bed spaces is a basic requirement in health care delivery.

The indices are household size per medical officer ($I.A_1$); Household size per nurse ($I.A_2$); number of people in households per community health workers ($I.A_3$); and household size per hospital bed space ($I.A_4$). These indices are expressed as:

$$I.A_1 = \frac{Np}{Nd} \quad (1)$$

Where:
$I.A_1$ = index of accessibility for number of persons per doctor
Np = number of persons in the households
Nd = number of doctors

$$I.A_2 = \frac{Np}{Ns} \quad (2)$$

Where:
$I.A_2$ = index of accessibility for number of persons per nurse
Np = number of persons in the households
Ns = Number of nurses

$$I.A_3 = \frac{Np}{Nc} \quad (3)$$

Where:
$I.A_3$ = index of accessibility for number of persons per community health worker
Np = number of persons in the households
Nc = number of community health workers

$$I.A_4 = \frac{Np}{Nb} \quad (4)$$

Where:
$I.A_4$ = index of accessibility for number of persons per hospital bed
Np = number of persons in the households
Nb= number of hospital beds

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents

The distribution of the respondents according to their socio-economic characteristics, access to health care services and utilization is as reported below:

Gender of household head

Table 1 show that 58% of the respondents have access to health care services while only 42.50% utilizes these services. 71% of the household heads were males while the remaining 29% were females. However, 41% of the male headed households have access to healthcare services while 17% of the female headed households have access to healthcare service. Out of these, about 78 and 61.76% of the male and female respectively, utilized healthcare service. This shows that the majority of the respondents were males. Male headed households have more access to healthcare services than female headed households which in turn makes them utilize healthcare services more in the study area.

Age of household head

Table 2 reveals that 71% of the respondents are in their economic active age (≤ 50 years). About 75.55% of the respondents within this age bracket accesses and utilizes healthcare service more than the elderly ones because they still have more energy to travel a wide distance to access the healthcare facilities. The mean age is 46 years. Majority (34.4%) of the respondents are within ages

Table 2. Distribution of respondents by age.

Age	Total		Healthcare Access		Healthcare Utilization	
	Frequency	%	Frequency	%	Frequency	%
20 – 30	27	13.50	17	8.50	12	70.58
31 – 40	46	23.00	28	14.00	22	78.57
41 – 50	69	34.50	40	20.00	31	77.50
51- 60	41	20.50	21	10.50	14	66.67
>60	17	8.50	10	5.00	6	60.00
Total	200	100.00	116	58.00	85	73.28

Source: Field Survey (2013).

Table 3. Distribution of Respondents by marital status.

Marital status	Total		Healthcare Access		Healthcare Utilization	
	Frequency	%	Frequency	%	Frequency	%
Single	45	22.50	25	12.50	18	72.00
Married	138	69.00	80	40.00	62	77.50
Divorced	13	6.50	8	4.00	4	50.00
Widowed	4	2.00	3	1.50	1	3.33
Total	200	100.00	116	58.00	85	73.28

Source: Field Survey (2013).

Table 4. Distribution of respondents by educational status.

Educational status	Total		Healthcare Access		Healthcare Utilization	
	Frequency	%	Frequency	%	Frequency	%
No formal education	87	43.50	52	24.50	36	69.23
Adult education	12	6.00	8	4.00	6	75.00
Primary education	47	23.50	28	13.00	22	78.57
Secondary education	23	11.50	16	7.50	12	75.00
Tertiary education	31	15.50	12	5.50	9	75.00
Total	200	100.00	116	58.00	85	45.50

Source: Field survey, 2013.

41 to 50 years, 20% have access to healthcare services while 77.5% with access utilized the health care services. The least are those above the age of 60 years.

Marital status of household head

Table 3 indicates that 69% of the respondents were married while 31% are unmarried/divorced. Out of the married, 40% have access to healthcare services while 77.5% of those with access utilized healthcare services provided in the rural area. Since most of the respondents were married, additional cost is incurred to maintain health of the wife during child birth as well as the upkeep of the children which may increase the participation of the respondents in health care use.

Educational status of household head

As shown in Table 4, 43.50% have no formal education while 6, 23.5, 11.5, and 15.5% had adult, primary, secondary and tertiary education respectively. Thirteen percent of those with primary education had access to health care services while 78.57% out of these, utilized the healthcare services. Furthermore, 24.5% of those

Table 5.Distribution of respondents by main occupation

Primary Occupation	Total		Healthcare Access		Healthcare Utilization	
	Frequency	%	Frequency	%	Frequency	%
Farming	74	37.00	52	26.00	38	63.46
Artisan	15	7.50	9	4.50	7	77.77
Trading	43	21.50	22	11.00	18	81.81
Salary earner	46	23.00	24	12.00	20	83.33
Wage earner	8	4.00	5	2.50	4	80.00
Others	14	7.00	4	2.00	3	75.00
Total	200	100.00	116	58.00	85	73.72

Source: Field Survey (2013).

Table 6. Distribution of respondents by distance to healthcare facilities.

Distance of hospital from home (km)	Total		Healthcare Access		Healthcare Utilization	
	Frequency	%	Frequency	%	Frequency	%
≤ 4	39	19.50	22	11.00	20	90.09
5 – 9	81	40.50	42	21.00	36	85.71
10 – 14	56	28.00	36	13.00	22	61.11
>14	24	12.00	16	8.00	7	43.75
Total	200	100.00	116	58.00	85	73.27

Source: Field Survey (2013).

with no formal education had access to healthcare service while 69.23% of the respondents utilized healthcare services. Hence, the level of education and literacy of a household will determine the kind of choices he takes especially in healthcare use. Most of the respondents in the study area are educated and this would have informed their healthcare choices.

Primary occupation of household head

Table 5 showed that 37% of the respondents are engaged in farming as their primary occupation while 7.5, 21.5, 23, 4% and 7% are artisans, traders, salary earners, wage earners and other forms of employment. This shows that farming is the predominant occupation in the study area. More so, farmers have the highest (26%) access to healthcare service with the lowest proportional (63.46%) uses of healthcare service. This is as a result of the fact that most households in the rural area depend mainly on agriculture, as their primary source of livelihood and cannot afford to pay for the high cost of healthcare services.

Distance of respondents to healthcare facilities

Table 6 shows that majority (40.5%) of the rural households lived 5 to 9 km to a public health center with 21% having access to healthcare facilities and 85.7% utilizing the facilities. Eleven percent of respondents living 4 km from the healthcare service provider have access to healthcare facilities while 90.09% of the respondents utilized it. 13% of the respondent who lives 10 to 14 km from healthcare service had access while 61.11% utilized the services. Forty-three percent of respondents living more than 14 km to their healthcare providers makes use of the available healthcare facilities. The result, therefore, indicates that utilization of available health facilities increases with proximity to the health centers.

Household size

The mean household size was 8 members. Table 7 reveals that 7% of respondents have family size of 1-4 members per household, whereas only 60% of the respondents within this group with access to healthcare facilities utilized it. Furthermore, those with household size above 14 members have the highest health service utilization with 85.71%.

Healthcare utilization pattern of the household

From the result, 11.50, 17.05, 5.50 and 24.0% have access to self-care, government, private and traditional healthcare provider respectively (Table 8). Traditional

Table 7. Distribution of respondents by household size.

Household size	Total		Healthcare Access		Healthcare Utilization	
	Frequency	%	Frequency	%	Frequency	%
1 – 4	14	7.00	10	5.00	6	60.00
5 – 9	128	64.00	88	45.00	64	72.72
10 – 14	44	22.00	11	5.50	9	81.81
>14	14	7.00	7	2.50	6	85.71
Total	200	100.00	116	58.00	85	73.72

Source: Field Survey (2013).

Table 8. Healthcare provider patronized by the household.

Healthcare Provider	Healthcare Access		Healthcare Utilization	
	Frequency	%	Frequency	%
Self-care	23	11.50	18	78.26
Government	34	17.00	21	61.76
Private	11	5.50	6	54.54
Traditional	48	24.00	40	83.33
Total	116	58.00	85	73.27

Source: Field Survey (2013).

healthcare was the most frequently utilized by the respondents, followed by self-care while private healthcare was the least. Out of those with access to traditional health care, 83.33% utilized it while 78.26, 61.76 and 54% utilized self-medication, government and private hospitals respectively. Traditional healthcare is mostly utilized because of its easy accessibility and low cost of treatment compared with the other forms of healthcare providers.

UTILIZATION OF HEALTHCARE FACILITIES

Utilization of health facilities by age

Age is expected to be positively related to utilization of health facilities (Dias et al., 2008). However, as depicted in Table 9, majority of household heads in their active and economic age seek health care from government hospitals with a few of them utilizing self-care and traditional care. Private hospitals are least utilized across the various age groups probably because of the high cost associated with their services since private health providers are out to maximize profit. The table further show that a higher proportion of the household heads within the age brackets of 20 to 30 years (40.74%) and 31 to 40 years (43.48%) utilized government hospitals, while those in age groups of 41 to 50 years (39.13%) sought healthcare from traditional sources. However, self-medication and traditional care are mostly utilized among household heads above 50 years of age.

Utilization of healthcare facilities by gender

The highest proportion of male-headed households (33.90%) utilized traditional health care facilities while 41.38% of female-headed households used self-medication (Table 10). However, a higher proportion of male-headed households (30.99%) seek modern health care services than female-headed households (27.59%). This implies that the level of utilization of modern health facilities is lower among female-headed households than among their male counterparts. This is consistent with the findings of Dias et al. (2008). This might be as a result of low level of access to productive assets among rural female-headed households.

Utilization of healthcare facilities by household size

The result shows that while utilization of modern health facilities decreases with household size, utilization of traditional health care facilities increases with household size (Table 11). Most of the households with 1 to 4 members utilized government hospitals while 28.57 and 35.71% of households with more than 14 members utilized self-care and traditional care respectively. The

Table 9. Utilization of health facilities by age.

Age	Government Hospital		Private Hospital		Self-Medication		Traditional Care		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
20 – 30	11	40.74	2	7.41	7	25.93	7	25.93	27	100.00
31 – 40	20	43.48	3	6.52	13	28.26	10	21.74	46	100.00
41 – 50	25	36.23	7	10.14	10	14.49	27	39.13	69	100.00
51- 60	5	12.20	11	26.83	16	39.02	9	21.95	41	100.00
>60	4	23.52	1	5.88	5	41.18	7	29.41	17	100.00
Total	64	32.00	24	12.00	44	22.00	68	34.00	200	100.00

Source: Field Survey (2013).

Table 10. Utilization of health facilities by gender.

Gender	Government Hospital		Private Hospital		Self-Medication		Traditional Care		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Male	44	30.99	18	12.68	32	22.54	48	33.90	142	100.00
Female	16	27.59	6	10.34	24	41.38	12	20.69	58	100.00
Total	64	32.00	24	12.00	44	22.00	68	34.00	200	100.00

Source: Field Survey (2013).

Table 11. Utilization of health facilities by household size.

Household size	Government Hospital		Private Hospital		Self-Medication		Traditional Care		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1 – 4	6	42.86	5	40.71	1	7.41	2	14.29	14	100.00
5 – 9	40	31.25	-	-	62	48.44	26	20.31	128	100.00
10 – 14	10	22.73	15	33.09	8	18.18	11	25.00	44	100.00
>14	1	7.14	4	28.57	4	28.57	5	35.71	14	100.00
Total	64	32.00	24	12.00	44	22.00	68	34.00	200	100.00

Source: Field Survey (2013).

result further shows that private hospitals are least utilized in the rural area probably because of high cost of consultation. It can be deduced that larger sized households may not be able to afford modern health facilities and thus turn to the utilization of self-medication and traditional health care services, which they consider relatively cheaper as a larger share of household expenditure will be spent on food.

Healthcare utilization by educational status

Education has an important effect on utilization of health care facilities. The result in Table 12 shows that the highest proportion (24%) of the rural household heads has primary education. The result also reveals that a larger percentage (67.69%) of households whose heads have tertiary education utilized modern health care facilities (government and private hospitals) while a higher percentage (68.96%) of households heads with no formal education do not utilize modern healthcare facilities. Likewise, 75% of households whose heads undergo adult literacy education do not utilize modern healthcare facilities. The result follows the findings of Mekonnen and Mekonnen (2002) that utilization of modern health care facilities increases with educational attainment.

Distance on the utilization of health facilities

Table 13 shows that only 39 households which represent 19.5% of the rural households live close (≤ 4 km) to a public health centre. Majority (35.9%) of the rural households within this distance seek healthcare services from government hospitals while a higher proportion (41.67%) of rural households living farther than 14 km utilized the traditional health centers. The result, therefore,

Table 12. Utilization of health facilities by educational status.

Educational status	Government Hospital		Private Hospital		Self-Medication		Traditional Care		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
No formal Education	15	17.24	12	13.79	31	35.63	23	33.33	87	100.00
Adult Education	2	16.67	1	8.33	4	33.33	5	41.67	12	100.00
Primary Education	17	36.17	6	12.77	9	19.15	15	31.91	47	100.00
Secondary Education	7	30.43	2	8.70	6	26.09	8	34.78	23	100.00
Tertiary Education	11	35.48	10	32.26	3	9.68	7	22.58	31	100.00
Total	64	32.00	24	12.00	44	22.00	68	34.00	200	100.00

Source: Field Survey (2013).

Table 13. Distance to healthcare centre from home and utilization of health facilities.

Distance of hospital from home (km)	Government Hospital		Private Hospital		Self-Medication		Traditional Care		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
≤ 4	14	35.90	4	10.26	11	28.21	10	25.64	39	100.00
5 – 9	27	33.33	10	12.35	13	16.05	31	38.27	81	100.00
10 – 14	18	32.14	6	10.71	15	26.79	17	30.36	56	100.00
>14	5	20.83	4	16.67	5	20.83	10	41.67	24	100.00
Total	64	32.00	24	12.00	44	22.00	68	34.00	200	100.00

Source: Field Survey (2013).

indicates that utilization of available public health facilities increases with proximity to the health centers, thus, rural households utilize self-medication and traditional care closer to their residence. This is expected to reduce their cost of transportation and rigour of accessibility to distant modern healthcare services.

Accessibility to healthcare services

Accessibility of health services has been shown to be an important determinant of utilization of health services in developing countries (Mekonnen and Mekonnen 2002). The result of the indices of accessibility to Public Health care facilities show that there is an average 111, 20, 61 and 6 patient to a doctor, a nurse, a community health worker and a hospital bed respectively (Table 14). This suggests that there is inadequate supply of health workers in the rural public health centers. This might reduce the level of utilization of such centers due to much time spent in accessing health care. The result further shows that there is inadequate supply of public health care facilities (both human and infrastructural) in rural Ogun State. Furthermore, there is unequal access to modern healthcare by the respondents in the study area. The patient ratio per health personnel goes a long way to determine the workload of the personnel and their efficiencies on the job. The number of patients to attend to per health personnel determine the waiting time of the patient, thereby measure the accessibility of patient to medical facilities. The lower the number of patients per health personnel, the better the accessibility of health care facilities. Bhattia and Cleland (2001) in their study have noted that the high use of private health care is due to easy access, shorter waiting time, longer or flexible opening hours, better availability of staff and drugs, and better attitude of staff.

CONCLUSION AND RECOMMENDATION

This study has shown that there is unequal distribution of health facilities as well as low level of accessibility of household to medical facilities in the study area. To this end, governments at all tiers should ensure equitable accessibility to health care delivery across the rural areas by deploying more medical and para-medical staffs to the rural areas. Rural development policies should promote the creation of enabling environment to enhance participation in modern health care delivery. Household heads should be encouraged to utilize modern healthcare facilities by organizing a sensitization programme to

Table 14. Indices of accessibility to healthcare facilities.

Villages in the Local Government Areas (LGA)	Persons per Doctor	Persons per Nurse	Persons per Community Health worker	Persons per Hospital beds
Opeji	87	16	52	5
Odeda	172	20	172	7
Atapeko	115	18	12	7
Ilara	111	20	61	6
Imeko	69	25	6	5
AVERAGE	111	20	61	6

Source: Field Survey (2013).

create awareness about the importance of using modern healthcare facilities. There should be establishment of public health centers in the core rural areas. This will increase the proximity and accessibility of rural people to public health facilities.

Conflict of Interest

The authors have declared that no conflicting interest exists.

REFERENCES

Aghion P, Peter H, Fabrice M (2010). "The Relationship Between Health and Growth: When Lucas Meets Nelson-Phelps." National Bureau Econ. Res. (NBER) Working Paper No. 15813.

Asenso-Okyere K, Chiang C, Thangata P, Andam KS (2011). Interactions between health and farm-labour productivity. International Food Policy Research Institute, Washington, DC.

Bhattia JC, Cleland J (2001). Health care seeking and expenditure by young Indian mothers in the public and private sectors. Health Pol. Plan 16:55–61.

Chakraborty N, Islam MA, Chowdhury RI, Bari WW, Akhter HH (2003). Determinants of the use of maternal health services in rural Bangladesh. Health Prom. Int. 18(4): 327-337.

Dias SF, Severo M, Barros H (2008). Determinants of health care utilization by immigrants in Portugal. BMC Health Serv. Res. 8:207.

Federal Ministry of Health (2008). The Nigerian Health Financing Policy, Federal Ministry of Health (FMOH), Abuja, Nigeria.

Hamid SA, Sadique Z, Ahmed S, Molla AA (2005). Determinants of choice of healthcare providers: Evidence from selected rural areas of Bangladesh. Pak. J. Soc. Sci. 3(3):437-444

Ibiwoye A, Adeleke TA (2009). A log-Linear Analysis of Factors Affecting the Usage of Nigeria's national Health Insurance Scheme. Soc. Sci. 4(6):587-592.

Manzoor I, Hashmi NR, Mukhtar F (2009). Determinants and pattern of health care services utilization in post graduate students. J. Ayub Med. Coll. Abbottabad 21(3):100-105.

Mekonnen Y, Mekonnen A (2002). Utilization of Health Care Services in Ethiopia. Calverton, Maryland, USA: ORC Macro.

NDHS (National Demographic Health Survey) (2008). Regent Park. Retrieved August 20 1009 from http://www.ndhs.ca/regentpark.

Olugbenga-Bello AI, Adebimpe WO (2010). Knowledge and Attitude of Civil Servants in Ogun State South Western Nigeria Towards the National Health Insurance. Nig. J. Clin. Pract. 13(4):421-426.

Onah H, Ikeako L, Iloabachie G, (2009). Factors associated with the use of elasticity of healthcare services in Enugu, Southeastern Nigeria. Soc. Sci. Med. 63(7):1870-1878.

Onokerhoraye AG (1999). Access and utilization of modern health care facilities in the petroleumproducing region of Nigeria: The case of Bayelsa State. Research Paper No. 162. Takemi Program in International Health Harvard School of Public Health.

Peters DH, Garg A, Bloom G, Walker DG, Brieger WR, Rahman MH (2008). Poverty and access to healthcare in developing countries. Ann. N Y Acad. Sci. 1136:161-171.

Ricketts TC (2009). Rural health in the United States. New York: Oxford University Press.

Sanusi RA, Awe AT (2009). An Assessment Level of National Health Insurance Scheme (NHIS) Among Health Care Consumers in Ogun State, Nigeria. Soc. Sci. 4(2):143-148.

World Bank (2010). The millennium development goals for health: rising to the challenges. Washington DC: World Bank.

Zwi AB (2001). Private health care in developing countries. Br. Med. J. 323:464–466.

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