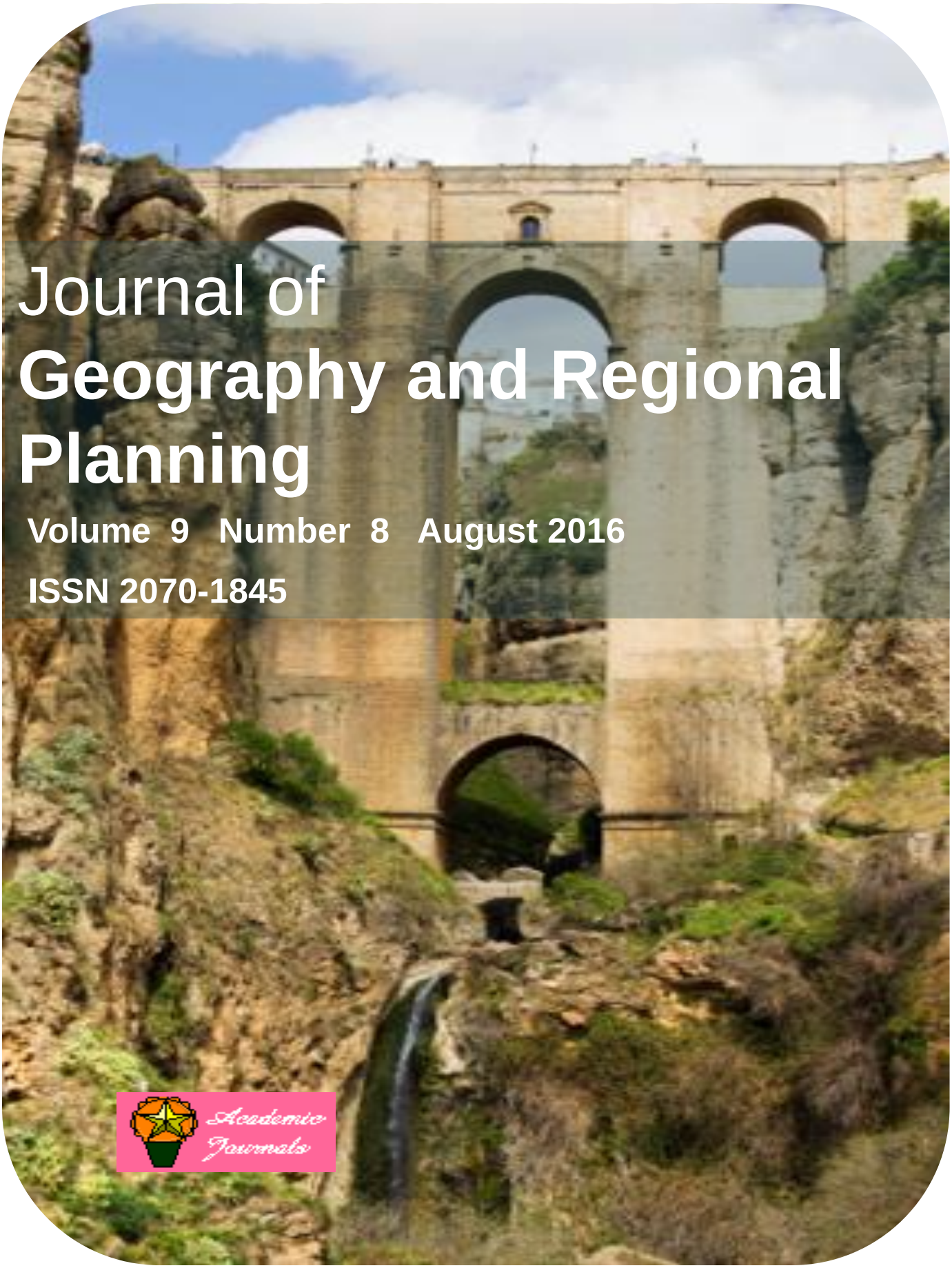

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Full Length Research Paper

GIS application for determining public transport access level in the Federal Capital Territory (FCT), Abuja-Nigeria

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The prevalence of private car for commuting in the Federal Capital Territory (FCT), Abuja is of concern to transport policy makers and planners because of its negative consequences on both physical and socio-economic environments. This study therefore investigates commuters' access to public transport using four key indicators (public transport fare, service frequency, walking distance to access points and waiting time at public transport terminals/bus stops). Relevant data were collected from the public transport operators and commuters using a combination of interview, questionnaire and GPS (Garmin 62x), the data collected were analysed and manipulated on Geographic Information System (GIS) Arc-GIS 9.3 environment to show areas with equal mean values of waiting time, transport fare, bus service frequency and distance to public transport access points. The results showed that Gwagwalada and Zuba axis with 58 mean bus frequency per day, average 109 metres to public transport access points, about 20 min mean waiting time in the park and N158 mean transport fare per tip has the best access to public transport in FCT but still fell short of best practices. The study recommended a redesign of public transport routes, bus stops and terminals across the FCT that will reflect its current physical development pattern, while stakeholders should stepped-up efforts to provide enough and affordable public transport services.

Key words: Access, points, public, transport.

INTRODUCTION

Transport needs of major cities in Nigeria now present significant challenges for policy makers as the unpredictable shift in population dynamics in response to the need for employment, housing and sustenance continues. The expansion of cities in Nigeria coupled with increasing urban population result in greater demand for transport provision. This demand however, has not always been met and effort to provide adequate transport infrastructural facilities are ad-hoc, uncoordinated and poor (Aderamo, 2010). Access to public transport has the

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potential of extending transport services to greater proportion of urban residents who do not have private cars and cannot afford exorbitant taxi fares (Andeleeb et al., 2007). It has the potential of being used as a policy tool to reduce the number of cars on urban roads and by implication reduce traffic congestion in the city.

The basic function of urban transport is to link residents and employment as well as producer and users of goods and services. The demand for public transport in most Nigerian cities is very high. This is due in part to the fact that a large proportion of urban residents are low-income earners who cannot afford personal vehicles. On the other hand, available means of public transport are very few and limited especially when compared with what obtains in developed countries of Europe and America where trains are used for intra and inter urban movement as part of an integrated urban transport system (Sumaila, 2012). A good and efficient public transport system is the one which enables commuters to travel where they want, when they want and at the price they can afford. Achieving this can be done through the development of a multi-modal transport system which provides a variety of public transport services to suit a wide range of individual needs.

Public transport service access level is defined as the overall measured or perceived performance of the public transport system from the commuters' point of view (Hay, 1977). It is used to denote the ease of getting to and quality of service derived from the operational characteristics of transportation facilities (Papacostas and Prevedouros, 2008). Public transport service accessibility indicators which include but not limited to bus service frequency, distance to access points public transport fare, transport time, bus service reliability and comfort reflect two important aspects of transport service: first, the degree to which transport service is available to a given location and secondly, the comfort and convenience of the service provided to commuters (Papacostas and Prevedouros, 2008). For any public transport service to be accessible within the framework of a viable public transport planning system, the indices mentioned earlier must be considered. These indices differ from both traditional highway service quality measures which are more vehicle-oriented than person-oriented. For any meaningful transportation planning, these indices within the framework of the geographical context must be integrated in the transportation planning system. This study therefore, examines the pattern of public transport access level in the Federal Capital Territory (FCT), Abuja-Nigeria.

LITERATURE REVIEW

Cities across the world are in a state of rapid transition, the inability and sustainability of these cities are intrinsically interwoven with not only the degree of efficiency and effectiveness with which existing transport capacity is managed but also how well intermediate and future transportation plans and programme are articulated, laid out and implemented in order to meet the needs of the people (Adesanya, 2011).

The spatial structure of cities especially in developing countries is highly varied and complex, some areas are adequately provided with services and facilities which in other area are grossly inadequate. The variation in the spatial structure results in different socio-economic characteristics of urban dwellers with strong challenges of getting equal and efficient urban service for the disadvantaged. The quality of life in most cities is poor and closely related to accessibility to alternative employment, education and medical facilities, essential public services and nature of recreational open spaces (Vasconcellos, 2011).

Generally, car ownership in Nigeria is low in the cities; there is an average of 4 cars per 100 populations which translates to about 0.04 car owned per person (Adesanya, 2011). With such relatively low level of car ownership the cities experience so much congestion with public transport. However, the situation is different in some countries; the levels of car ownership are 0.831% in Brazil, 0.8% in Argentina, 0.825% in South Africa and 0.683% in India. If vehicle growth will be twice the growth of income there will be a greater necessity for protective measures for traffic management in Nigerian cities (Ogwude, 2011).

A comparison of government and private operation of public transport operations in Nigeria shows that the state, and local government public transport is more organized while private sector operators are largely unorganized. Private sector operators rely mainly on revenue and financial support from informal sector such as friends, relative. Government – owned public transport have better trained staff and maintenance facilities than most of the private sector operators; their service are often provided on fixed routes and are relatively cheaper that those provided by private sector operators. Government owned public transport operator also have service schedules, but in practice are rarely followed because of the inadequacies of vehicle, declining fleet utilization rates, growing competition with private and para-transit operators, poor traffic management, congestion especially during peak travel periods and other problems associated with the operating environment (Umar 2003). Estimate of transport demands in metropolitan Lagos in the 1990 range from 7 to 10 million passenger trips daily out of which over 95% are undertaken by road, primarily by car bus and taxi (Mabogunje, 2008).

In a study of public transport in Nigeria, the World Bank (2001) and Adetunji (2000) reported that taxis and private vehicles carrying fare paying passengers represent 53% of the public transport trips, while 30% made use of motorcycles. In many cities in developing countries,

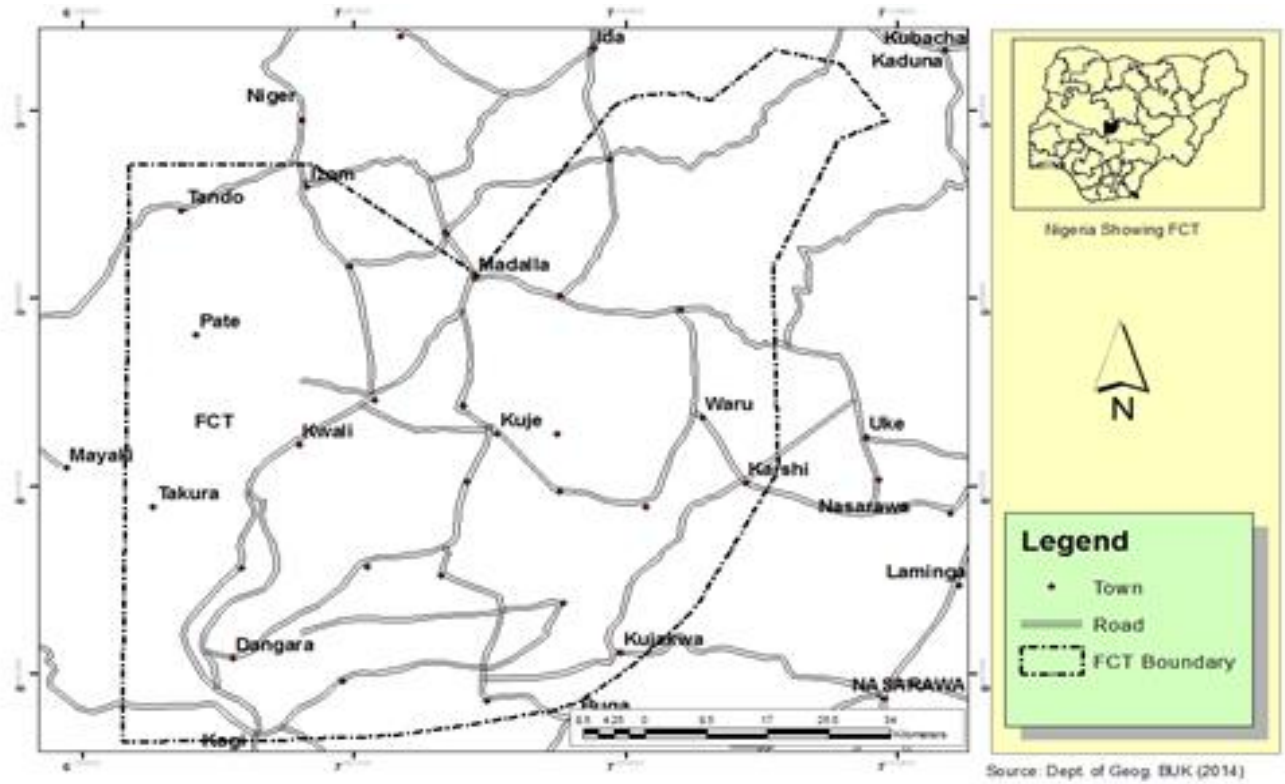

Figure 1. The Federal Capital Territory, Abuja.

motorcycles account for about 90% of feeders' trips to taxis and mini bus terminals. Similarly, in a study of the supply of transport infrastructures in Lagos metropolis, Ogunsanya et al. (2004) found that most urban road networks are not only poorly developed with feeder streets, they are grossly inadequate and their inadequacies more often than not forced vehicles to concentrate on the primary roads with serious implications on commuters modal choice and mobility pattern especially along the same urban transport corridors. The World Bank (1997) and Adesanya et al. (2002) affirmed that urban poor in Nigeria pay very high proportion of their income for transport services and spend long period of trekking time, travelling time and waiting for infrequent and unreliable bus service.

The study area

The FCT was created in 1976 in pursuance of the Federal Government's decision to relocate the Federal Capital of Nigeria from Lagos. Within the Territory a site was selected, where an entirely new modern city was and is being developed as the new Capital City. With an area of 8,000 square kilometres the territory can be compared in terms of land mass with the states of Rivers, Enugu, Ondo and Osun. While the states of Anambra, Ekiti, Lagos, Imo, Akwa Ibom, Ebonyi and Abia are much smaller in size. As the extensive Territory is not intended to become one of the states of the Federation, it has been conceptualized and operationalized as the administrative Territory of the Country. The FCT- Abuja is centrally located within Nigeria's geographical space, which makes it equally accessible to all parts of the country.

The population projections and estimates by Doxiadis (1977) put FCT at 124,678 people in 1977, and rising to about 132,816 at the onset of physical developments in 1980. By 1991, the population of FCT has increased to 378,671 thousand. The Federal Capital Development Authority (FCDA) was established in 1976 to provide platform for administration and the development of transport infrastructure in the city. Today, the FCDA has developed massive transport infrastructure to meet the transport demand of the city. One of the main areas of the transport need of the city is mass transit system that will move the ever increasing city population. The current public transport supply is grossly inadequate which compels most commuters to rely heavily on private automobiles with its attendant consequences on traffic and socio-economic environment of the city (Figure 1).

MATERIALS AND METHODS

The method of data collection adopted in this research is questionnaire survey and interview with the operators. The

questionnaire was designed to cover the key indicators of public transport accessibility namely: commuters waiting time at terminals, walking time to terminals, public transport service frequency on routes and public transport fare. A total of 950 copies of questionnaires were administered on commuters at 17 major public transport terminals operated by government and private sector.

After removing the defective ones only 872 copies of questionnaires were used for analysis. This figure represents about 5% of the FCT's commuters. The adoption of 5%sample size for the commuters is justified on two grounds. Firstly, Borg and Gall (1971), suggested a minimum of 5% sample size as being adequate for population of 10,000 above and minimum of 10% for population of 5000 and below, especially where the population of studies is homogenous as it is the case with the FCT commuters. Secondly, the need to reduce the likelihood of double sampling of either the commuters or the operators, bearing in mind that they both could make multiple trips between and along a route within and between days of the months which the survey lasted.

A systematic random sampling of one out of every 5 commuters found at each bus terminal was interviewed. The questionnaire survey was carried out from early morning hours of 7:00 am to 4:00 pm. The survey was done simultaneously at all the 17 major bus terminals with the help of research field assistants who were recruited for that purpose. The interview was targeted at eliciting information on the operation on the mode of operation and challenges.

The data collected on four key public transport accessibility indicators from the survey points were analyzed by computing descriptive statistics mean table for the respective variable on statistical package for social sciences (SPSS) 19.3 version. The result of the analysis was used to map the spatial variation of the four variables on ArcGIS 9.3 software. The four maps of the spatial variation of the four public transport accessibility variables were later superimposed to find out whether or not there are core area in the territory were public transport access level can be said to be better, that is where the bus service frequency is high, walking distance to access points is shorter, where waiting time at access points is lower and public transport fare is low.

RESULT AND DISCUSSION

Spatial variation of public transport access level

A major source of public transport supply variability which invariably affects its level of access by commuters' is the frequency of public transport bus service, walking time to bus stops, waiting time at bus stop and public transport fare (Jones, 2004). These four key variables were used to delineate the spatial pattern of commuter's access to public transport in the FCT.

Public transport means service frequency

The regularity of public transport service enhances commuter's access to it and vice versa. In the context of this work, bus service frequency connotes the number of buses that arrive at the major terminal with the purpose of conveying commuters for movement within FCT. The degree of commuters waiting at terminals is greatly influenced by the regularity and irregularity of public transport arrival at bus stops/ terminals per unit of time. Table 1 present the calculated mean public transport services for the major terminals in the FCT.

The mean public transport service frequency calculated for each terminal varied from one terminal to another as depicted in Table 1 and Figure 2. As it can be observed from Figure 2, the bus service frequency was higher in the city centre and decreases to the city's periphery. Specifically, Wuse and Garki Area 1 bus terminals had the highest hourly mean frequency of 103.8 and 93.1 buses respectively (Table 1). This is because, all intra-city public transport coming from the city periphery (that is, Zuba, Gwagwalada, Bwari, Lugbe, Nyanya and Kubwa) empties into them. In terms of real time availability of buses (barring other forms of delay) may infer better access level to public transport services by commuters.

Again, the mean public transport frequency for Nyanya, Lugbe, Zuba and Kubwa with mean hourly frequency of 84.2, 68.7, 58.9 and 56.1 vehicles respectively is relatively high. It is to be noted that these settlements are not only located or served by better road network, they are pockets of densely populated residential zones where large volumes of commuters reside. All things being equal, commuter's access to public transport here and its adjoining settlements should be moderately high. Kwali, Kuje and Gwagwalada zones have lower mean hourly public transport service frequency, because they are somewhat far from the city centre. Therefore, these areas exhibit low accessibility to public transport buses which the commuters sought for.

Commuters mean walking distance

Commuters walking distance from point of interests at trip origin or destination to service access points at bus stops or terminals remain one of the critical elements that determine commuter's access to public transport services. Walking distance of a commuter can be defined as the distance a commuter's walk before reaching the nearest terminal or bus stops from either the trip origin or destination to catch any public transport ride. The extent to which the commuters walk before reaching the nearest terminals depends on the spacing between the adjacent public transport routes and the spacing between the adjacent public transport bus stops/terminals (Jende and Surti, 1976). If the total bus service in a place is spread, commuters walking distance should be short and if the public transport services are concentrated in the route that means long walk by the commuters (Faulk, 1990). The worldwide average commuter's walking distance recommended by World Bank (2000), ranges from 300-500 metres from dense urban area and 500-100 meters for low dense urban area.

The result of commuters' average walking distance in all the major terminals of FCT measured in metres is also displayed in Table 1 and Figure 3. It is interesting to note

Table 1. Public transport calculated mean accessibility indicators and their rankings in major terminals.

S/N	Name of major public transport terminal	Mean bus service frequency	Ranking	Mean walking distance (metres)	Ranking	Mean waiting time (minutes)	Ranking	Mean public transport fare per route (Naira (₦)	Ranking
1	Zuba by U- Turn	58.4	5	109.2	1	24.4	5	165.1	14
2	Zuba- Opposite Dankogi	38.1	10	150	3	26.6	9	158	13
3	Gwagwalada by Market	22.1	11	118.9	2	20	2	133.3	10
4	Gwagwalada by El-Rufai Motor Park	19.3	13	206	5	20.4	3	325	17
5	Kuje Park	16.3	12	367.4	9	50.9	17	165.7	16
6	Abuja City by Wuse Market	103.8	1	409.7	13	23.5	4	116.6	3
7	Abuja City by Area 1	93.6	2	379	11	28.8	12	123	7
8	Kwali Park	12.2	14	367.5	10	31.3	15	167.5	15
9	Kubwa Park by Fed. Housing Authority	43.9	8	414.4	15	30.1	13	147.9	11
10	Kubwa park by Village	56.1	7	418.4	16	27.6	10	121.9	5
11	Bwari Park by Junction	39.3	9	316.9	6	30.7	14	127.6	8
12	Nyanya Park by Under Bridge	84.2	3	336.2	7	46.8	16	152.6	12
13	Lugbe Park by Express way	68.7	4	400	12	28.2	11	121.9	5
14	Dutse Alhaji Par by Area 1	56.2	6	346.9	8	18.7	1	131.8	9
15	Nyanya Urban Mass Park	3.6	16	478.9	17	26.1	8	103.9	2
16	Kubwa Urban Mass Park	4.2	15	413.6	14	25.9	7	79.5	1
17	Gwagwalada Urban Mass Park	3.1	17	187.5	4	25	6	118.7	4
Total Average Mean for all Terminals		42.5	-	322.3	-	27.9	-	N272.2	-

that, the three areas with shorter walking distance to public transport terminals/ bus stops; Zuba-U turn (109.2), Zuba opposite Dankogi (150) and Gwagwalada by market (118.9) lie completely outside the city centre. Wuse market park and Area 1 Garki park (the two major terminals within the city centre have mean walking distance of 409.7 and 379 metres, respectively. The implication of this is that the Wuse market and the Garki Area 1 Park in which the commuters disembarked and embarked in the case of city's inbound and outbound trips respectively are not the final destination of the commuters, meaning that the commuters later resort to either long trek or other intermediate means of transport to get to their activity location.

It is important to note that the Central Area and the Three Arm zone in which most government institutions that attract and generate traffic of fixed time work place trip have no major public transport terminals closer. This can then imply that most FCT commuters trek long distance before getting to their nearest bus stops/terminal. One major factor responsible for this, and which was discovered during field survey was the inadequate public transport route traversing the city centre. For instance, Wuse ll, Maitama and Asokoro Districts of the city centre were not adequately covered by the bus route; leaving the commuters around these areas at the mercies of car drops services.

Commuters mean waiting time

Optimum mean waiting time world wide as recommended by the World Bank (2000) otherwise referred to as the bus headway, ranges from 5 to 10 min indicating high quality public transport service access level and the maximum time commuters are expected to wait for the arrival of bus at the terminal/bus stop ranges from11-20 minutes which indicate moderate accessibility. When the commuter waiting time exceeds 20 minutes, it portends poor access level (World

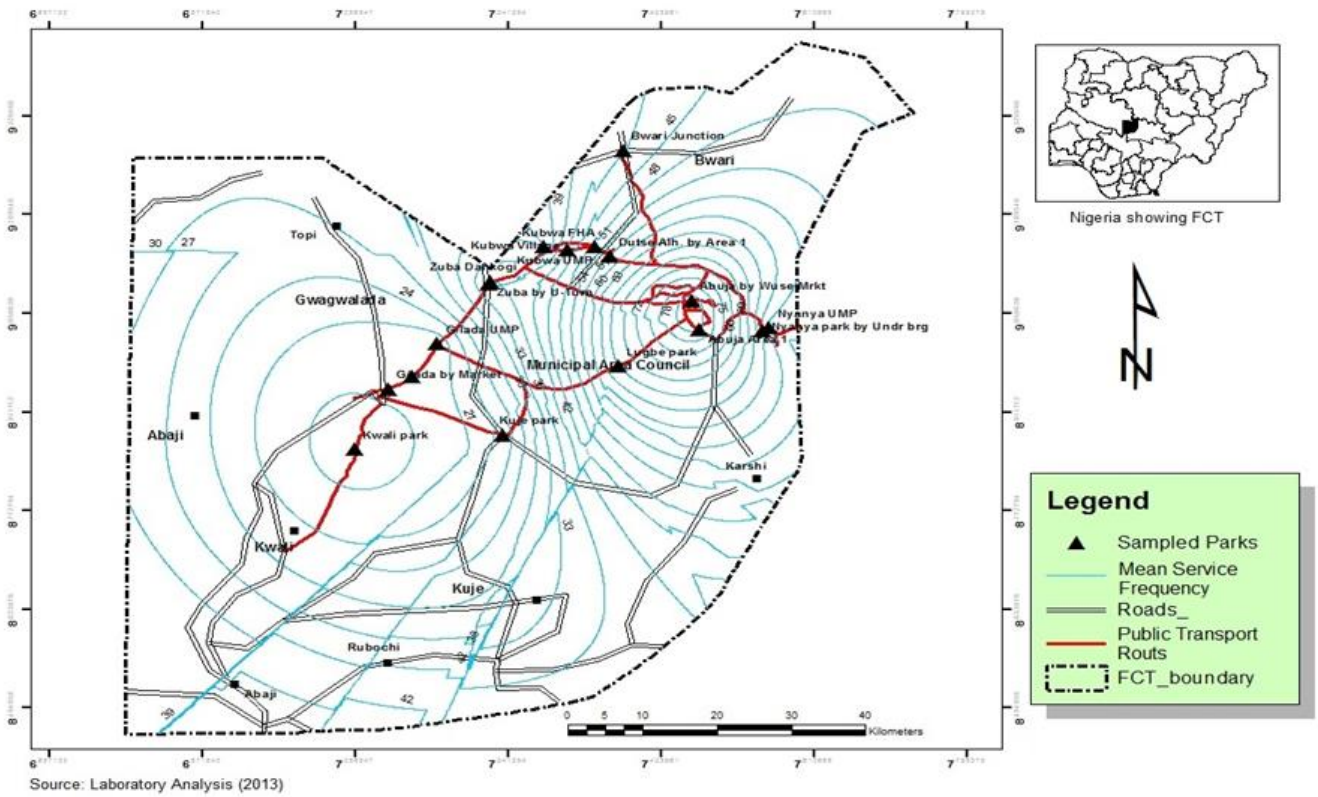

Figure 2. Public transports mean service frequency.

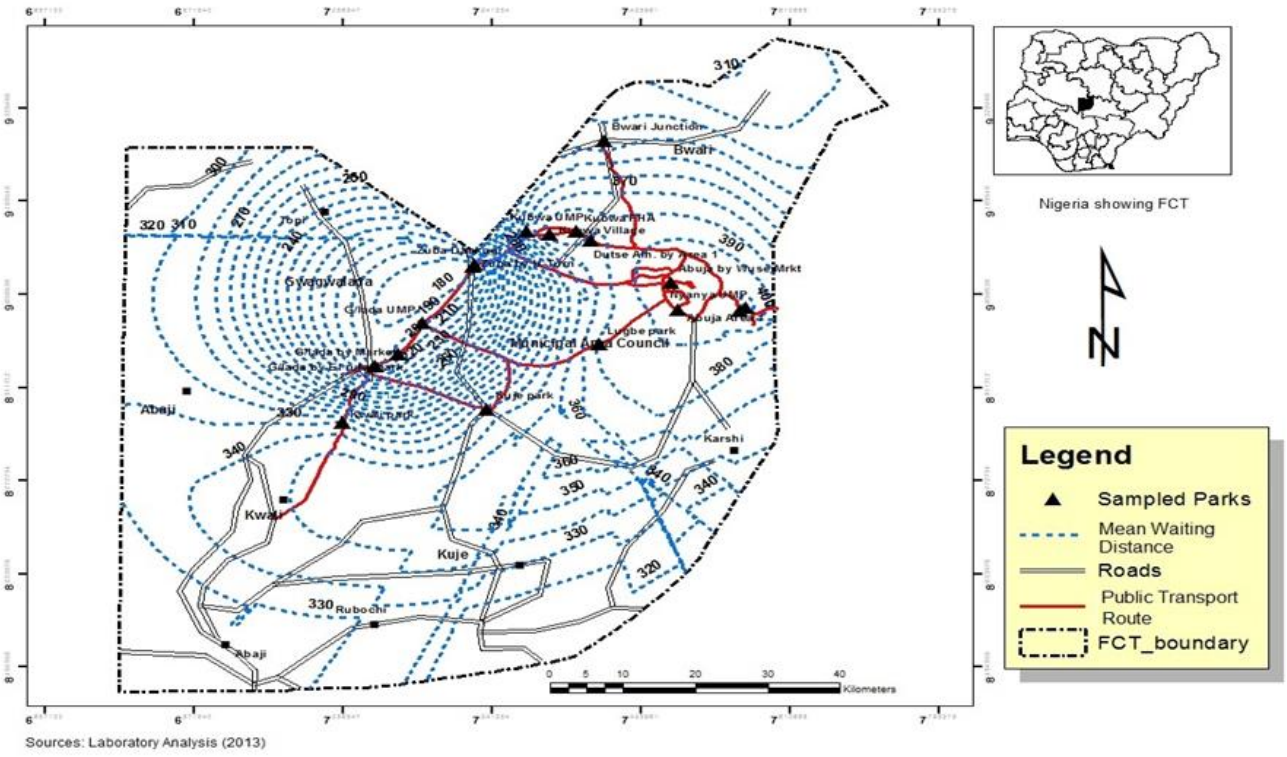

Figure 3. Commuters' mean walking distance.

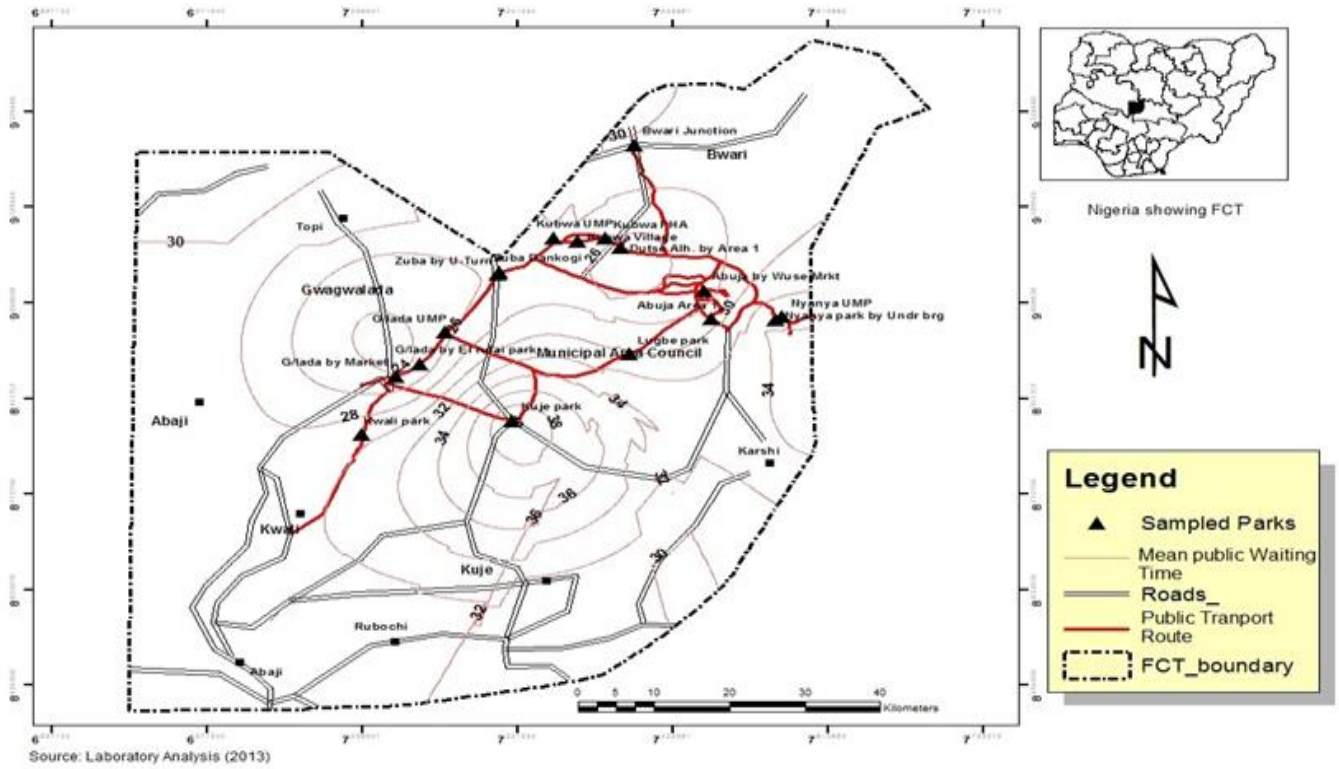

Figure 4. Commuters' mean waiting time at public transport terminals/bus stops.

Bank, 2000). Table 1 reveals that within the context of World Bank standard, no single location in FCT has good access level. At best, the Dutse Alhaji, Area 1 and Gwagwalada by market can qualify for moderate access level, because they have mean waiting time of 18.7, 28.8 and 20. 4 min respectively.

The Gwagwalada by El- Rufal (20.4), Zuba by Dankogi (20.6) and Zuba by U- turn with 24.4 min respectively have long waiting time for public transport and by implication poor level of access. Looking at scenarios from Kuje motor park (50.9), Nyanya under bridge (46.8), Kubwa by FHA (28.8 minutes) and Bwari with 30.7 min, it can therefore be concluded that public transport access level and waiting time is poor all through the FCT. This might be one of the disincentives for public transport patronage, and the prevalence of private car use in FCT. Figure 4 further illustrates this finding.

The commuters waiting time at the AUMTCO park at the three principal axis of Nyanya, Kubwa and Gwagwalada is not in any way better as 26.2, 25.2 and 25 min waiting time were recorded against them respectively. Figure 4 presents further graphical illustration. Interviews with the authorities of AUMTCO revealed that though they have a pool of buses that could operate on a standard bus headway of 5 to 10 minutes along all routes, the challenge is the non-availability of commuters to guarantee fully loaded return trip. Thus, it makes no economic sense in running an empty bus service in the name of higher bus frequency to reduce commuters waiting time. It is to be noted that, commuters trip is principally unidirectional- to the city centre in the morning hours and outwards to the periphery during the afternoon and late evening hours. Again, the capacity of road during the rush hours are limited because there is no dedicated lanes for public transport buses, hence the traffic congestions limit the bus trip frequency.

Mean public transport fare

The amount of money a public transport operator charges as fare influenced how commuter's patronage will be secured. This is because, there is usually a fixed proportion of disposable income that the commuters are willing to attribute to workplace, social and other forms of commuting per unit of time. Odumosu (2004) argued that commuting cost should not be more that 30% of commuters' disposable income, the lower the public transport fare, the higher the possibility of commuters using the public transport. This argument becomes more rational against the backdrop of the fact that commuting costs on the part of the commuters is the sum total of the monies expended in other (intermediate) means of transport from trip origin to immediate bus stop/terminals (where he/she board the public transport) and from the public transport final bus stop to the commuters final destination. The result of the mean public transport fare in FCT is presented also shown in Table 1.

The result shows that the mean public transport fare in the FCT was at its lowest in AUMTCO parks/ buses; Kubwa (₦79.5), Nyanya (₦103.9) and Gwagwalada (₦118.7). This is because these buses are government owned and are operated by an agency of the Federal Capital Territory Administration called, Abuja Urban Mass transit Company (AUMTCO). They are not solely a profit making outfit, but to provide and efficient transport service to commuters at a subsidized rate. The company enjoys grants and subventions from the Ministry of Federal Capital Territory Administration. With regards to other private public transport operators in FCT, Wuse park within the city centre mean public transport fare is the best with a value of ₦116.6, this is followed by Kubwa village and Lugbe park which tallied at (₦121.9), Abuja city by Area 1 has a mean value of N123 and Bwari park has ₦127.6 in that order. Mean public transport fare in the FCT has the highest value in Gwagwalada by El-Rufal Motor Park with a mean vale of ₦325.

Observation at the park during the survey shows that this motor park (Gwagwalada by El-Rufai Motor Park) is operated by a private company outfit, which operates small capacity, green painted air conditioned buses between Gwagwalada and the city centre. Kuje and Zuba by U-turn Motor Park are within the mean value of 165.7 and 165.1 respectively. The public transport fare structure adopted by most operators in FCT is the flat rate structure, indicating same fare from origin to destination payment irrespective of how close or how far the commuters will go before disembarking relative to the bus final terminal or bus stop. Despite this, the public transport operators pick passengers along the way, not minding the fact that the commuters who alighted had paid for the seat till the end of the trip. These practices adopted by the operators contribute to the number of illegal stopping along the trip. The practice also prolong bus trip time, impair commuters comfort and safety- as the buses may likely engage in over loading during rush hour, reduce bus service frequency thereby contributing to public transport supply- demand gap.

The mean public transport fare displayed here also reflect the fact that the distances of each location from the city centre to the suburb has influence on the mean public transport fare, hence Gwagwalada, Kuje and Zuba have higher mean public transport fare values. This therefore implied that physical distance of trip is a major factor considered by operators to arrive at the public transport fare along the route. This is so, because some vehicle consumables like fuel and maintenance costs, vary directly with the distance covered by the public transport vehicle. The spatial pattern of commuters; mean public transport fare is presented in Figure 5.

The core area

The essence of overlaying (Figures 1 to 4 as shown in Figure 5) is to determine whether or not there will be any core area(s) within FCT where shortest waiting time for public transport, shortest walking distance to the nearest bus stop, cheapest public transport fare and highest bus service frequency can be found. As observed, there is no clear cut core area, but what can be termed as multi-nuclei core areas lie in pockets of locations, principally around the city centre where public transport commuters enjoy the highest degree of bus frequency, while the Gwagwalada area have the least walking distance and waiting time at bus stops/terminals. This result is at variance with the work of Ali (2010) in his assessment of the quality of intra urban bus services in the city of Enugu, which identifies a single central core area around the CBD for the city of Enugu-Nigeria.

The two core areas in Figure 6 appear to be the two major economic nerve centre of FCT, where most of the administrative, educational, business and commercial activities were located. They are characterized by the greatest concentration of business offices, massive high-rise buildings, for both public and private establishments. Specifically, these buildings include; government Ministries, Departments and Agencies (MDA's), foreign embassies, wholesale and retail commercial outlets, banks, university, construction companies, churches, mosques and staff quarters just to mention a few. These core areas have the highest densities of roads in the FCT. Because of the high concentration of economic and social activities in the areas, they therefore become the originating and terminating points of large numbers of bus commuter trips to and from the rest of FCT most part of the day.

CONCLUSION AND RECOMMENDATIONS

The study shows that Abuja city at the Wuse and Garki Area 1 terminal has the highest hourly bus mean frequency. This is because, most public transport coming from the city periphery (Zuba, Gwagwalada, Bwari, Lugbe and Kubwa) empties into them. In terms of real time availability of buses, this may infer better accessibility to public transport services. This is followed by Nyanya, Lugbe, Zuba and Kubwa terminals, because these settlements are not only served by better road network, but also there are pockets of densely populated residential zones around them where large volumes of commuters resides; The three areas with shorter walking distance to public transport terminals/ bus stops, Zuba- U turn, Zuba opposite Dankogi and Gwagwalada by market, lie completely outside the city centre. The Central Area and the Three Arm Zone where most government institutions that serve as attractor and generators of fixed time work place trips have no close public transport terminals. This makes most FCT commuters walk long distance before getting to their nearest bus stops/terminal. Commuters waiting time in FCT terminals is at its best in Dutse Alhaji by Area 1, Gwagwalada by market and El-Rufai Motor Park. However, neither of these locations

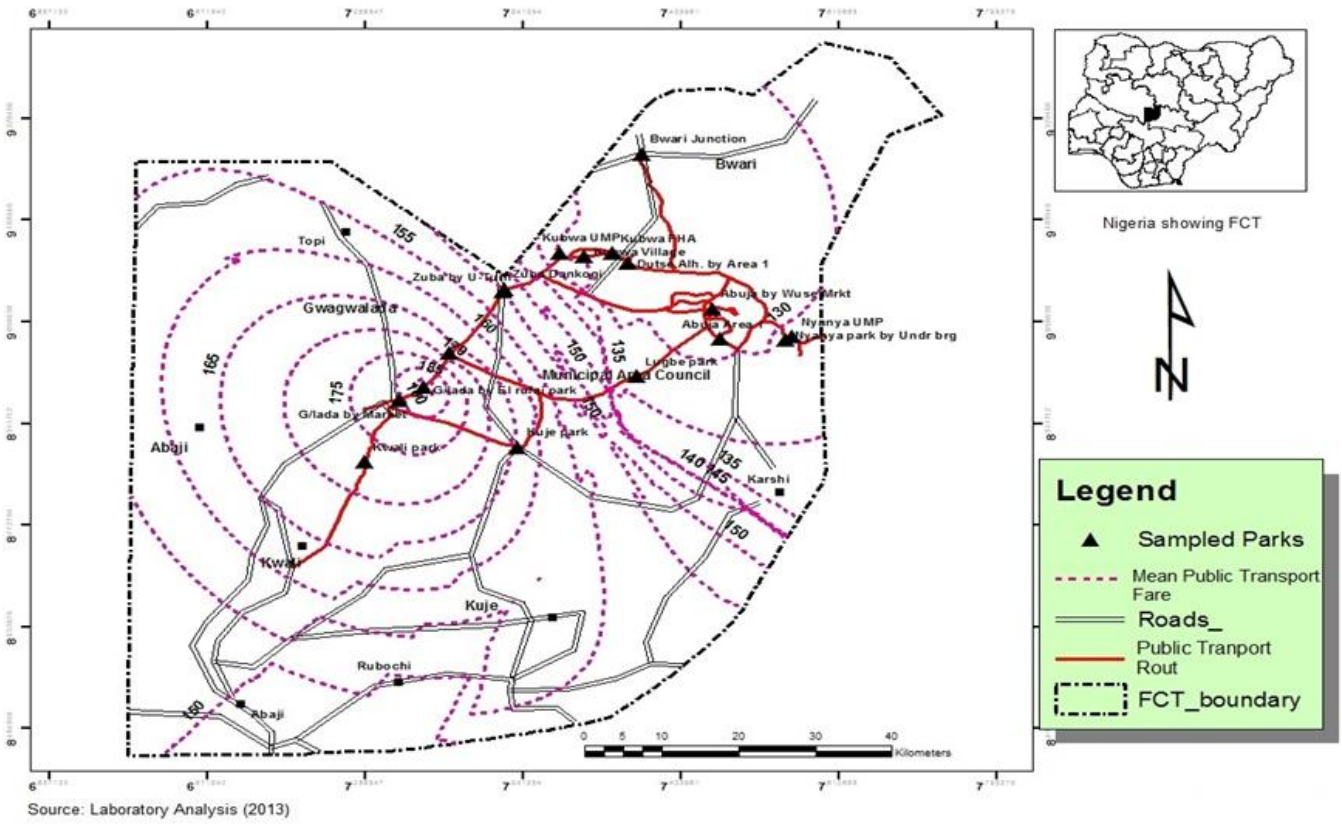

Figure 5. Mean public transport fare.

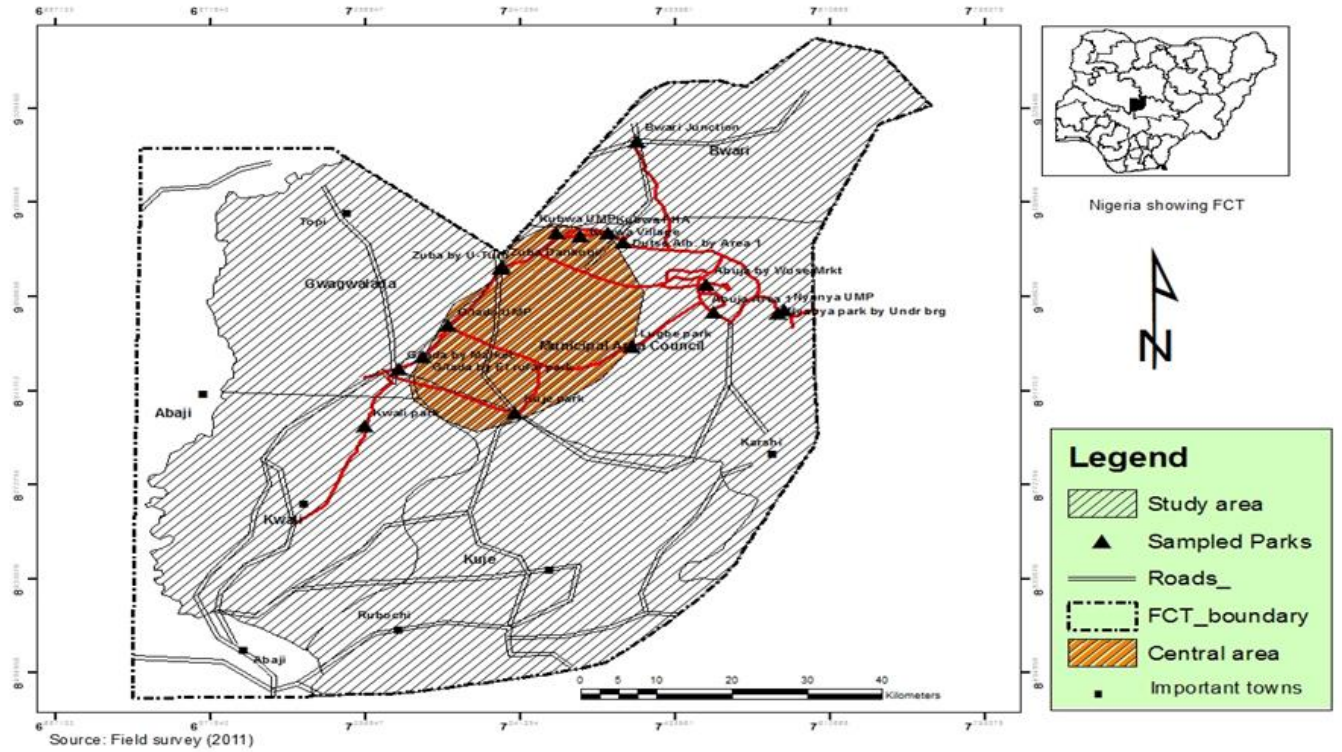

Figure 6. Core area with highest public transport access level.

meets international standard and thus could be one of the disincentives for public transport patronage and the prevalence of private car use in the Territory.

The mean public transport fare in FCT was lowest in AUMTCO parks; Kubwa, Nyanya and Gwagwalada parks, this is because these buses are government owned and are operated by an agency of the Federal Capital Territory Administration called, Abuja Urban Mass transit Company (AUMTCO). The company enjoys grants, subventions and subsidies from the Ministry of Federal Capital Territory. With regard to other private public transport operators, Wuse park within the city centre has the best, followed by Kubwa village and Lugbe parks. There is no clear cut core area where public transport service is at best practice, but a pocket of multi-nuclei core areas lie around the City Centre and Gwagwalada axis. These two areas appear to be the major economic nerve centre of FCT, where most of the administrative, educational, business and commercial activities were located. On the basis of the aforementioned, it is hereby recommended that Both the FCT administration, Area Councils and private sector organizations should collaborate to provide a sound, neat and safe public transport buses for commuters, with a view to increasing service frequency, reduce waiting time and public transport fare, thereby making it more accessible to the commuters with or without private car.

In the light of the foregoing, the study recommended a redesign of the public transport routes, bus stops and terminals across the territory to reflect its current physical development pattern and a further step by the stakeholders to provide adequate, clean and affordable public transport services throughout the length and breadth of the territory. The routing of such transport services should link-up all major activity centres (public institutions, markets, schools etc). This will eliminate frequent need for intermediate transport and the associated costs or long distance walking to the existing public transport bus terminals/stops and ultimately improve the current level of access to public transport service.

Conflict of Interests

The authors have not declared any conflict of interests.

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The influence of socio-cultural characteristics on commercialization of smallholder dairy value chain development in Uasin Gishu County, Kenya

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Livelihoods of many rural households in the developing economies majorly depend on smallholder farming activities. Smallholder dairy farming is the single largest component of agriculture in Kenya. Uasin Gishu County is the leading milk producer in Kenya with subsistence, semi-commercialized and commercialized farmers constituting 70, 20 and 10%, respectively. Smallholder dairy farming in Kenya grows at 4.1% per annum compared to 1.2% for agriculture as a whole. Commercializing smallholder dairy value chain is therefore important in providing pathway out of poverty, and for sustainable rural development. Commercialization of smallholder dairy value chain development is variable and is not yet developed enough in the scale of commercialization index to enable producers benefit from increased income to stimulate rural development. This may be because of the influences of Socio-cultural characteristics of the smallholder producers. The objective of this study is to find out the influence of socio-cultural characteristics on commercialization of smallholder dairy value chain development. Social survey research design was used to obtain both secondary and primary data. A sample size of 384 smallholder dairy producers was studied out of a total population of 50,457 respondents. Data analysis procedures used in this study includes: mean, standard deviation, Pearson correlation coefficient, Spearman's rank correlation coefficient and multiple regressions. The results of this study showed that the socio-cultural characteristics of smallholder dairy producers have significant influence on the commercialization of smallholder dairy value chain development.

Key words: Commercialization, smallholder dairy producers, smallholder dairy value chain development, socio-cultural characteristics, Uasin Gishu County.

INTRODUCTION

Globalization, urbanization, migration and rising per capita income trends are some of the forces that drive changes in consumption behavior towards high value agriculture. These trends create market niches for commodities such as fresh fruits, vegetables, processed and semi-processed maize meal and dairy products (Omiti et al., 2006). These intensification enhancing interventions need to be considered in the context of

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producers' ability. The dairy sector is one of the critical agricultural sub-sectors in Common Market for East and Southern Africa (COMESA) and East Africa Community (EAC) countries, with high potential for improving food security and welfare of families. These increasing market opportunities for dairy production represents exciting challenges and opportunities for improving food security, income generation and employment in COMESA and EAC countries (GoK, 2010a). The EAC countries have more than 100 million people, whose demand for food and dairy products is always rising due to increasing urbanization and awareness among population on good nutrition in the families.

Dairy farming in Kenya is the single largest component of agriculture. It grows at 4.1% per annum compared to 1.2% for agriculture as a whole (IFAD, 2015). Furthermore, it accounts for 3.5% of the total gross domestic product (GDP), and 14% of agricultural GDP (IFAD, 2015). Moreover, dairy farming is dominated by smallholder producers (80%), and produce about 80% of total milk production and 70% of the total milk marketed in the Kenya (IFAD, 2015; GoK, 2010a).

Kenya National Dairy Master Plan (GoK, 2010a) which is consistent with the agricultural sector development strategy (ASDS), 2010 to 2020 and the Kenya Vision 2030 aims to transform the prevalent subsistence smallholder dairy farming to competitive, commercial and sustainable dairy value chain that will lead to economic growth, poverty alleviation, wealth creation and employment. Commercializing smallholder dairy farming is an indispensable pathway towards sustainable rural development for most developing countries relying on the dairy farming as an important pathway out of rural poverty (GoK, 2010a; Ele et al., 2013).

The main purpose of subsistence system is to produce, and to maintain household food self-sufficiency by using mainly non-traded and household generated inputs. The semi-commercial system is focused towards generation of marketable surplus and maintaining household food security by using both traded and non-traded farm inputs. In commercial system, profit maximization is the main motive of the entrepreneur and inputs are predominantly obtained from markets (Ele et al., 2013; Hall, 2005). Poulton et al. (2008) defines agricultural commercialization as an agricultural transformation process in which farmers shift from mainly consumption-oriented subsistence production towards market- and profit-oriented production systems. Commercialization of smallholder dairy value chain development usually takes a long transformation process from subsistence to semi-commercial, and then to fully commercialized dairy farming (Jaleta et al., 2009; GoK, 2010a; Agwu et al., 2013).

Smallholder farming is paramount to livelihoods of many rural households in developing economies. Smallholder dairy producers with the knowledge of determinants of competitiveness may benefit from the improvements in their technical performance to generate higher incomes. Inadequate access to market may also influence intensification in terms of poor access to modern inputs and credit, poor infrastructure, inadequate access to markets, and limited access to modern technologies (Kibiego et al., 2015). Thus, it is not possible for the smallholder dairy producers to integrate with the market, and enjoy the benefits of commercialization smallholder dairy value chain development unless the socio-cultural characteristics of the producers influencing market access are addressed

During the period up to 1969, the dairy industry operated as an open market with various independent dairies being active market participants, while between 1969 and 1992 and primarily due to the rationalisation of the dairy industry by the Government, a monopolistic market situation was created. By mid-1992 to date, the Government liberalised the industry (GoK, 2010a, 2013b).

In Kenya small holder dairy farming is characterized by poorly developed market linkages and unreliable market outlets due to a number of factors including pronounced seasonal fluctuations in milk output and prices, poor rural infrastructure (roads and electricity), as well as the lack of management and business skills and inefficiencies in the post-harvest segment of the milk value chain. Kenya has an extensive formal marketing network comprising large milk processors and dairy cooperatives, and even larger informal market where smallholder dairy producers and small scale milk traders make direct sales of milk to consumers. About 80% of milk currently marketed in Kenya goes through informal channels in which smallholder producers and traders dominate (IFAD, 2015). The informal sector dominance is mainly due to an inefficient processing sector and consumer preference for raw milk which is cheaper.

The smallholder dairy producers in Uasin Gishu County are categorized in the commercialization process as: 70% are subsistence, 20% are semi-commercialized and 10% are commercialized (GoK, 2013a). This indicates that the commercialization of smallholder dairy value chain development is variable, and is not yet developed enough to enable producers benefit from increased income and stimulate rural development (GoK, 2010a; GoK, 2013a). This may be influenced by socio-cultural characteristics (Cefer et al., 2014; Boogaarda et al., 2006). The Country and the Uasin Gishu County also have huge untapped potential for commercial-orientation of smallholder dairy value chain development (GoK, 2010a; GoK, 2013a; GoK, 2013c).

METHODOLOGY

Area of study

Uasin Gishu County is situated in the former Rift Valley Province

with a total area of 3,327.8 Km2. It extends between longitude 34є°50′ and 35°37′ east and 0°03′ and 0°55′ north. It is made up of six Sub-Counties namely: Soy; Turbo; Kapsaret; Kesses; Ainabkoi and Moiben (GoK, 2013a). The county is the leading milk producing county in Kenya with three (3) categories of dairy producers namely: subsistence (70%), semi-commercialized (20%) and commercialized (10%) (GoK, 2013a; GoK, 2013c). The County therefore, is mainly characterized by subsistence oriented smallholder dairy producers.

Research design and method of data analysis

The study used cross-sectional research design. Methods of data analysis includes: Descriptive statistics, namely mean and standard deviation; inferential statistics namely; correlations and regression namely Pearson, spearman's rho and multiple regression respectively. The model given below was used to examine the dependence structure between random variables:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n + \varepsilon.$$

Where: Y = Average HCI (Dependent variable).
X_{i-n} = socio-cultural characteristics (Independent variables)
β_0 = Constant or Point of intercept on Y axis
β_1-n = Regression coefficients.
ε = Residual term or the error

The degree of commercialization of smallholder dairy value chaindevelopment was measured using Household Commercialization Index (HCI) given by the formula below:

$$HCI = \left[\frac{\text{Gross value of milk sales per household per month}}{\text{Gross value of total milk production per household per month}}\right] x100$$

The household commercialization index (HCI) measures the extent to which household production is oriented towards the commercialization. It ranges from zero to 100%. A value of zero signifies a totally subsistence oriented producer. The closer the index is to 100%, the higher the degree of commercialization (Nmadu et al., 2012; Muhammad-Lawal et al., 2014). HCI was applied in this study in measuring the dependent variable. This study used dairy milk production and dairy milk sales in measuring HCI of the households of smallholder dairy producers. This (Jaleta et al., 2009; Zhou et al., 2013; Poulton et al., 2008; Muhammad-Lawal et al., 2014) provides scale of commercialization (HCI) as: 0 to 30%, subsistence oriented farmer:31 to 65%, semi-commercialized farmers: 66% and commercialized farmers100%.

RESULTS AND DISCUSSIONS

Descriptive results

The socio-cultural characteristics of the producers are analyzed using descriptive statistics (Table 1). The proportions of respondents as per their level of access to knowledge and technology are as follows:

59.4% of the respondents had men alone accessing knowledge and technology, 29.1% both man and woman, and 11.5% had woman alone.

This means that most of the producers had man alone accessing knowledge and technology. This makes the respondents who are women notable effectively to access the markets due to lack of knowledge and technology. The proportions of respondents as per their level of access to assets are as follows:

21.1% of the respondents had men alone accessing assets, 74% both man and woman, and 4.9% had woman alone.

This implies that most of the respondents had both man and woman accessing productive assets. The proportions of respondents as per their level of education are as follows:

44% of the producers had reached secondary level education, 20.9% diploma/certificate level, 13.8% primary level of education and 4.6% had adult literacy education.

This shows that most of the respondents (81.6%) had attained secondary level of education and above. 95.4% of the respondents had attained primary level of education and above. This makes the respondents to be able to access the markets through access to market information. The proportions of respondents as per their level of control of income by gender are as follows:

65% of the respondents had men alone controlling income, 26.7% both men and women, and 8.3% had women alone.

This suggests that most of the respondents had men alone controlling income. The proportions of respondents as per their level of control of assets by gender are as follows:

74.9% of the respondents had men alone controlling assets, 16.8% both men and women, and 8.3% had women alone.

This means that most of the respondents had men alone controlling assets. The proportions of respondents as per their decision making on dairy aspects by gender are as follows:

67.2% of the respondents had men alone making decision on dairy aspects, 16.4% both men and women, and 16.4% had women alone.

This suggests that men alone dominated in decision making on dairy aspects. The proportions of respondents as per the age of the household head are as follows:

Table 1. Descriptive results of Social- cultural characteristics.

Access to knowledge and technology by gender	Frequency	Valid percent	Cumulative percent
Man alone	222	59.4	59.4
Both man and woman	110	29.1	70.9
Woman alone	43	11.5	100
Total	384	100	-
Access to assets by gender			
Man alone	79	21.1	21.1
Both man and woman	284	74	78.9
Woman alone	21	4.9	100
Total	384	100	-
Level of education of the house hold head			
Adult literacy education	18	4.6	4.6
Primary	53	13.8	18.4
Secondary	169	44	62.4
Diploma/ Certificate level	66	20.9	83.3
Graduate level training	64	16.7	100
Total	384	100	-
Control of income by gender			
Man alone	243	65	65
Both man and woman	101	26.7	35
Woman alone	40	8.3	100
Total	384	100	-
Control of assets by gender			
Man alone	280	74.9	74.9
Both man and woman	63	16.8	25.1
Woman alone	41	8.3	100
Total	384	100	-
Decision making on dairy aspects by gender			
Man alone	261	67.2	67.2
Both man and woman	63	16.4	32.8
Woman alone	60	16.4	100
Total	384	100	-
Age of respondents in years			
25 .00-35.00	40	10.4	10.4
36.00-45.00	128	33.3	43.7
46.00-55.00	153	39.9	83.6
56.00-65.00	51	13.1	96.7
Above 65 years	12	3.3	100
Total	384	100	-
Land ownership by respondents			
Family land/inheritance	163	44.5	44.5
Own purchased land	200	52.5	55.5
Leased land	21	3	100
Total	384	100	-

Table 1. Cont'd.

Religion of respondents			
Catholics	69	18	18
Protestants	302	78.6	82
Others	13	3.4	100
Total	384	100	-
Born in community by respondents			
Yes	248	64.6	64.6
No	136	35.4	35.4
Total	384	100	-

Table 2. Correlation results of socio-cultural characteristics.

S/N	Independent variable	Correlation Model	
		Pearson Correlation	Spearman's rho
1	Access to knowledge and technology	0.940**	0.813**
2	Access to assets	0.875**	0.890**
3	Level of education	0.820**	0.826**
4	Control of income	-0.733**	-0.691**
5	Control of Assets	-0.695**	-0.721**
6	Decision making	0.680**	0.600**
7	Age	-0.600**	-0.525**
8	Land ownership	0.501*	0.616*
9	Religion	0.045*	0.067*
10	Born in the community	-0.498*	-0.375*

****** Correlation is significant at the 0.01 level (2-tailed); *Correlation is significant at the 0.05 level (2-tailed); Sample size, N = 384; Correlation between each variable and itself = 1.00.

10.4% of the respondents were the ages of 25 -35 years while majority of the producers (73.2%) were 36-55 years of age.

This implies that fewer youth are involved in dairy farming. The proportions of respondents as per their land ownership were as follows:

44.5% of the producers had family land/inheritance, 52.5% had purchased land, and 3.0% had leased land.

This means that most of the producers had purchased their land. The proportions of respondents as per their religion are as follows:

18% of the respondents were Catholics, 78.6% were Protestants, and 3.4% were others.

This implies that most of the respondents were Protestants. The proportions of respondents as per their being born in the community are as follows:

64.6% of the respondents born in the community, whereas 35.4% were migrants.

This means that most of the respondents were born in the community.

Inferential results

The correlation and regression analysis are used to test the association between socio-cultural characteristics of respondents and commercialization of smallholder dairy value chain development using the household commercialization index (Tables 2, 3 and 4).

The correlation coefficients in Table 2 indicate that the household commercialization index of the respondents is significantly correlated with the socio-cultural characteristics (independent variables). However, some

Table 3. Regression results of socio-cultural characteristics.

Independent variable	Coefficient	Std. error	T-ratio
Access to knowledge and technology	0.208**	(0.215)	0.967
Access to assets	0.190**	(0.179)	1.061
Level of education	0.148**	(0.125)	1.184
Control of income	-0.108**	(0.110)	-0.982
Control of Assets	-0.105**	(0.092)	-1.141
Decision making	0.095**	(0.078)	1.218
Age	-0.085**	(0.069)	-1.232
Land ownership	0.026*	(0.026)	1.000
Religion	0.014*	(0.004)	3.500
Born in the community	-0.019*	(0.071)	-0.268
Cons	0.285	(0.633)	0.450

****** Coefficient is significant at the 0.01 level (2-tailed); * Coefficient is significant at the 0.05 level (2-tailed); Sample size, N = 384. R= 0.880; R^2 = 0.774; adjusted R^2= 0.687.

Table 4. Household commercialization index (HCI) results for Socio-cultural characteristics.

Access to knowledge and technology by gender	Frequency	Valid percentage	Average household commercialization index
Man alone	222	59.4	29
Both man and woman	110	29.1	58
Woman alone	43	11.5	26
Total	384	100	37.7
Access to assets by gender			
Men alone	79	21.1	24
Both Men and Women	284	74	28
Women alone	21	4.9	23
Total	384	100	25
Level of education of house hold head			
Adult literacy education	18	4.6	26
Primary	53	13.8	28
Secondary	169	44	29
Diploma /Certificate	66	20.9	48
Graduate level training	64	16.7	69
Total	384	100	40
Control of income by gender			
Men alone	243	65	27
Both Men and Women	101	26.7	68
Women alone	40	8.3	25
Total	384	100	40
Control of assets by gender			
Men alone	280	74.9	25
Both Men and Women	63	16.8	52
Women alone	41	8.3	23
Total	384	100	33.3

Table 4. Cont'd.

Decision making on dairy aspects by gender			
Men alone	261	67.2	24
Both Men and Women	63	16.4	61
Women alone	60	16.4	21
Total	384	100	35.3
Age of respondents in years			
25.00-35.00	40	10.4	29
36.00-45.00	128	33.3	60
46.00-55.00	153	39.9	28
56.00-65.00	51	13.1	23
Above 65 years	12	3.3	21
Total	384	100	53.7
Land ownership by respondents			
Family land/inheritance	163	44.5	20
Own purchased land	200	52.5	67
Leased land	21	3	23
Total	384	100	36.7
Religion of respondents			
Catholics	69	18	22
Protestants	302	78.6	53
Others	13	3.4	20
Total	384	100	31.7
Born in community by respondents			
Yes	248	64.6	25
No	136	35.4	55
Total	384	100	40

correlations were more powerful statistically at 1% level of significance than the others at 5% level. Access to knowledge and technology, access to assets, level of education, control of income, decision making and age have correlation coefficients greater than 0.5 (+ or -), and they are significant at 99% confidence level. On the other hand, land ownership, religion and born in the community have low Pearson coefficients of 0.501, 0.045 and -0.498 respectively at $\alpha = 0.05$. The regression coefficients show that these socio-cultural characteristics influence the household commercialization index. Access to knowledge and technology, access to assets, level of education and decision making on dairy aspects were found to have positive relationship with HCI and highly significant at 1%. Control of income, control of assets and age of the producers on the other hand had negative relationship with HCI and highly significant at 1%. Land ownership and religion had positive relationship with HCI but significant at 5%. Born in the community had negative relationship with HCI but significant at 5%.

Capital R (0.880) is the multiple correlation coefficients that tell us how strongly the multiple independent variables are related to the dependent variable. The R Square statistics (0.774) means that the ten independent variables (social cultural variables) in the regression model account for 77.4% of the total variation in the given HCI. The higher the R-squared statistic, the better the model fits the data. In this case, the model fits data with a high significance considering there are lots of other variables not in our model which influence HCI.

The HCI of the respondents were determined, and the results are indicated in Table 4. The HCI ranges from level of 25% (subsistence) to level of 53.7% (semi-commercialized). The results of correlations, regressions and HCI of socio-cultural characteristics shown in Tables 2, 3 and 4 respectively explain the following:

Access to knowledge and technology

Correlation results of a Pearson correlation coefficient of 0.940 and Spearman's rho of 0.813 shows that there is positive relationship between respondent's access to knowledge and technology, and the average household commercialization index. The coefficients are highly significant at 1%. Similarly, in Table 3, regression results shows that access to knowledge and technology has a standardized coefficient of 0.208 meaning that access to knowledge and technology is positively associated with household commercialization index, and coefficient is highly significant at 1%. A unit (one percent) increases of level of access to knowledge and technology causes an increase of HCI by 0.208 (20.8%). Respondents who were only men having access to knowledge and technology had an average HCI of 29%, and in cases where only women had access they had HCI of 26%. In the cases where both men and women had access to knowledge and technology, the HCI was 58%. The results therefore show that for higher commercialization index to be achieved in dairy farming, both genders should access knowledge and technology in increasing dairy production and access to markets for higher HCI.

This study finding is confirmed by the results obtained by Farinde and Taiwo (2003) that one of the biggest challenges to the stakeholders involved in the process of agricultural transformation in Sub-Saharan Africa is the high percentage (70 to 80%) of women responsible for household food production. Until recently, women were usually excluded from variety of services such as access to inputs, and they were neglected by agricultural extension services. In addition, some institutional arrangements such as market contractual agreements were exclusively for male-headed households. Female-headed households are therefore expected to have lower commercialization indexes compared to their male counterparts. The results are in line with that of Ochola et al. (2003) on culture, traditions and society. The results also conform to that of Tangka et al. (1999) on women and sustainable development of market-oriented dairying in East Africa.

According to Kurosaki (2003), demand for modern technologies promote the input side of production and facilitate the development and advancement of technological innovations. The use of modern technologies can result in higher productivity and production entering markets. Jaleta et al. (2009) found that specialized production leads to higher productivity through greater learning by doing, scale economies, exposure to new ideas through trade (better knowledge diffusion through exchange), and also better incentives in the form of higher income. The household-level technological changes can help to secure food self-sufficiency under a risky food-market environment.

The importance of resource-saving and high-enhancing technological innovations and their adoption by the ultimate users are unquestionable in smallholder commercialization process (Jeleta et al., 2009; Amoako, 2003). Adopting a temporal perspective, they argued that, in the short-run, increased commercialization could occur without change in agricultural technologies, but the inverse would be less likely due to the indispensable demand-side pull for technological innovations. The findings also conform to that of Omiti et al. (2006) that remoteness restrict access to information about technologies and changing prices, leaving the rural smallholders unable to respond to changes in market incentives.

According to Kariuki in the Standard Newspaper, Friday May 8, 2015, expanding on knowledge strengthens one's qualifications, present high value to the company due to acquired knowledge and helps one to stay marketable. Today's job market is stiff calling for employee to expand on their skills and knowledge to stay relevant, competitive and be in a better position for jobs in different market segments. Limited knowledge and skills are the major issues affecting access to employment and income generating opportunities.

Access to assets

According to correlation results of a Pearson correlation coefficient of 0.875 and Spearman's rho of 0.890 it shows that there is a positive relationship between respondent's access to assets, and the average household commercialization index. The coefficients are highly significant at 1%. Similarly, regression results show that access to assets has a standardized coefficient of 0.190 meaning that high level access to assets is positively associated with higher household commercialization index and, coefficient is highly significant at 1%. A unit (one percent) increases of level of access to assets causes an increase of HCI by 0.190 (19%). The HCI of respondents where both men and women were accessible to assets is highest (28%), whereas in cases where men alone had access to assets have HCI of 24% and for women alone had the lowest HCI (23%). Involvement of both genders in commercialization is very crucial. This is because the respondents are able to invest in dairy production jointly for higher dairy productivity and HCI. Men and women should all become agents of positive change and sustainable development in the society.

The results conform to that of Heierli and Gass (2001) who argue that assets empower the rural poor by increasing their incomes and make them less vulnerable to shocks, and the extent of vulnerability determines household commercialization index. Highly vulnerable households are expected to have lower commercialization index. Relatively well endowed with agricultural capital have high potential of commercializing.

The acquisition and ownership of productive assets can pave the way for household to participate in economic activities. Households with relatively higher production levels have higher probability
of market participation and commercialization.

According to Jayne et al. (2012), improving access to land among the land-constrained smallholder households would be a seemingly effective way to reduce poverty, as a very small incremental addition to land access is associated with a large relative rise in commercialization and consequently in income. Gebreselassie and Sharp (2008) found out in their study that coefficient for land is statistically significant at 1% while the coefficient for oxen ownership is relatively high but significant only at the 5%.

Level of education

Correlation results of a Pearson correlation coefficient of 0.820 and Spearman's rho of 0.826 shows that there is positive relationship between respondent's level of education and the average household commercialization index. The coefficients are highly significant at 1%. Similarly, regression results shows that level of education has a standardized coefficient of 0.148 meaning that high level of education is positively associated with higher household commercialization index and, coefficient is highly significant at 1%. A unit (one percent) increases of level of education causes an increase of HCI by 0.148 (14.8%). The results show that HCI level increases with the increase of education levels. Respondents with graduate level of training have the highest level of commercialization (69%); primary level have 28%; secondary level have 29%; diploma/certificate level have 48%whereas those with adult literacy education have the lowest commercialization level (26%). This is because the respondents with higher level of education are able to increase their dairy productivity through access to knowledge and technology, and access to market through access of market information among others issues of marketing.

Education is an important tool to escape poverty, but only if the education system reaches the right people with the right content (Heierli and Gass, 2001). Intellectual capital as captured by education is hypothesized to play a positive role in influencing market participation and HCI. Level of education gives an indication of the household ability to process information and causes some producers to have better access to understanding and interpretation of information than others. High education level is important, as it is likely to lead to the reduction of search, screening and information costs. However, the expectation may be reversed when there are competing and more remunerative employment opportunities available in the area that require skills that are enhanced by more education (Lapar et al., 2003).

Education also makes the producers to access market information, and be able to engage in trade effectively. Gebreselassie and Sharp (2008) found out in his study that coefficient for literacy of the household head is positive and significant, which implies a high probability of better production among farm households with an educated head (compared to households with illiterate heads). According to Simonyan et al. (2010), education would significantly enhance producers' ability to make accurate and meaningful decisions. They also opined that level of education raises human capital and increases their level of managerial abilities which is an incentive for commercialization. Nmadu et al. (2012) found out that age of producers, marital status, educational status, number of years in poultry production, type of birds and system of production increased technical efficiency and HCI of commercial poultry farmers. Ele et al. (2013) found out that on average, a household head is married and has between 19 and 22 years of farming experience, and has had at least a primary school education, which indicates that they can at least read and write, an important factor in the commercialization of farming. Human capital elements such as education, experience, skills, capabilities and talents of family members are essential in commercializing smallholder agriculture. There are some individuals who inherently have better skills and capabilities to do the implicit cost-benefit analyses required and apply their talents to quickly adapt to and exploit new opportunities (Jaleta et al., 2009).

Control of income

According to correlation results of a Pearson correlation coefficient of -0.733 and Spearman's rho of -0.691 which shows that there is a negative relationship between respondent's control of income, and the average household commercialization index. The coefficients are highly significant at 1%. Similarly, in Table 3, regression results shows that control of income has a standardized coefficient of -0.108 meaning that high level of control of income by one gender is negatively associated with lower household commercialization index and, coefficient is highly significant at 1%. A unit (one percent) increases of level of control of income by one gender causes a decrease of HCI by 0.108 (10.8%).

According to HCI results, households where income is controlled by both men and women, the commercialization level was highest (68%) and was lowest where income is controlled by only women (25%). In cases where income was controlled by men alone, HCI was 27%. This is because the money generated and controlled by both men and women is reinvested in the dairy for increased productivity hence higher HCI. Jaleta et al. (2009) reported that the impact of smallholder commercialization on the gender dimension depends on the commodity's gender specific labor demand and on who controls the income generated. The shift from staple

maize to sugarcane production in Kenya and the Philippines was associated with a significant reduction in the percentage of women's labor use in agricultural activities, from 50.5 to 1.2% in Kenya and from 9.1 to 2.5% in the Philippines. However, in Guatemala, the shift from maize to vegetable production increased the proportion of women's labor use from 6.1 to 21.5%. Whatever proportion of female labor is involved in cash crop production, income from these crops is usually controlled by men.

Control of assets

Pearson correlation coefficient of -0.695 and Spearman's rho of -0.721 show that there is negative relationship between respondent's control of assets and the average household commercialization index. The coefficients are highly significant at 1%. Similarly, regression results show that control of assets has a standardized coefficient of -0.105 meaning that high level of control of assets by one gender is negatively associated with lower household commercialization index and, coefficient is highly significant at 1% (Table 3). A unit (one percent) increases of level of control of assets by one gender causes a decrease of HCI by 0.105 (10.5%). Results of HCI indicate that respondents where assets were controlled by both men and women has commercialization index of 52%; in cases of men alone HCI was 25% and where assets were controlled only by women, commercialization index was 23%. This is due to the fact that joint control of productive assets by both gender empowers them to increase the dairy productivity and access to markets hence increased HCI.

Decision making on dairy aspects

According to the earlier mentioned correlation results of a Pearson correlation coefficient of -0.680 and Spearman's rho of -0.600 it shows that there is negative relationship between respondent's decision making on dairy aspects, and the average household commercialization index. The coefficients are highly significant at 1%. Similarly, in Table 3, regression results show that decision making on dairy aspects has a standardized coefficient of -0.095 meaning that there was a highly significant negative relationship between respondent's decision making on dairy aspects, and the average household commercialization index and, coefficient is highly significant at 1%. A unit (one percent) increases of level of decision making on dairy aspects by one gender causes a decrease of HCI by 0.095 (9.5%). Results of HCI indicate that respondents where decision making on dairy aspects was made by both men and women has commercialization index of 61%; men alone was 24% and in cases where decision making was made only by women, commercialization index is 21%. This is because women are also important agents in decision making on commercialization of smallholder dairy value chain development process. The findings are in line with those of Manfre et al. *(*2013) on reducing the gender gap in Agricultural extension and advisory services. How to find the best fit for men and women

Age of respondents in years

As shown earlier, correlation results of a Pearson correlation coefficient of -0.600 and Spearman's rho of -0.525 shows that there is a negative relationship between respondent's age, and the average household commercialization index. The coefficients are highly significant at 1%. Similarly, regression results show that age of respondents head has a standardized coefficient of -0.085 (Table 3) meaning that respondent head is negatively associated with household commercialization index and, coefficient is highly significant at 1%. A unit (one percent) increases of age of respondent head causes a decrease of HCI by 0.085 (8.5). According to HCI results, respondents of 36 to 45 years old have higher commercialization index (highest HCI of 60%) and respondents of 65 years and above have lower commercialization index (lowest HCI of 21%). The other respondents had HCI results as follows: 25-35 years had 29%; 46-55% had 28% and 56-65% had 23%. The results are due to the fact that relatively young respondents are more commercial-oriented than older ones. This is because young respondents have high level of education and are able to access information and technology for increased dairy productivity and market access.

According to Nmadu et al. (2012), age of farmers among others characteristics increased technical efficiency and HCI. Randela et al. (2008) reported that the relationship with age is expected to be negative depending on the stages of development. Younger farmers are expected to be progressive, more receptive to new ideas and to better understand the benefits of agricultural commercialization. In addition, relatively young farmers usually have higher socio-economic status that, *inter alia*, enables them to be faced by lower transactions costs. Younger farmers also have higher levels of education and contact with outside world. In most cases, older farmers view farming as a way of life rather than as business and have strong emotional or almost biological connection with farming and land.

Land ownership

Correlation results earlier mentioned of a Pearson correlation coefficient of 0.501 and Spearman's rho of 0.616 shows that there is a positive relationship between respondent's ownership of land, and the average household commercialization index. The coefficients are

significant at 5%. Likewise, regression results show that ownership of land has a standardized coefficient of 0.026 meaning that owning land is positively associated with higher household commercialization index and, coefficient is significant at 5%. A unit (one percent) increases of owning land causes increase of HCI by 0.026 (2.6%). According to HCI results, respondents with own purchased land have higher commercialization index of 67% and whereas respondents with family /inherited land have lower commercialization index of 20%. The one with leased land have HCI of 23%. This is because respondents who purchase land have high potential and capacity to maximally utilize the available land thereby obtaining higher productivity and HCI.

Randela et al. (2008) reported that access to arable land is a necessary condition for market participation. The larger the size of a arable land a household uses, the higher the production levels are likely to be, and the higher the probability of market participation and HCI. Gebreselassie and Sharp (2008) found out that land and oxen, which could also be used as proxies for capital stock, are found to be important in explaining the variation in the level of production his sampled households. The coefficient for land is statistically significant at 1% whereas the coefficient for oxen ownership is relatively high but significant only at the 5% level.

Religion of the household

According to correlation results of a Pearson correlation coefficient of 0.045 and Spearman's rho of 0.067 which shows that there is a positive relationship between respondent's religion and the average household commercialization index. The coefficient is significant at 5%. Similarly, regression results show that religion of the respondent has a standardized coefficient of 0.014, meaning that religion has positive influence on the household commercialization index and, coefficient is significant at 5%. A unit (one percent) change in religion causes increase of HCI by 0.014 (1.4%). The HCI results show that respondents who were Protestants have higher commercialization index of 53% whereas those who were from Catholics have HCI of 22%, and those from other denominations have lower commercialization index of 20%. The results therefore mean that respondents from protestants have some exposure to knowledge and technology for dairy production and market access compared to those from other denominations.

Born in the community

According to correlation results of a Pearson correlation coefficient of -0.498 and Spearman's rho of -0.375 it shows that there is a negative relationship between producers being born in the community, and the average household commercialization index. The coefficients are significant at 5%. Similarly, regression results show that being born in the community has a standardized coefficient of -0.019 meaning that being born in the community has negative influence on the household commercialization index and, coefficient is significant at 5%. A unit (one percent) change being born in the community causes reduction of HCI by 0.019 (1.9%). The results above show that respondent who were migrants have higher commercialization index of 55% and whereas those who were born in the community have lower commercialization index of 25%. This is mainly as result of migrants being more commercial oriented than those born in the community. In the new environment, migrants have little social networks which force them to work hard to improve their livelihoods hence higher HCI.

This result is similar to the one of Randela et al. (2008) that found out that farmers born in the same community have low level of commercialization compared to the migrants who have little social support and networks. This makes the migrants to work hard to enhance their livelihood through increased market participation and HCI. The result is also supported by information obtained from both key informants and focused group discussion that migrants are more pro-commercialization compared to those born in the community. This is because the drive for migrants is mainly commercial orientation while drive for those born in the community is normally business as usual. The result is also in line with the findings of Holt, (2009) that individuals often become entrepreneurs by being thrown into situations that force them to fashion their own means of economic livelihoods. Immigrants fit this model. Circumstances afford few options for these persons who frequently establish independent ventures.

CONCLUSION AND RECOMMENDATIONS

Based on the study results, the socio-cultural characteristics of smallholder dairy producers particularly access to knowledge and technology; access to assets by gender; access to education; control of income by gender; control of assets; decision making on dairy aspects and age in years have highly significant influence on commercialization of smallholder dairy value chain development. In view of these results, the National and County Governments should formulate policies, strategies, projects and programs that may encourage access to knowledge and technology and assets by both men and women for increased level of commercialization; enforce access to education to all citizens and ensure that all sexes have control of income and assets for increased commercialization; develop special programs for women and youth to empower them to access credit,

land and appropriate technology and encourage the involvement of youth in the dairy value chain development to promote succession planning and enhance commercialization.

Conflict of Interests

The authors have not declared any conflict of interests.

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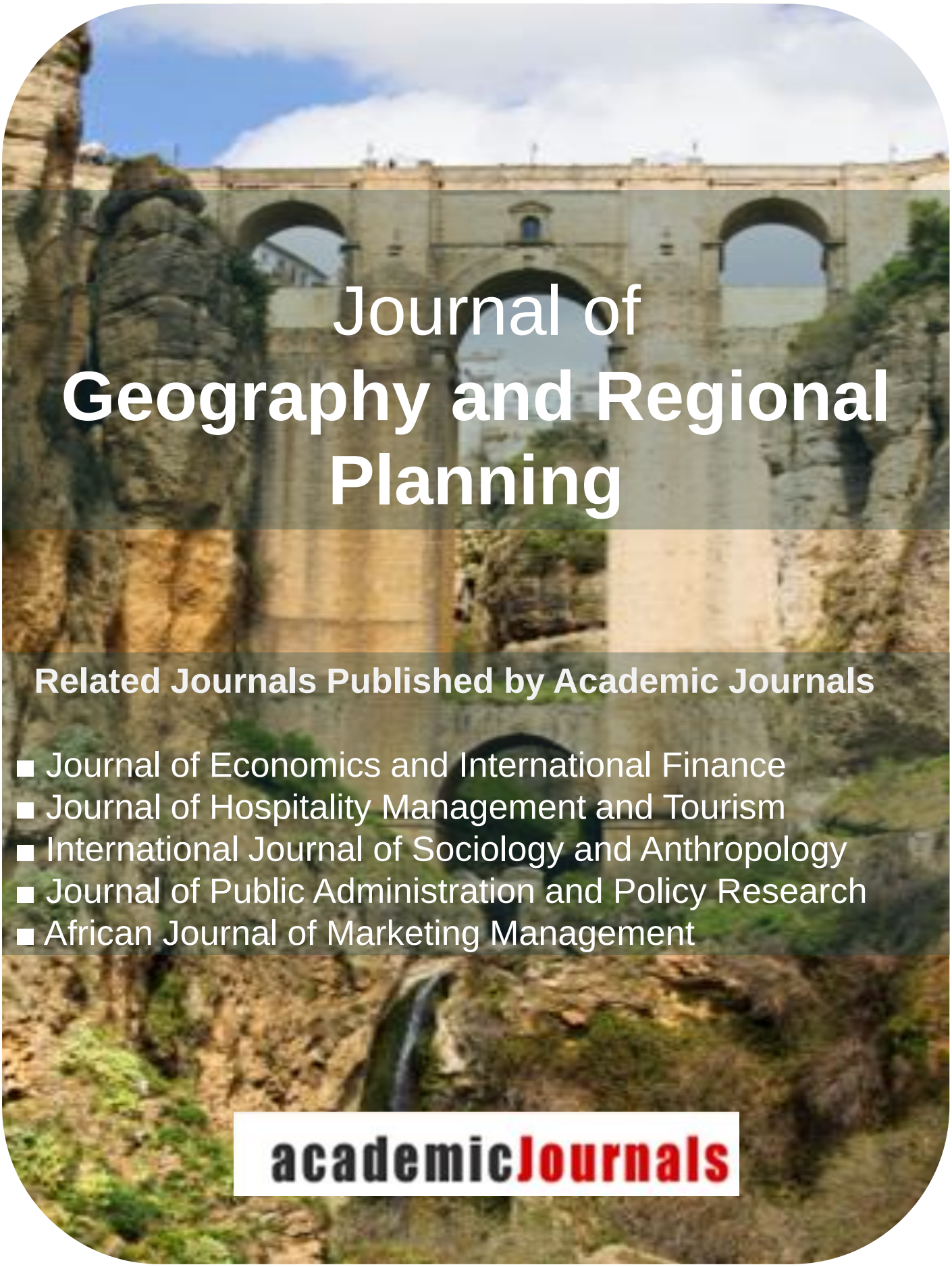

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