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Pitout JDD, Church DL, Gregson DB, Chow BL, McCracken M, Mulvey M, Laupland KB (2007). Molecular epidemiology of CTXM-producing Escherichia coli in the Calgary Health Region: emergence of CTX-M-15-producing isolates. Antimicrob. Agents Chemother. 51: 1281-1286.

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Journal of Development and Agricultural Economics

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Journal of Development and Agricultural Economics Vol. 5(1), pp. 1-6, January 2013
Available online at http://www.academicjournals.org/JDAE
DOI: 10.5897/JDAE11.093
ISSN 2006- 9774 ©2013 Academic Journals

Full Length Research Paper

Technology competencies required by secondary school graduates in maintenance, servicing and repairing of electronic machines for agribusiness occupations to minimize wastage

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Accepted 11 June, 2012

This study focused on technology competencies required by secondary school graduates in maintenance, servicing and repairing of electronic machines for agribusiness occupations to minimize wastage. Three research questions and three hypotheses guided the study. The study made use of survey and functions of industry designs. It was carried out in Enugu State, Nigeria. The population for the study was 73, made up of 13 teachers of computer education and 60 computer and phone technicians. A 47 skill item questionnaire was used for data collection. Five experts validated the instrument. Split half technique and Pearson product moment correlation method were used to determine the internal consistency of the instrument. A reliability coefficient of 0.86 was obtained. Seventy three copies of the instrument were administered to the respondents. All the copies were retrieved and analyzed using mean and standard deviation to answer the research questions and t-test statistic to test the hypotheses. The study found out that 19 competencies in maintenance, servicing and repairing of computer, 15 competencies in maintenance, servicing and repairing of internet and 13 competencies in maintenance, servicing and repairing of phone were required by secondary school graduates for success in e-waste management in agribusiness. It was therefore recommended that the findings of this study be utilized by skill acquisition centres to train secondary school graduates for employment in maintenance, servicing and repairing of computer, internet and phone.

Key words: Agribusiness, e-waste, e-waste management, technology competencies, training.

INTRODUCTION

Agribusiness comprises all buying and selling activities of agricultural inputs and outputs. Weick (2001) stated that agribusiness is a generic term for the various businesses involved in food production including farming, seed supply, agric-chemicals, farm machinery, wholesale and distribution, processing, marketing and retail sales. Davis and Golberg in Nwibu (2006) explained agribusiness as the sum of all operations involved in the manufacturing and distribution of farm commodities and items made from them. Olaitan et al. (2010) simplified agribusiness as the sum of all the economic activities involved in distribution, marketing and supplying of farm inputs to the farmers and farm outputs to the target consumers. Nwankwo et al. (2010) emphasized that modern day business are conducted and facilitated through the use of telephones, fax machines and computer, and communication networks through the internet. This phenomenon, the authors clarified, has given birth to the contemporary e-commerce, e-government, e-medicine, e-banking, e-education among others. Gazette (2008) explained that the e stands for electronics in today's technology language. In the area of the study, most electronic

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machines company used to facilitate agribusiness include telephone, computer and internet. These e-machines become e-waste when they are considered out of use in agribusiness due to malfunctioning.

E-waste, in the opinion of Kozlan (2010), is all electronic equipment or products with power plug, and batteries which have become obsolete due to advancement in technology, changes in fashion, style and status, and nearing the end of their useful life.

The author continued that e-waste encompasses over growing range of obsolete electronic devices such as computer, savers, main frames, monitors, televisions and display devices, telecommunication devices such as cellular phones and pagers, calculators, audio and video devices, printers, scanners and so on. The Environmental Protection Agency (2007) reported that about 50 million tones of e-waste are produced every year especially from developing countries. The agency estimated that in 2006 and 2007, only 15 to 20% of e-waste was recycled, the rest went directly into landfills and incinerators. Morgan (2006) while describing e-waste as loosely discarded surplus, obsolete or broken electrical or electronic devices, stressed that it causes serious health and pollution problems if not well-managed. Some electronic scrap components contain contaminants such as lead, cadmium, beryllium, mercury and brominated frame retardants. The author cautioned that recycling and disposal of e-waste as a means of management may involve significant risks to workers and communities. Chea (2007) stated that due to the lack of government legislations on e-waste management, standards for disposal, proper mechanism for handling these toxic hi-tech products, mostly end up in landfills or partly recycled in an unhygienic conditions and partly thrown into waste streams.

E-waste management, in this study, involves all effort being made to elongate the life span of electronic machines through maintenance, servicing and repairs to make the e-machines functional for reuse in agribusiness. Nick in Gazette (2008) suggested that individual or companies should consider re-using electronic devices before throwing them out or recycling them. The author advised that if the product still functions, one should consider passing it on to friends or family or donating them to charity or second hand stores. Warren in Gazette (2008) criticized recycling and burning as the easiest means of e-waste management. The author buttressed that electronic devices should be maintained, serviced and repaired to increase their life cycle. It should be given to friends, families or returned to the manufacturers through their customers.

In the area of the study, data for e-waste produced yearly is not available and there is no electronic company available to recycle the e-waste. The commonest way of e-waste management, as observed by the researchers, is disposing unusable electronic devices such as computer and cell phone by burning or keeping them in the house for decorative purposes. Gazette (2008) stated that manufacturing companies such as Sony Erickson, Sony Panasonic, Motorola, Nokia, and Samsung have certified that maintenance, servicing and repairing of e-devices for re-use remain the best e-waste management, and e-waste management through maintenance, servicing and repair could be engaged in by secondary school graduates if they are equipped with the technical know-how or skills. Secondary school graduates, in the context of this study, are those individuals who have completed six years of secondary school education but could not secure admission into any higher institution or employed in any job. Olaitan et al. (2009) observed that unemployed secondary school graduates have no means of survival except by depending on their parents. This indicates that they need to be employed to reduce poverty. E-waste management in agribusiness could provide good employment opportunity for this class of graduates if they possess the technology competencies in maintenance, servicing and repairing of e-waste.

Technology in the submission of Quirk (1995) involves new machines (electrical and electronics), equipment, and ways of doing things that are based on modern knowledge about science and computers. Competency in the statement of Olaitan and Ali (1997) is the successful performance of a task through the use of knowledge, skills, attitude and judgement. In reference to this study, technology competencies involve the knowledge, skills and attitude required by secondary school graduates for maintenance, servicing and repairing of e-waste for reuse and reduction of environmental pollution in the area of the study. The secondary school graduates could acquire technology competencies through training module in e-waste management.

Training as explained by Onuka (2008) is a skill acquisition process through which learners are taught new knowledge and skills and how to apply them. The author further stated that the objective of training individuals in an occupation such as e-waste management is to assist them to acquire professional skills for establishing and/or improving their business. Training packages in an occupation are better organized in modules. A module, in the view of Olaitan and Ali (1997), is a unit of standard measurement. It is a segment of an instructional programme. In this study, training modules refer to segments of a skill acquisition through which learners are exposed to the competencies in e-waste management for easy learning and mastery by the learners. If secondary school graduates are exposed to the technology competency training modules in e-waste management, it could provide them with self or paid employment in e-machines in agribusiness.

The purpose of the study

The purpose of the study, therefore, is to identify

technology competencies required by secondary school graduates in maintenance, servicing and repairing of electronic machines for agribusiness occupations to minimize wastage. Specifically, the study sought to identify competencies in maintenance, servicing and repairing of computer, internet and phone.

Research questions

What are the competencies required by secondary school graduates in:

(1) Maintenance, servicing and repairing of computer?
(2) Maintenance, servicing and repairing of internet?
(3) Maintenance, servicing and repairing of phone?

Research hypothesis

There is no significant difference in the mean ratings of the responses of teachers of computer education and computer and phone technicians on the competencies required by secondary school graduates in maintenance, servicing and repairing of computer, internet and phone.

METHODOLOGY

Three research questions were developed and answered by the study and three hypotheses were formulated and tested at 0.05 level of significance ($P \leq 0.05$).

Survey research and functions of industry designs were adopted for the study. Olaitan et al. (2000) stated that survey research design is the plan, structure and strategy that the investigator wants to adopt in order to obtain solution to research problems using questionnaire in collecting, analyzing and interpreting the data. Olaitan et al. (1999) described functions of industry as a design in which development of a training programme is derived from the basic functional areas of an industry or teaching operational divisions or development of an industry. The two designs were suitable for this study since it used questionnaire to obtain data and develop a training module based on the functional areas of e-waste management.

The study was carried out in Enugu State, Nigeria. The population for the study was 73, made up of 13 teachers of computer education in universities and 60 phone and computer technicians. The population was small and therefore, the entire population constituted the sample for the study.

A 47 skill item questionnaire was developed from literature reviewed and information from technicians in the phone and computer maintenance firms and used for data collection. The questionnaire had a four-point response scale options of highly required (HR), slightly required (SR), required (R) and not required (NR). Five experts validated the instrument, three were from the Department of Vocational Teacher Education (Computer), and two were from the phone and computer maintenance firms. Teachers of computer education are those individuals professionally trained to equip students with knowledge and skills in computer programmes such as computer operations, programming, maintenance, servicing and repairing.

A technician, in the explanation of Hornby (2006), is an individual whose job is keeping a particular type of equipment such as computer and phone in a good condition. Their corrections and suggestions were used to produce the final copy of the questionnaire. Split-half technique and Pearson product moment correlation method were adopted to determine the internal consistency of the instrument. A reliability coefficient of 0.86 was obtained. Six research assistants were hired and briefed on how to handle the questionnaire while administering them on the respondents. All the copies of the questionnaire were retrieved and analyzed.

Weighted mean and standard deviation were used to answer the research questions, while t-test statistic was used to test the hypothesis of no significant difference. A cut-off point (arithmetic mean) of 2.50 was used for decision-making.

Any item with a mean rating of ≥2.50 was regarded as a competency item that was required while any competency item with a mean of <2.50 was regarded as not required. Also, any item with a standard deviation 0.00 and 1.96 indicated that the respondents were close to the mean and not too far from one another in their responses. The null hypothesis of no significant difference was accepted for any item whose t-calculated value was less than the t-table value while it was rejected for any item whose t-calculated value was greater than the t-table value.

RESULTS

The results of the study were obtained from the research questions answered and the hypotheses tested. Table 1 revealed that all the 19 competency items had their mean values ranged from 3.03 to 3.94. This showed that the mean values were above the cut-off point of 2.50, indicating that the respondents agreed that the items were competencies required by secondary school graduates in maintenance, servicing and repairing of computer. The table also showed that the standard deviation of the items ranged from 0.58 to 1.14, indicating that the respondents were not too far from the mean and from the opinion of one another in their responses. The table revealed that all the 19 items had their t-calculated values less than their t-table values at probability of 0.05 level of significance and 71° of freedom. This indicated that there was no significant difference in the mean ratings of the responses of the two groups of respondents on the competencies required by secondary school graduates in maintenance, servicing and repairing of computer.

Table 2 revealed that all the 15 competency items had their mean values ranged from 3.25 to 3.96. This showed that the mean values were above the cut-off points of 2.50, indicating that the respondents agreed that the items were the competencies required by secondary school graduates in maintenance, servicing and repairing of internet. The table also showed that the standard deviation of the items ranged from 0.71 to 1.09, indicating that the respondents were not too far from the mean and from the opinion of one another in their responses. The table revealed that all the 15 items had their t-calculated values, less than their t-table values at the probability of ≤ 0.05 level of significance and 71° of freedom. This indicated that there was no significant difference in the mean ratings of the responses of the two groups of

Table 1. Mean ratings and t-test of the responses of the teachers of computer education and computer technicians on competencies required by secondary school graduates in maintenance, servicing and repairing of computer.

S/N	Item statement	$\overline{X}_r$	$\overline{X}_1$	$\overline{X}_2$	SD	t-cal	Rmks
Maintenance M-A_1, ability to:							
1	Switch off computer and its accessories after use	3.49	3.26	2.40	0.80	*1.19	*NS
2	Install and update a strong anti-virus software to protect the computer	3.59	3.11	1.97	0.89	0.39	*NS
3	Power computer and its accessories using a high quality surge protector like UPS	3.94	3.72	3.63	0.90	1.25	*NS
4	Stabilize the current supply with an adequate voltage stabilizer	3.18	3.26	3.42	0.58	1.02	*NS
5	Provide adequate ventilation for the computer in operation	3.68	3.90	3.82	0.99	0.71	*NS
6	Dust computer units regularly	3.58	3.67	2.47	0.83	0.81	*NS
7	Keep computer in a safe, dry and cool working condition	3.53	3.08	2.86	1.01	0.91	*NS
8	Cover computer if not in use for a long time	3.88	3.33	2.12	0.98	0.96	*NS
Servicing M – A_2							
9	Recharge or change primary battery if weak	3.60	3.50	2.28	1.08	0.29	*NS
10	Straighten the bent pins on the keyboard pot or replace if damaged	3.62	3.11	2.81	0.97	0.26	*NS
11	Dispense dust out of the computer system with appropriate gadget	3.18	3.26	3.42	0.58	1.02	*NS
12	Clean the mother board with brush soaked in methylated spirit or fuel	3.03	3.91	3.76	0.79	0.67	*NS
13	Press sockets to ensure correct tightening	3.03	3.91	3.76	0.79	0.67	*NS
14	Grease/oil moving parts of the computer like ejector	3.06	3.96	3.40	0.70	0.34	*NS
Repairing M – A_3							
15	Connect all cables correctly	3.94	3.72	3.68	0.90	1.25	&NS
16	Boot the system for functionality	3.19	3.73	3.65	1.14	1.21	*NS
17	Troubleshoot to identify the fault	3.36	3.98	3.98	0.81	0.85	*NS
18	Remove the damaged part and replace with recommended part	3.88	3.99	3.79	0.95	1.01	*NS
19	Reboot the system and test for functionality	3.58	3.42	3.18	1.02	0.23	*NS

N = 43; 13 teachers and 30 computer technicians. M = Module, $\overline{X}_r$ = mean required, $\overline{X}_1$ = mean of teachers, $\overline{X}_2$ = mean of technicians, SD = standard deviation, t-table = 1.96, t-cal. = t-calculated values, S = significant, NS – not significant, * = required, ** not required. Rmks, remark.

respondents on the competencies required by secondary school graduates in maintenance, servicing and repairing of internet.

Table 3 revealed that all the 13 competency items had their mean values ranged from 3.06 to 3.94. This showed that the mean values were above the cut-off point of 2.50, indicating that the respondents agreed that the items were competencies required by secondary school graduates in maintenance, servicing and repairing of computer. The table also showed that the standard deviation of the item ranged from 0.39 to 1.20, indicating that the respondents were not too far from the mean and from the opinion of one another in their responses. The table revealed that all the 13 items had their t-calculated values less than their t-table values at the probability of ≤ 0.05 level of significance and 71° of freedom. This indicated that there was no significant difference in the mean ratings of the responses of the two groups of respondents on the competencies required by secondary school graduates in maintenance, servicing and repairing of phone.

DISCUSSION

The result of the study revealed that 19 competencies in maintenance, servicing and repairing of computer, 15 competencies in maintenance, servicing and repairing of internet and 13 competencies in maintenance, servicing and repairing of phone are required by secondary school graduates for success in e-waste management in agribusiness.

The findings of the study afore stated are in agreement with the findings of Olaitan et al. (2010) in a study on technology skills required for capacity building of instructors in teaching agribusiness to students in schools of agriculture in south eastern Nigeria, where it was found out that the instructors needed capacity building in skills in the application of computer and internet for effective teaching of agribusiness to their students in schools

Table 2. Mean ratings and t-test analysis of the responses of the teachers of computer education and computer technicians on competencies required by secondary school graduates in maintenance, servicing and repairing of internet.

S/N	Item statement	$\overline{X}_r$	$\overline{X}_1$	$\overline{X}_2$	SD	t-cal	Rmks
Maintenance M-B_1, ability to:							
1	Load internet with adequate number of computers that match the capacity of the saver	3.62	3.49	3.22	0.74	0.54	*NS
2	Supply saver with correct power voltage	3.94	3.72	3.68	0.90	1.25	*NS
3	Keep the saver in a safe, dry and cool working condition	3.88	3.99	3.79	0.95	1.01	*NS
4	Dust the saver regularly	3.36	3.98	3.78	0.81	0.85	*NS
5	Load credit card regularly	3.96	3.74	3.68	0.90	1.25	*NS
Servicing M-B_2							
6	Disconnect the saver from power supply	3.74	3.63	3.53	0.76	0.32	*NS
7	Disengage the saver into parts	3.25	3.63	3.36	0.71	0.19	*NS
8	Dispense dust from the disengaged parts	3.58	3.42	3.18	1.02	0.23	*NS
9	Clean parts with methylated spirit or fuel and dry	3.67	3.89	3.81	0.98	0.70	*NS
10	Couple back the parts and test for functionality	3.92	3.70	3.61	0.88	1.23	*NS
Repairing M-B_3							
11	Connect saver to power supply	3.57	3.66	2.46	0.82	0.80	*NS
12	Troubleshoot saver to identify fault	3.51	3.06	2.84	1.00	0.89	*NS
13	Loosen saver into major parts	3.85	3.30	2.09	0.95	0.93	*NS
14	Remove faulty part(s) and replace with recommended part(s)	3.61	2.50	2.29	1.09	0.29	*NS
15	Couple back the parts and test for functionality	3.59	3.11	1.97	0.79	0.39	*NS

N = 43; 13 teachers and 30 computer technicians. M = module, $\overline{X}_r$ = mean required, $\overline{X}_1$ = mean of teachers, $\overline{X}_2$ = mean of technicians, SD = standard deviation, t-table = 1.96, t-cal. = t-calculated values, S = significant, NS – not significant, * = required, ** not required. Rmks, remark.

Table 3. Mean ratings and t-test analysis of the responses of teachers of computer education and phone technicians on the competencies required by secondary school graduates in maintenance, servicing and repairing of phone.

S/N	Item statement	$\overline{X}_r$	$\overline{X}_1$	$\overline{X}_2$	SD	t-cal	Rmks
Maintenance M-C_1, ability to:							
1	Put phone in a waterproof leather bag	3.91	3.68	3.81	0.99	0.71	*NS
2	Charge the battery when down or replace if weak	3.70	3.92	3.61	0.90	1.24	*NS
3	Clean dust from phone regularly	2.07	3.52	2.85	1.00	0.90	*NS
4	Unplug phone from power supply when fully charged	3.33	3.86	2.12	0.96	0.95	*NS
Servicing, M-C_2							
5	Disengage phone into parts	3.27	3.19	3.43	0.59	1.20	*NS
6	Dispense dust from the disengaged parts	3.26	3.20	3.40	0.50	1.03	*NS
7	Clean the mother board with methylated spirit and dry	3.10	3.59	2.92	0.79	0.39	*NS
8	Couple the parts and test for functionality	3.98	3.09	3.78	0.77	0.67	*NS
Repairing, M-C_3							
9	Connect phone to power supply and switch on	3.93	3.36	3.39	0.86	0.83	*NS
10	Troubleshoot to identify fault	3.73	3.19	3.65	1.14	1.22	*NS
11	Disengage phone into parts	3.73	3.94	3.68	0.90	1.24	*NS
12	Remove faulty part(s) and replace with recommended part(s)	3.95	3.06	3.40	0.70	0.34	*NS
13	Couple the parts back and test for functionality	3.70	3.19	3.66	1.15	1.21	*NS

N = 43; 13 teachers and 30 computer technicians. M = module, $\overline{X}_r$ = mean required, $\overline{X}_1$ = mean of teachers, $\overline{X}_2$ = mean of technicians, SD = standard deviation, t-table = 1.96, t-cal. = t-calculated values, S = significant, NS – not significant, * = required, ** not required. Rmks, remark.

of agriculture.

CONCLUSION AND RECOMMENDATION

The application of technologies such as computer, cell phone and internet to facilitate agribusiness requires efficient maintenance, servicing and repairing of these equipments by the business man; if these are lacking, the technologies become wasted incase of any trouble with their operations and functionality. To reduce wastage, the study therefore identified competencies in the maintenance, servicing, repairing of computer, internet and cell phone for agribusiness occupation.

It was recommended that the findings of this study be utilized by skill acquisition centres to train secondary school graduates in agribusiness on maintenance, servicing, and repairing of computer, internet and phone.

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Journal of Development and Agricultural Economics Vol. 5(1), pp. 7-11, January 2013
Available online at http://www.academicjournals.org/JDAE
DOI: 10.5897/JDAE12.003
ISSN 2006- 9774 ©2013 Academic Journals

Full Length Research Paper

Economics of farm safety: The Nigerian scenario

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Accepted 31 May 2012

Investing in farm safety is a win-win game. Apart from improving the financial bottom line of a farm business, it increases and improves the labour productivity of farm workers, which in turn improve agricultural sector. Consequently, agricultural accidents place a great burden on the economy resulting in reduced return on investment (ROI) in agriculture and the burden of injuries/illness (BOI) is increased. This impedes efficiency of the workers, decreased agricultural output and profitability. The dearth of information on the economic relationship of farm safety and ROI, especially in agriculture with focus on a developing country like Nigeria stimulated this research by assessing the economic implication of farm safety practices on agriculture in Nigeria. 100 respondents with agriculture as primary occupation were randomly selected from farming households in Ibadan, Nigeria. Health and work performance questionnaire (HPQ), work limitation questionnaire and interview schedule were adopted for data collection. The research revealed that about 80 and 75% of the respondents had severe wrist/hand injury and lower back pain, respectively which are work related. 63% of the respondents on average have been prevented from doing their work as a result of occupational injuries and illness which leads to lost time, restricted work cases and fatalities leading to production loss. Also, 80% of the respondents do not use any form of personal protective equipment (PPE). Inadequate information and awareness coupled with cost implication were ranked highest on the farm safety adoption constraint list. Thus, information dissemination on farm safety, a subsidized well implemented farm safety programme and farm accident record keeping are recommended.

Key words: Nigeria, farm safety, economics.

INTRODUCTION

The realization of the African Green Revolution and its contribution to food security and economic growth in Sub-Saharan Africa is threatened by many factors (Ngigi, 2009). The direct effect of these factors on agricultural production and food security will be exacerbated by greater exposure to occupational diseases and illnesses that reduce labour productivity. Sub-Saharan Africa countries have more than 54,000 fatal occupational accidents annually; approximately, 42 million work-related accidents took place that caused at least three days' absence from work; the fatality rate of the region is 21 per 100,000 workers; the accident rate is 16,000 per 100,000 workers; and the fatal accident rate in agriculture is 22.5 per 100,000 (Hämäläinen, 2005). On a global scale, agricultural accidents place a great burden on the economy, resulting in reduced return on investment (ROI) in agriculture; moreover, the burden of injuries/illness (BOI) is on the increase. This impedes workers' efficiency, decreases agricultural output and weakens productivity.

Farm safety is therefore a focal issue for improved agricultural productivity; with the expansion of agricultural technology, there is a growing health concern that agricultural workers will face, in addition to traditional health risks with the new occupational health and safety hazards. Even in countries where the primary health care is well developed, occupational health care in agriculture is often non-existence. Nigerian farmers have little or no knowledge of health and safety as it relates to agriculture. Agriculture as practiced today in some countries is crude

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and unsafe, exposing millions of workers to hazards with many sustaining injury and probably death (Mostafa, 2003). The issue of health and safety in agriculture is inconsequential in a developing nation like Nigeria or if at all considered, it is still at a very low ebb or non-existence despite the fact that agriculture is the mainstay of her economy. Agriculture was the most important sector of the economy before the decline in the 1970s due to oil boom. It created jobs and generated employment, and engaged about 70% of the labor force (Kwanasahi et al., 1998). A greater fraction of the country's population of over 167 million depends on agriculture for their livelihood today either directly or indirectly. Unfortunately, this sector is deep seated culture of unwise risk taking and lack appreciation of the role of good health and safety management (Chris, 2008). Farm workers are exposed to hazard ranging from chemical, physical, ergonomics, biological and psychosocial hazards thereby leading to disorders such as musculoskeletal disorder and diseases like carcinogenicity (cancer causing), mutagenicity (induce mutations), tetragenicity (affect the fetus), psychiatric disorder and delayed neuropathy, and the dusts have been known to cause diseases ranging from byssinosis, occupational asthma, pneumonitis and non-specific chronic obstructive pulmonary disease (COPD) (Mostafa, 2003). After construction, agricultural sector has the worst record for work related fatalities and one of the worst for occupational ill health and injuries (Chris, 2008).

A healthy workforce is definitely one of the most important economic assets to a nation. An unhealthy workforce on the other hand is an economic loss to a nation which in turn affects productivity (Karen et al., 2005). At the individual level, good health can directly increase general output (e.g. through reduced absenteeism, injury and illnesses as well as improved morale and general work-well being. Consequently, economists and historians have focused much attention on better understanding of productivity determinants. There is an increasing awareness that human capital is a key factor. Recently, however, increasing attention has been given to health as a form of human capital (Emile, 2002). Poor health state erodes human capital and reduces resilience to shock and reduces productivity as well as impaired physical and mental capacity (Soekirman, 2010).

A need for farm safety programme

According to International Labour Organization (ILO) report in 2000, as cited by Oluwagbemi (2007), revealed that 170,000 (50.7%) agricultural workers are killed each year from the total of 335,000 in fatal workplace accidents worldwide. Therefore, special attention is needed for the health and safety of agricultural workers, who constitute three quarters of the Nigerian working population. Health and safety has been identified to have a strong influence and invaluable to any sector of the economy. Effective management of health and safety can help to deliver improved productivity and efficiency. It has been tied to positive performance indicators (PPIs) (Smallman and John, 2001). "Agriculture" covers not only farming, but also many other associated activities such as crop processing and packaging, irrigation, pest management, grain storage, animal husbandry, construction and agricultural work also refer to as domestic tasks (carrying water or fuel-wood, etc). The distinguishing characteristics of agricultural work is the fact that it is carried out in a rural environment where there is no clear-cut distinction between working and living conditions. As agricultural work is carried out in the countryside, it is subject to the health hazards of a rural environment as well as those inherent in the specific work processes involved (ILO, 1996). Due to the nature of agricultural work, workers in this sector are prone to many hazards; hence, there is a need for farm safety programme for workers. Recent innovation in agriculture has also added drastically to the dangers or hazards faced by farm workers. Effective health and safety programme should be in place to mitigate the effect of such hazards.

Nigeria has little or no data on workers health and safety record in agriculture probably because the workers are peasant and rural dwellers coupled with the fact that they are insensitivity to the role safety can play in the development and productivity of the sector. The dearth of information on the economic relationship of farm safety and ROI especially in agriculture with focus on a developing country like Nigeria stimulated this research. This research intends to bridge this gap by assessing the economic implication of farm safety practices on agriculture in Nigeria.

MATERIALS AND METHODS

This study was carried out in Ibadan metropolis in Oyo State, Nigeria. The state has thirty-three local government areas. Its population is 1,338,659 according to census results for 2006, with coordinates 7°23′47″N, 3°55′0″E and Area 1,189.2 (3,080 km^2). Ibadan has a tropical wet and dry climate, with a lengthy wet season and relatively constant temperatures throughout the course of the year. Ibadan wet season runs from March through October, though August sees to an extent a break in precipitation. This lull nearly divides the wet season into two different wet seasons. The remaining months form the city's dry season. Like a good portion of West Africa, Ibadan experiences harmattan between the months of November and February. Agriculture is the main occupation of the people of Oyo State. The climate in the state favours the cultivation of crops like maize, yam, cassava, millet, rice, plantains, cocoa, palm produce, cashew, etc (Ibadan Wikipedia, 2011). Data were obtained using a health and work performance questionnaire coupled with structured interview schedule, administered to 100 respondents with agriculture as the primary occupation. These respondents were randomly selected from the faming population in the area; this was supplemented with secondary data from reports, publications and internet. Simple statistics such as mean, mode, and Likert scaling were used for the data analysis. BOI are the cost

Table 1. Result.

Demographic characteristics	Frequency	%
Age (years)		
20-30	30	30
31-40	40	40
>40	30	30
Sex		
Males	80	80
Females	20	20
Marital status		
Single	20	20
Married	80	80
Religion		
Christianity	40	40
Islam	40	40
Traditional	20	20
Educational background		
No formal education	30	30
Primary	45	45
Secondary	15	15
Tertiary	10	10
Hazard awareness		
Yes	40	40
No	60	60
Personal protective equipment (PPE) usage		
Yes	20	20
No	80	80

of occupational injuries and ROI is the returns on investment.

RESULTS AND DISCUSSION

Table 1 reveals that 80% of the respondents were male, signifying a male dominated occupation, with a modal age group of 31 to 40 which denote age range of vigour and strength. 10% of the respondents had tertiary education, and 45% had primary education as the highest educational level attained, which implies that they have little or no formal education which has be proven to have a strong tie to adoption of innovation and modern practices. This study revealed that 60% of the respondents are not aware of any inherent hazard in agriculture, this connote the fact that health and safety in agriculture as it relates to occupational health and safety is at a lower ebb in the country; hence, there is a need for awareness campaign. Also, 80% of the respondents do not use any form of personal protective equipment which still reflect the poor awareness level.

Health and work performance questionnaire (HPQ) questions response

Statistics of respondents that have experienced one form of discomfort in the past 12 months related to their occupation

Figure 1 reveals that 80% of the respondents had wrist/hand injury, 75% had lower back pain and 55% knee injury in the last 12 months resulting from their job which shows that occupational injury in agriculture is prominent, which is probably due to the poor awareness level of stakeholders in the sector in identifying the roles that health and safety can play in maximizing productivity.

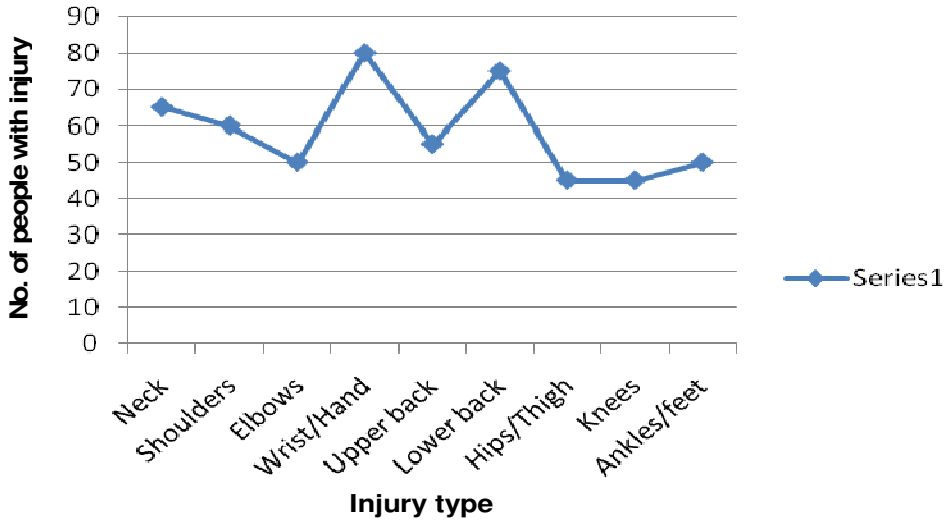

Figure 1. The distribution chart of injury and type

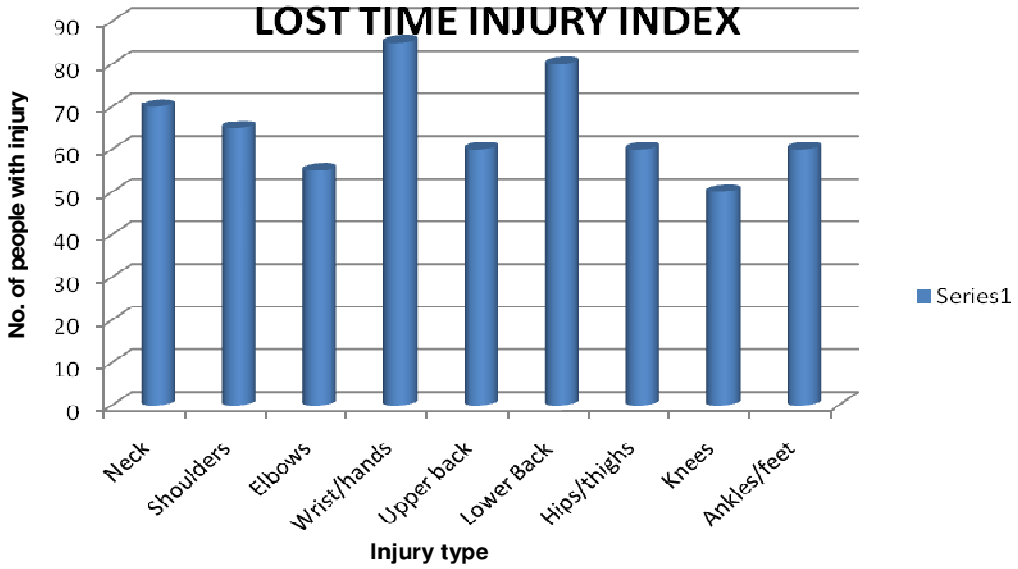

Figure 2. Lost time injury index chart

Statistics of respondents that have at any time during the last 12 months been prevented from doing their work because of discomfort in their body part

Figure 2 reveals that 80% of the respondents have been prevented from doing their job as a result of wrist/hand injury and 75% have also been prevented as a result of lower back injury. These occupational injuries or work related injuries have resulted in lost time or lost production and restricted work cases which has reduced productivity. The study also revealed that poor information and awareness (27.6%) and cost implication (26.9%) rank first and second in the adoption constraints list for farm safety programme, respectively. This fact could be linked to poverty and unavailability of farm accidents record and other information on farm safety in Nigeria.

RECOMMENDATIONS

Based on the findings of this study, the following are recommended:

(1) Formulation and implementation of farm safety policies in Nigeria.

(2) Adequate information dissemination on farm safety.
(3) Workers in agriculture should be educated/trained on agricultural hazards and means of prevention.
(4) Massive poverty reduction programme, since it is a bottleneck to adoption.
(5) Awareness on usage and the provision of personal protective equipment (PPE) for workers ranging from hang cloves, coveralls, footwear, ear muffs at a subsidized rate.
(6) Extension agents, cooperative societies, and trade unions should be equipped with accurate information so that they can enlighten farmers on the hazards.
(7) Proper record keeping on agricultural health and safety should be encouraged for performance review.

Conclusively, the importance of farm safety to the development of the sector cannot be overemphasized. Human capital such as health has been described as a determinant for productivity, hence the wealth, financial and holistic growth of the sector is a function of the health and well being of workers in the sector. Investing in farm safety programme is therefore a win-win game, because it is better and cheaper to invest in safety rather than bear the cost of working in an unsafe environment.

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Journal of Development and Agricultural Economics Vol. 5(1), pp. 12-18, January 2013
Available online at http://www.academicjournals.org/JDAE
DOI: 10.5897/JDAE12.042
ISSN 2006- 9774 ©2013 Academic Journals

Full Length Research Paper

The structure of food demand in urban city of Nigeria: An application of a Linearized Almost Ideal Demand System (LA/AIDS)

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Accepted 4 December 2012

Household-level micro data were fitted on Linearized Almost Ideal Demand System (LA/AIDS) model to estimate the structure of starchy, animal protein, plant protein and fatty foods demand in Uyo Metropolis of Akwa Ibom State, Nigeria. Panel data used in this study came from four months household food consumption survey. Thirty responding households were randomly selected for the data collection. Estimates of LA/AIDS revealed that the budget shares of different food sub-groups for the sample households responded significantly to changes in the household size, marital status, household's head education and income levels. Using a system of equations, the estimated expenditure elasticity revealed that starchy and animal protein foods had expenditure elasticity less than zero which implies that, they are "necessity" goods; while plant protein and fat food items were "luxuries". Also, the estimated own-price elasticity coefficients were negative indicating that as the prices of each food group increase, the relative share of household expenditure decrease accordingly. Cross-price elasticity coefficients for some food groups were negative indicating they are "complementarities", while others have positive coefficients suggesting they are "substitutes". Based on findings from this study, recommendations to increase demand for these food groups are made.

Key words: Household, demand, linearized almost ideal demand system (LA/AIDS), Uyo, elasticities.

INTRODUCTION

For better growth and development, an average man needs to consume adequate quantities of different food items in the right proportions. This is referred to as "the balanced diet". Carbohydrate, protein, fats and oil, vitamins, minerals and water are the classes of food that constitute a balanced diet and which when consumed provides the body with energy, growth, development and repairs. The place of food in supplying nutrients to the growing population cannot be over emphasized, and depending on the income of the households, demand and consumption of food classes differ. While some food items are price and income elastic, others are inelastic. The general economic welfare challenges facing most Nigerian urban households affect the demand and subsequent consumption of these food items, and as a result poor households tend to demand more of starchy foods and less of protein food (FAO, 1980; Akintola and Udoh, 2002). The demand for food as it is the case for any other commodity depends on a number of factors which include income, own-price, consumer preferences, and prices of other substitutes. Demographic factors, such as changes in household size and in the age distribution of the population, can bring about changes in consumption demand for food drives production, and therefore stands out that, the more food item that is

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demanded; the more its production is encouraged.

An evaluation of the demand function for food items is very important, and needs immediate attention. Empirical studies on food demand among consumers in major Nigerian cities had received low priority among researchers even in the face of rising food demand and deficit domestic supply. This issue is further compounded by the increasing food insecurity and the geometric rise in the population of the country. The food demand function can be estimated from maximizing the utility function subject to budgetary behaviour of the consumer, in that the consumer maximizes utility from consumption, given income and the market prices of the commodity. There are various algebraic specifications of the demand system, and these include: the Linear and Quadratic Expenditure Systems, the Rotterdam model, Translog model, the Working model, and the Linearized Approximated Almost Ideal Demand System (LA/AIDS) (Taljaard et al., 2003).

The LA/AIDS model has become a choice model for many applied demand analyses, since its introduction by Deaton and Meulbauer in late 1970s. The model is the most favoured in demand analysis because it is flexible, avoids nonlinear estimation and allows for estimation of price, expenditure, income and cross price-elasticities. It also allows for wider range of variables to be included in the household demand modeling (Glewwe, 2001; Barnett and Seek, 2008). Besides, its application could be of interest especially in Akwa Ibom State where food demand analyses are uncommon. The rationale for this research is that very few economic researches have been conducted on estimation of food demand in Uyo metropolis. As a result, it can be said that estimates for food demand elasticities needed for demand projections for food items do not exist in the metropolis for many products. Hence efficient economic policy on food demand in the state which is hinged on the availability of reliable food demand function estimates could be jeopardized. Therefore, this study is basically aimed at estimating staple food demand parameters in Uyo metropolis in Akwa Ibom state. The estimated elasticities can be used to measure the impact of agricultural policies and to predict the future consumption in the context of food security in terms of access, availability, stability and food quality.

METHODOLOGY

Study area

The research was conducted in Uyo Metropolis, in Uyo local government area of Akwa Ibom State. Uyo is one of the 31 local government areas of Akwa Ibom State. It is centrally located and lies between latitude 5.05° North and longitude 80°East within the equatorial rainforest belt. Uyo has a dual status as a state capital and a local government headquarters. It is bounded by Abak, Itu, Uruan, Ibesikpo Asutan and Etinan local government areas. Uyo has a population of 309,573, consisting of 153,113 males and156,460 females (National Population Commission, 2006).

Sampling size and sampling procedure

A Multi-stage random sampling procedure was used to select households from different streets in Uyo Metropolis. First, five streets were randomly sampled among major streets in Uyo metropolis. The streets were Abak road, Nwaniba road, Ikot Ekpene road, Aka road and Ikpa road. The second stage involved a systematic sampling of six households in each of the selected street using sampling interval of 10. A total of 30 households were selected in this study area for data collection. The selected households were visited once weekly and consistently for a period of 16 weeks. We choose this period to enable the sampled households to express fully the demand pattern for all listed food groups.

Aids model specification

According to Deaton and Muellbauer (1980), the AIDS model is usually specified as:

$$W_i = \alpha + \sum_j^n \gamma_{ijn} LnP_j + \beta_i Ln(X/P) + \mu_i \quad i = 1, \ldots, n \tag{1}$$

where, W_i is the budget share of the i^{th} good (that is, $W_i = P_i Q_i / X$); P_j is the weighted average price of items in group j^{th}; X is the total expenditure on the group of goods being analyzed; μ_t is the random error term; P is the translog price index of group of goods being analyzed and is defined as:

$$LnP = \alpha_0 + \sum \alpha_j LnP_j + \frac{1}{2}\sum_i^n \sum_j^n \gamma_i LnP_i LnP_j \tag{2}$$

When Equation (2) is integrated into Equation (1), the system becomes non-linear, thus complicating the estimation process. To overcome this problem, the Stone's price index defined in Equation (3) was used instead of the translog price index in Equation (1) according to Deaton and Meulbauer (1980) and Sasaki (1993).

$$LnP^* = \sum_{i=1}^n W_i LnP_i \tag{3}$$

The resultant model is called Linearized Approximate AIDS Model (LA/AIDS) (Blanciforti et al., 1986; Wessells et al., 1997; Balcombe et al., 2003; Jeffry and Brown, 2008). The substitution of the Stone's price index for the translog price index causes a simultaneity problem, because the dependent variable (W_i) also appears on the right-hand side of the LA/AIDS model (Eales and Unnevehr, 1988). To eliminate this problem, we replaced W_i in equation 3 with its predicted value W* which is then inserted into equation 4 yielding the unbiased LA/AIDS expressed as:

$$W_i = \alpha_i + \sum_j^n \gamma_{ij} Ln P_j + \beta_i \left(LnX - \sum_{i=1}^n W^* Ln P_i \right) + \mu_i \ldots \tag{4}$$

Equation 4 was further transformed by incorporating the socioeconomic characteristics of responding households into it. The resulting Equation (5) was then applied to the empirical data, and the estimated parameters were used to calculate the required elasticities and also to represent the effect of socio-economic characteristics of respondents.

$$W_i = \alpha_i + \sum_j^n \gamma_{ij} Ln P_j + \beta_i \left(LnX - \sum_{i=1}^n W^* Ln P_i \right) + \sum \varphi V + \mu_i \tag{5}$$

Table 1. AIDS model for household demand for starchy food in Uyo metropolis (budget share for starchy food).

Variable	Coefficient	Standard error	t-value
Constant	0.006	0.029	0.207
Sex	0.005	0.005	1.016
Age	0.001	0.000	1.383
Marital status	0.000	0.003	-0.097
Education	0.001	0.001	0.945
Household size	0.093	0.032	2.909**
Household income	-0.024e-08	0.008	-2.735***
Effect of real income (β_i)	-0.047e-05	0.009	-5.000***
Weighted unit price of starchy food (γ_{ij})	0.084	0.019	4.353***
R^2	0.768		
F statistics	8.701 ***		

, and * represent 5 and 1% levels of significance. Source: Results from LA/AIDS model.

From j = 1… 4 differentiated food item classes. In this study, the four food classes were starchy food; animal protein; plant protein; fats and oil. α_i = average value of the budget share of food items; β_i = effect of real income on the budget share of the food items; γ_{ij} = effect of the prices of items in group i[th] on the budget share of item i[th] φ = coefficients of household socio-economic variables; V = vector of socio-economic variables of responding households defined as follows: Sex = dummy variable (male = 1 and female = 0); Age = age of household head measured in years; HHS = household size measured in numbers; Marital status = dummy variable (married =1 and unmarried = 0); Education = years spent in formal education by the household head; Income = household's head income measured in naira (₦); Other variables are as defined previously in Equations (1) to (4).

Following the above specifications, the expenditure, own-price and cross-price elasticities of demand for the four groups of food were computed using the estimated parameters of the LA/AIDS model. The close approximate formulae for computing coefficients of elasticity for the food groups are given by Equation (6), (7) and (8) respectively (Jabarin and Al-Karablieh, 2011; Adejobi et al., 2009; Taljaard et al., 2003 and Abdulai and Jain, 1999).

Expenditure elasticity:

$$(E_{ij}) = 1 + \left\{\frac{\beta_i}{W_i}\right\} \quad (6)$$

Own-price elasticity

$$(E_{ij}) = \frac{\gamma_{ij}}{W_i} + (\beta_i - 1) \quad (7)$$

Cross – price elasticity

$$(E_{ij}) = \left(\frac{\gamma_{ij}}{W_i}\right) - \left(\frac{\beta_i W_j}{W_i}\right) \quad (8)$$

RESULT AND DISCUSSION

The result of the estimation of LA/AIDS model as specified in equation (5) for the starchy food is shown in Table 1. The diagnostic tests revealed the R^2 value of 0.768, which implies that about 76.80% of total variability in the budget share of starchy food is jointly explained by the specified independent variables in the model. The F statistic of 8.701 is statistically significant at 1% probability level; this means that the R^2 is significant. This result attests to the overall goodness of fit of the LA/AIDS specified regression model.

The empirical results in Table 1 showed that the household size, household's income, effect of real income, weighted unit price of starchy food are significant variables that affect the budget share of starchy food among responding households in this study area. The budget share of starchy food has a positive inelastic relationship with the respondent's household size and weighted unit price of starchy food. This implies that 10% increase in the household size and weighted unit price of starchy food would lead to a less than 10% increase in budget share of starchy food. Also, a 10% increase in the household's income level and effect of real income would lead to a less than proportionate increase in the budget share of household demand for starchy food. This result with respect to household size and income appearing as important demand shifters collaborates the finding of Akintola and Udoh (2002).

Table 2 shows the estimates of LA/AIDS model for plant protein food. The R^2 explains about 92.40% of total variation in the budget share of protein food that is attributed to the specified independent variables in the model. The F statistic of 31.70 is statistically significant at 1% probability level; this means that the estimated R^2 is statistically significant. The empirical result showed that marital status, household size, household income level, effect of real income on the budget share of plant protein food (β_i) and weighted unit price of plant protein (γ_{ij}) were statistically significant and had positive inelastic relationships with the budget share of household demand for plant protein foods. The results imply that 10% increase in these variables would result in a less proportionate 10% increase in the dependent variable.

Table 3 revealed the estimates of LA/AIDS model for animal protein food in this study area. The diagnostic

Table 2. LA/AIDS model for household demand for plant protein foods on Uyo Metropolis (budget share for plant protein food).

Variable	Coefficient	Standard error	t-value
Constant	-0.064	0.037	-1.725*
Sex	0.002	0.009	0.273
Age	-9.814e-05	0.001	0.147
Marital status	0.014	0.005	2.752 ***
Education	0.013	0.009	1.391
Household size	0.006	0.001	4.214***
Income	0.028e-08	0.009	2.968***
Effect of real income (β_i)	0.009	0.002	3.625***
Weighted unit price of plant protein (γ_{ij})	0.000	0.000	12.707***
R^2	0.924		
F statistics	31.703***		

*, and *** represent 10 and 1% levels of significance. Source: Results from LA/AIDS model.

Table 3. LA/AIDS model for household demand for animal protein foods in Uyo metropolis (budget share for animal protein food).

Variable	Coefficient	Standard error	t-value
Constant	-0.194	0.139	-1.392
Sex	0.035	0.034	1.024
Age	0.000	0.002	0.099
Marital status	0.008	0.018	0.457
Education	0.016	0.006	2.779***
Household size	-0.084	0.014	-5.971***
Income	0.126e-07	0.068	1.865*
Effect of real income (βi)	-0.002	0.001	-1.738*
Weighted unit price of animal protein (γ_{ij})	0.036e-05	0.011	3.374***
R^2	0.569		
F statistics	3.470***		

* and *** represent 10 and 1% levels of significance; Source: Results from LA/ AIDS model.

tests revealed that the F- statistic was significant at 1%, and this showed the overall correctness and fitness as well as the significance of R^2 in the estimated model. The R^2 however indicates that, explanatory variables in the model explain about 56.90% of total adjusted variation in the budget share of household income that is spent on animal protein food. However, the size of the R^2 is moderate, which indicates that other important determinants of budget share spent on animal protein food may not capture in the model.

The slope coefficients of education, household income level and weighted price of animal protein are positive and significant determinants of the share of household budget spent on animal protein food. On the other hand, the household size and effect of real income (β_i) had negative inelastic relationships with the dependent variable. This implies that, 10% increase in the household size and effect of real income (β_i) would lead to a less than proportionate increase in the dependent variable. Also, 100% increase in the education, household income level and weighted price of animal protein would lead to a less than proportionate increase in the budget share for animal protein food. Table 4 showed the estimates of LA/AIDS model for fatty food in this study area. The diagnostic statistics revealed that the F statistic (5.30) was significant at 1%, and this showed the overall goodness of fit as well as the significance of R^2 in the estimated equation. The R^2 of 66.9 indicates that, explanatory variables in the model explains about 66.90% of total adjusted variation in the budget share of household income that is spent on fatty food.

The empirical results showed that education of household head, the real income on the budget share of fatty food items and weighted price of fatty food have positive significant impact on the budget share of fatty food out of the total food expenditure. The results reveal

Table 4. LA/AIDS model for household demand for fat foods in Uyo metropolis.

Variable	Coefficient	Standard error	t-value
Constant	-0.059	0.088	-0.667
Sex	0.004	0.020	0.209
Age	0.000	0.001	-0.167
Marital status	0.004	0.011	0.354
Education	0.049	0.021	2.348**
Household size	-0.003	0.008	0.336
Income	-7.750e-08	0.000	-0.619
Effect of real income (β_i)	0.047	0.011	4.203***
Weighted unit price of fatty food (γ_{ij})	0.173	0.045	3.833***
R^2	0.669		
F statistics	5.302***		

** and *** represent 5 and 1% levels of significance; Source: Results from LA/AIDS model.

Table 5. Household expenditure elasticity for food classes.

Food subgroup	Elasticity
Starchy	0.117
Animal protein	0.987
Plant protein	1.207
Fat and oil	2.042

Source: Field Study (2010).

Table 6. Household own- price elasticities for food classes.

Food sub-group	Elasticity
Starchy	-1.047
Animal protein	-1.002
Plant protein	-0.991
Fat and oil	-1.048

Source: Field Study (2010).

that education of the household head is a positive determinant of the proportion of the share of household budget spent on fatty food.

Estimation of elasticity

Expenditure elasticity

The expenditure elasticity can be interpreted as the percentage change in quantity demanded of a group of commodity when income changes by one percent holding every other variable constant. The expenditure elasticity is often used to categorize commodities into luxury and necessity. A commodity is considered luxury if the expenditure elasticity is greater than one, and necessity if unity or less than unity. The coefficient of expenditure elasticity is always positive. Expenditure elasticity for starchy, animal protein, plant protein and fat food sub-group are presented in Table 5. Expenditure elasticities for plant protein (1.207) and fatty food (2.042) are greater than one, indicating that they can be considered luxury goods. Although the expenditure elasticity for animal protein (0.987) is less than one, it is close enough to one, which is the cut-off point between luxury and necessary products. The relative low expenditure elasticity of starchy food (0.117) indicates that starchy food can be considered as one of the most necessity food items in this study area. The results reveal that 10% increase in the respondent's income would lead to 20.42, 12.70, 9.87 and 1.17% increase in the demand of fatty food, plant protein food, animal protein and starchy food respectively. The result for starchy food items confirms Bennett's law which states that starchy staple' share of the budget tends to decline as household income increase, and vice versa.

Own-price elasticity of demand

Own price elasticity measures the degree of responsiveness of the budget share allocated to various food sub-groups as their respective prices change. The own -price elasticities for starchy, animal protein, plant protein and fatty food sub-groups are presented in Table 6.
The own-price elasticities for starchy food (1.407), animal protein (1.002) and fatty food (1.048) are greater than one, implying that their prices have elastic relationship with their quantities demanded. On the other hand, the elasticity of plant protein (0.991) is less than unity, indicating inelastic relationship. The negative signs on the elasticity coefficients are indicative that as the prices of the respective food sub-groups increased the relative share (in percentage) of food expenditure decreased more than proportionately for each of the food sub-

Table 7. Household cross-price elasticity for food classes.

Food classes	Starchy	Animal protein	Plant protein	Fat and oil
Starchy	0.000	0.001	-0.009	-0.044
Animal protein	0.176	0.000	-0.003	-0.031
Plant protein	0.048	0.001	0.000	-0.008
Fat and oil	0.048	0.001	-0.009	0.000

Source: Field Study (2010).

groups in this study area. For instance, 10% increase in the price of starchy food, animal protein, plant protein and fatty food items would lead to 10.47, 10.02, 9.91 and 10.48% reduction in the demand of the respective food items. However, the result satisfies *a priori* theoretical expectation and is consistent with the Engel's finding which says that the price elasticity coefficient is normally negative.

Cross-price elasticity of demand

Cross-price elasticity is the degree of responsiveness of the share of total food budget allocated to a particular food sub-group as a result of changes in the prices of other food sub-groups. The cross-price elasticities for the different food sub-groups are presented in Table 7.

The findings revealed that the relationship among some sub-groups were negative, showing the presence of the substitutability characteristics of this groups. For instance, plant protein and animal protein have cross-price coefficient of -0.003. This implies that, 10% increase in the price of animal protein would result in 0.03% increase in the demand for plant protein. Similarly, 10% increase in the price of fatty food would lead to 0.44% increase in the demand of starchy food. The findings also revealed that some sub-groups had positive relationship among them, implying the existence of complementarity in the sub groups. For instance, a 10% increase in the prices of animal protein would cause about 17.60% increases in the demand for starch food and vice versa. Similarly, 100% increase in the price of starchy food would result in 4.80% increase in demand of plant protein and fatty foods respectively.

CONCLUSION AND RECOMMENDATIONS

This study fitted LA/AIDS model using panel data derived from households in Uyo metropolis. The model results provide statistical estimates and prove the theoretical expectation regarding the demand for certain food type in this study area. For instance, the expenditure elasticities of all food classes have positive signs, implying that as income increases, food demand will increase too. Also all food classes had negative own-price elasticities of demand, which implying that they satisfy a priori demand theory and are thus normal goods. Furthermore, the estimates of the cross-price elasticity reveal that the food sub groups studied have both positive and negative signs implying that some food types are complementary while others are substitutes. Based on results of these findings, we recommended that policies to increase the income and improved working conditions of the households in this study area should be formulated so as to enhance their purchasing power. Government should also formulate policies that help to stabilize food prices so as to enhance household's minimum daily food requirement and encourage appropriate consumption of different food classes.

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Journal of Development and Agricultural Economics Vol. 5(1), pp. 19-34, January 2013
Available online at http://www.academicjournals.org/JDAE
DOI: 10.5897/JDAE12.120
ISSN 2006- 9774 ©2013 Academic Journals

Full Length Research Paper

Cotton institutions and perverse incentives for fertilizer traders in Benin

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Accepted 22 November, 2012

Agricultural development in Benin is constrained by low productivity mainly due to low use of mineral fertilizers and improved seeds. After more than two decades of the cotton state company's monopoly, a market liberalization program is being implemented since the 1990s but still fail to meet farmers' needs for quality fertilizers and efficient supply-chain services. This paper discusses Benin's state-controlled licensing system, which forms the market liberalization program's institutional basis. Empirical evidence is given of the relationships between the theory of institutions and transaction costs, and its application in the fertilizer supply chain management. In Benin, the licensing system particularly illustrates a case of institutional failure, where distorted rules of the game and collusion between traders and market regulation institutions in the play of the game provided perverse incentives to private oligopolies in the liberalized market. Indeed, the distortions were beneficial for the trade alliances which were in a position to largely influence the setting and application of the rules, thereby discouraging other traders to compete with better fertilizer quality and marketing service delivery. Tests on operations management, competition and entrepreneurship were performed to demonstrate that competition is lacking, and that in this condition other traders cannot create value in the cotton-oriented fertilizer supply-chain and promote a liberalized entrepreneurial economy.

Key words: Cotton institutions, market liberalization, fertilizers, licensing system, perverse incentives, competition, entrepreneurship, operation management, marketing service delivery.

INTRODUCTION

Agriculture in Benin contributes about 35% to GDP and employs 80% of the active population, but its annual growth (3.6% in 1990 to 2005) is still below population growth (3.2% p.a.). Cotton provides about 37% of the country's export revenues and 70% of agricultural exports (AProCA, 2008; Kpadé, 2011). It accounts for about 80% of fertilizer use (IFPRI-LARES, 1998; Adegbidi et al., 2000; Honfoga, 2007). However, low productivity and non-sustainability of agriculture in cotton zones has become real development concerns. Although these zones are the most suitable for agricultural production, cotton yields are low (in average 1 kg/ha against a potential of 3500 to 4000 kg/ha) due to low and decreasing fertilizer use per ha, while food crop production is lagging far behind and cannot meet the growing urban food demand.

Specific policies which intended to promote food crops include, among others: (a) the "Orientations de la Politique Economique du Bénin" or "Directives for Economic Policy of Benin" (1995 to 1997), which set precise targets for main food crops with the aim of linking them to more rewarding markets; and (b) the "Programme National de Sécurité Alimentaire (PNSA)" (2008 to 2015), a comprehensive food security program aiming to increase food availability and accessibility through production intensification, agricultural diversification and value-chains development. The PNSA has become part of the "Plan Stratégique de Relance du Secteur Agricole (PSRSA)" or "Strategic Plan for Boosting the Agricultural Sector" (2009 to 2015). These

policies evolved from implementation, review and rectification of structural adjustment programs, but in the practice they have not been visible in enhancing food crop production. In general, the terms of trade of cotton-producing countries have been declining since the mid-1990s and recent increases in fertilizer prices are more than three times crop price increases (Ivo, 2008).

Structural adjustment programs (SAPs) have been implemented in Benin during the mid-1980s to limit the state budgetary deficits and restore productivity and economic growth (Minot et al., 2000; Minot and Daniels, 2002). In the early 1990s, SAPs became effective in the agricultural sector, and the private sector was encouraged to take up inputs' procurement and distribution, especially for cotton production with regard to its contribution to the country's economy. In the early years of market liberalization, fertilizer consumption dropped but increased rapidly thereafter as a result of the cotton boom in 1994 which followed the CFA franc devaluation; in 1999, it reached 114,000 metric tons, the highest level ever observed in the country. Between 1999 and 2000, total fertilizer consumption dropped by 40%, when the state marketing board (SONAPRA) withdrew from the input market but remained the major seed cotton buyer in the country. Thereafter, in spite of a slight recovery in the northern regions, fertilizer consumption remained around only 80,000 metric tons/year until 2004. Average fertilizer use intensity was only 10.4 kg/ha in 2004, and crop yields, especially for food crops, remain far below the potential. In 2005, total consumption fell to 50,000 metric tons (SNV, 2005). The subsector's recovery remained slow so far. This backward trend unveiled the confusions in the cotton sub-sector's institutional reforms and the subsequent market crisis.

Considering the strong relationships between economic development, agricultural productivity increase and fertilizer use (Mokwunye et al., 1996), this paper addresses the impediments to fertilizer use in Benin with particular emphasis on domestic market-related constraints. The following sections include: (1) a short literature review that brings forth the main concepts of the study; (2) analytical methods and hypotheses; and (3) results and discussion, including: an overview and discussion on the rules of the game in the fertilizer market in Benin (licensing system); the play of the game in response to that system, along with changes in the cotton sub-sector; an analysis of the quality of distribution service and incentives in the supply-chain, through a discussion on marketing services and prices prescribed by the licensing system. This leads to the test on operations, that is, hypothesis 1: higher profits accrue from superior quality; the tests on competition and entrepreneurship (hypotheses 2 and 3) through a discussion that highlights the impediments to both concepts by the licensing system and the perverse incentives for traders thereof. Finally, conclusion is drawn and policy recommendations formulated.

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

Liberalization and institutions in West-African cotton sub-sector

Effective agricultural development policies are once more at the centre of international development policy and research, as the 2008 World Development Report "Agriculture for Development" testified. A rethink was prompted by the disappointing outcomes of market liberalization and structural adjustment policies implemented over the last 30 years. Despite early expectations, these policies have not generally resulted in increases of yield or market volume of food and cash crops (Shepherd and Farolfi, 1999; Poulton et al., 2004; Dorward et al., 2004). The explanations for this disappointing state of affairs include incomplete implementation of liberalization policies, with poor sequencing and policy reversals (Jayne and Jones, 1997; Jayne et al., 2002); weak market institutions, property rights, information systems and infrastructure (World Bank, 2002); and transaction risks and coordination problems in smallholders' commodity chains (Dorward et al., 1998; Dorward, 2001). Therefore, African governments are now tempted to reconsider the organization of their agricultural markets and assess the functioning of the institutions that supervised the agricultural supply chains so far.

Liberalization of the cotton subsector in Benin aimed at a more efficient allocation of resources by means of responsible institutions which would establish transparent regulations to encourage competition among private entrepreneurs. The shift was worth it, as adjustment policies in the past were regularly criticized to have neglected the need for coordination in the chains (Kydd and Dorward, 2004; Poulton et al., 2004). Yet, in spite of that shift the results have been disappointing. The new institutions seem to reflect the interests of some stakeholders that have been successful in defending their positions. Studies in other countries reveal that political motivations explain the distortions that occurred in liberalized African agricultural markets. These include: dependency on former colonies for foreign trade and protection of interest groups such as pre- or post-colonial wealth clusters (North, 1994); deficit of democracy and poor legal settings (Hodgson, 1998); rent-seeking behavior of public agents, corruption and diversion of newly established market institutions from transparency (Wallis and Dollery, 1999; Ellis, 1992; Dedehouanou, 2002); and finally limited access to information due to class-oriented diffusion (Atkins and Bowler, 2001), high illiteracy rate among consumers, poor communication infrastructure and absence of independent market information systems. As a result, transactions costs are high in African liberalized agricultural markets, as institutions failed to enforce transparent rules that encourage competition among traders.

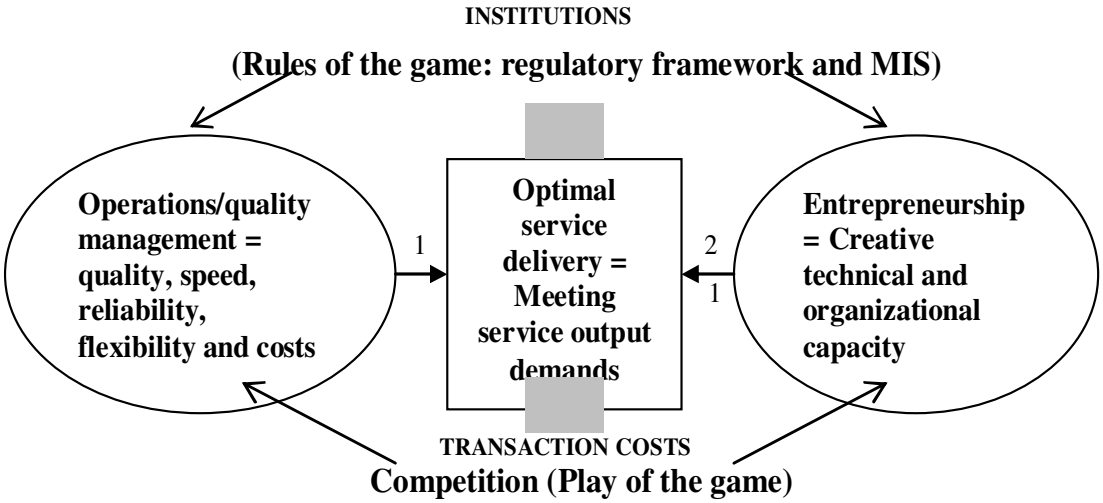

Figure 1. Traders and supply chain management in the business environment. MIS = Market information systems; 1 = Cost reduction strategies and innovations; 2 = Innovations for harnessing profitable business opportunities. The dominant type of innovations is on top of the arrow. The combination of 1 and 2 by traders evolves with time (technological progress and institutional maturity), leading to the dynamic efficiency of a market chain

There is a widespread consensus that existing institutions that coordinate exchange in African agricultural supply chains are deficient and form a major explanation for the disappointing agricultural production (Fafchamps and Gabre-Madhin, 2001). The theory of institutional economics provides the theoretical foreground to understand the strength of this argument.

North (1991) defines institutions as follows: "Humanly devised constraints that structure political, economic, and social interactions. They consist of both informal constraints (sanctions, taboos, customs, traditions and codes of conduct) and formal rules (constitutions, laws, property rights)." Consequently, institutions are rules that coordinate transactions between firms in the supply chain and therefore determine the incentive system for each of the actors involved. Understanding these incentives helps explain why certain business relationships flourish while others perish. Indeed, institutions are important to understand the business relationships between firms in the chain. The more institutions will be prompt to promoting transparent trade rules, the lower transactions costs will be. Good institutions create transparency in the market, help reduce transaction costs in the supply chains by formulating clear rules of the game, and enable smooth negotiations and contract drafting among channel members. Williamson (2000) uses a similar approach and makes a distinction between two concepts: institutional environment and channel governance. The institutional environment, that is, the rules of the game, refers to constitutions, laws and especially property rights. Such an institutional environment, which is laid on good governance by public trade regulatory agencies and market information systems, forms the basis for competition and allows efficient operations' management in the supply chains by traders. Channel governance, that is, the play of the game, concerns the attempts of economic actors to adjust their incentive structures to the institutional environment and take advantage of the given opportunities. In order to understand the changes in fertilizer distribution in Benin, this study applies these concepts. The rules of the game define the formal rules, while the play of the game shows how actors reacted to these formal rules and grasped available opportunities.

Traders apply their innovativeness (creative technical and organizational capacity) to increase their efficiency in service delivery (entrepreneurship). This leads to lower costs of operations, more profitable business opportunities harnessed, and better quality of services tailored to the needs of consumers. In Figure 1, institutions indirectly influence entrepreneurs, but directly determine the conditions for competition (vertical shadowed band). Subjected to these conditions, traders/entrepreneurs operate along the horizontal arrows with the goal of optimal service delivery.

Liberalization of fertilizer distribution is constrained by the fact that major economies of scale exist (Geroski et al., 1990). This implies that small scale entry is difficult and, therefore, monopoly power may dissolve the positive effects of liberalization. In the specific market under study, this implies that the actions of the relatively powerful fertilizer distributors need to be regulated in order to protect the fragile position of farmers.

The rules of the game should accommodate this danger and prescribe some appropriate limits for the play of the game. Yet, over-emphasizing this concern (that is, regulatory prescriptions and controls) may hamper competition and block innovative propensity or entrepreneurship. Liberalization needs regulation but also

encouragement for entrepreneurship. This paper describes formal institutions that regulate fertilizer market in Benin and how they are enforced. It aims to contribute to understanding why market performance is disappointing.

Trade operations, supply chain management, marketing flows and quality of service delivery

A supply chain is the succession of market actors who ensure the transfer of goods from its place of production to where consumers want to get it. It is economically efficient when trade operations (marketing flows) are conducted at the lowest costs possible, according to the knowledge and techniques available to provide consumers with the product at desired quality (ILRI, 1995; Coughlan et al., 2001). The desired quality embraces physical and non-physical aspects. It proceeds from the quality of marketing flows' management or supply chain management by traders. Such management includes the methods of selling and buying, which implies a careful study of how to deliver various marketing services, and to design specific approaches to satisfy different client groups or market segments (Coughlan et al., 2001).

Competition and entrepreneurship

Competition refers to a situation where traders can propose different quality levels of marketing services at prices that correspond to consumers' choices and reflect the lowest costs possible, under a regulatory setting that prevents cheating or abuse of consumers. Entrepreneurship includes strategies developed by entrepreneurs to harness business opportunities and meet consumers' demands. As opposed to planning, entrepreneurship is driving liberalized economies (Audretsch and Thurik, 2004). In the modern entrepreneurial economy, business formats evolve quickly and firms have to innovate continuously. According to the principles of entrepreneurship in the market process (Kirzner, 1991), traders/entrepreneurs combining their knowledge of information gaps with their ability to harness profitable business opportunities is the key to a dynamic trade that fosters economic develop-pment. Entrepreneurship implies that the remuneration structure encourages entrepreneurial initiatives. In liberalized markets, traders should be encouraged to diversify their supply-chains through relevant innovations in service delivery. At the same time, they should be allowed to harness the benefits of their innovative efforts by institutions that facilitate the process of 'rules of the game and play of the game'. Indeed, the role of goods trade institutions is to allow a commensurate share of innovation benefits among channel members, an attitude that fosters the provision of better services to consumers.

Competition, entrepreneurship and operations management are normally correlated, and this is even unavoidable (Figure 1). Entrepreneurship and operations management refer to the internal management of the supply-chain, that is, the conduct of channel flows by the members of the supply-chain, while competition refers more to the external environment of the chain. Competition is bound by market institutions that should prevent unlawful rush to clients and encourage traders' inclination for trade ethics and quality service delivery. In the play of the game, traders develop initiatives to adapt themselves to, or to take advantage of the rules of the game set by institutions in the sense of reducing transaction costs and searching new profitable market opportunities, for example, new business-to-business or business-to-consumers relationships (Ghauri et al., 2003). In doing so, they embark on entrepreneurship in the market process and innovate for a greater satisfaction of consumers (Kirzner, 1991).

On the contrary, if traders negatively adapt to the regulatory framework by colluding with, or diverting market institutions from transparency, then such institutions are weak or rent-seeking driven, and may be therefore giving perverse incentives to traders. Overall, anything that reduces or hampers the economic performance of the supply-chain, especially by giving abnormal advantages to traders at the expense of consumers, is negative and called in this paper "perverse incentive for traders". Therefore, if the tests on competition and entrepreneurship lead to rejection of the related hypotheses—a result that should be the same for the test on operations—then perverse incentives are prevalent in the marketing system.

Analytical framework and hypotheses

This analysis of the liberalized fertilizer market in Benin consists of three building blocks which derive from a practical operationalization of the conceptual framework. Firstly, it describes the rules of the game and the play of the game, and the institutional changes that occurred therein, through an analysis of institutions and supply chains, and how coordination of transactions evolved. Secondly, it highlights quality of distribution service and incentives in the supply chains: higher profits should come from delivery of superior quality of service; a method is developed to measure the quality of distribution service and its relationship with distribution costs and firm profits. Finally, it explains the nature of competitive pressures and entrepreneurship in the fertilizer market in Benin. This involves an analysis of how competition and entrepreneurship are influenced by the institutional environment.

Therefore, the three major tests: test on operations, test on competition and test on entrepreneurship are done to verify the following hypotheses, using qualitative/-

descriptive and quantitative methods:

Hypothesis 1: There is a positive correlation between service quality index and profitability, that is, profits are being harnessed by entrepreneurs as a reward for their innovative efforts for quality improvement.
Hypothesis 2: A transparent market control/regulation system that encourages dynamic efficiency exists to legitimize the issuing of import licenses to traders and encourage competition in Benin.
Hypothesis 3: Liberalized market institutions foster entrepreneurship, that is, such institutions enable traders to innovate in service delivery (meeting the desired service output demands), and to gain the accruing benefits (incentive structure) while being responsible for eventual damages to society.

The empiric model used here illustrates the relationship between the theory of institutions and transaction costs on the one hand, and its application in supply chains through operations management, competition and entrepreneurship on the other hand. Now, we describe for each test the variables or specific chain performance criteria for which data were collected.

Test on operations

Operations management generally distinguishes five performance criteria: quality, speed, reliability, flexibility and costs (Slack and Lewis, 2002; Dornier and Fender, 2007). Quality refers to the physical characteristics of the product. Speed concerns the time the operations take. Reliability verifies whether delivery promises are kept and flexibility refers to ability to change the operations at clients' request. Finally, the cost component analyses whether the operations are conducted at the lowest costs that are congruent with desired quality grades of marketing service (Coughlan et al., 2001). Some of these performance indicators are used in this paper to assess the effectiveness of fertilizer distribution in Benin. The test of hypothesis 1 will put emphasis on the 'quality-cost' relationship. For the purpose of empirical analysis, the quality of distribution service is broken into three major categories of marketing services, as usually distinguished in the fertilizer marketing literature: 'fertilizer quality' (nutrients' content and physical characteristics), 'availability' (storage facilities and supply network management) and 'accessibility' (price, promotion, credit and client approach packages). Hypothesis 1 is tested to verify the congruence between quality management (product's quality, availability, accessibility) and cost. Indeed, in a functioning market system good performance needs to be remunerated by the system. This means that in regions where farmers have high service delivery expectations, the profits of fertilizer suppliers need to be relatively high. If the relation is negative the market system provides perverse incentives.

Test on competition

Hypothesis 2 relies on the concept that in a competitive environment, legitimacy of market institutions is key to supply chain efficiency and good market performance, that is, an autonomous market authority exists to avoid monopoly power using a transparent market information system with equal access for all customers.

Test on entrepreneurship

Hypothesis 3 is drawn on the idea that in underdeveloped fertilizer markets, 'institutional pull' or capacity-building support to traders is more relevant than 'institutional railing' which rather set rules to limit the side effects (environmental damages, income gaps and social exclusion) of capitalistic growth in developed countries. Meeting the needs of poor farmers for sustainable food and income security should guide entrepreneurship in developing countries.

METHOD OF DATA COLLECTION

Data used for the above described tests proceed from a research conducted from 2003 to 2007 on fertilizer distribution in the liberalized cotton sub-sector in Benin. They concern fertilizer supply-chains and traders' marketing strategies under the licensing system. A field survey was done in the two main cotton-producing regions – Zou-Collines (ZA) in the center and Borgou-Alibori (BA) in the north – of the country to collect primary data on fertilizer use and farmers' evaluation of fertilizer marketing services. The sample was made of 577 farmers selected in 191 villages of 14 communes (8 in ZA and 6 in BA). Communes and villages were chosen purposively taking into account different levels of fertilizer use, crop production diversity and levels of soil degradation. Farmers were "randomly" chosen from lists of members of village-level cotton producers' organizations so as to get small-, medium- and large-scale farmers according to area cultivated. The resulting sample was therefore representative of cotton producers in the two zones. Selected farmers were interviewed on: (a) their technical skills in fertilizer use, (b) how they rate (poor or good) the marketing services presently offered to them by traders under the licensing authority's prescriptions, and (c) what improvements or different needs in future service delivery they desire (service output demands).

The fertilizer use aspect (a) addressed technological variables (area cultivated, area and crops fertilized, fertilizers quantities, doses of application, intensity of fertilizer use, rate of diffusion, complementary inputs/technologies, etc.). The service quality aspect or marketing survey (b and c) is the main data source for this paper. It addressed the total quality of marketing services (referred hereafter as 'service quality'). For both types of survey, structured questionnaires were administered to farmers from October 2004 to February 2005, while non-structured interviews were held with traders and national-level organizations and institutions involved in fertilizer distribution in Benin. These include traders' organizations and the cotton sub-sector's administration which oversees the licensing system. Additional qualitative information was also obtained through secondary sources. While the structured questionnaires provide data for the test on operations management, interviews with traders and cotton institutions, and

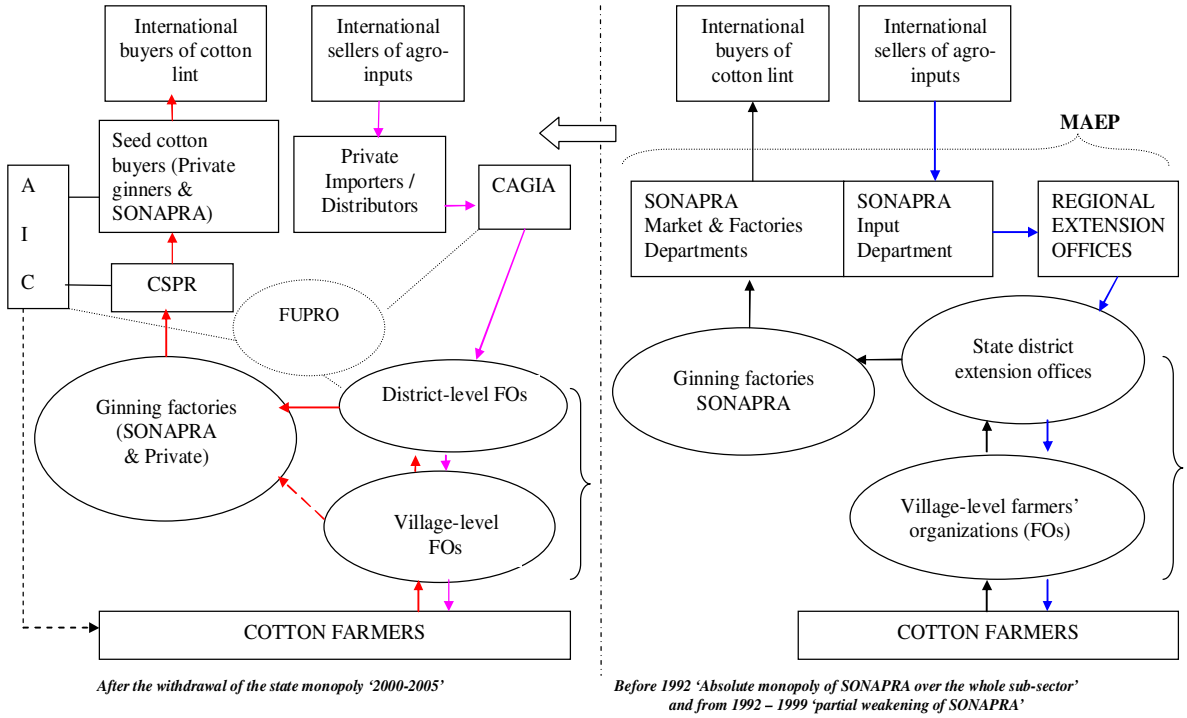

Figure 2. Changes in the cotton sub-sector institutions and operational management in Benin.

other sources of information, generated the database for the test on competition and entrepreneurship.

RESULTS AND DISCUSSION

The rules of the game in the fertilizer market and their justification in Benin

The market liberalization process in Benin evolved over 4 periods: the early years, when entry rules were established to guide and control private businesses (1992 to 1994); the cotton boom period which registered greater entry of private traders because of attractive cotton prices and input supply conditions after the CFA devaluation (1994 to 1999); the withdrawal of the state marketing board (SONAPRA), the setting-up of new market institutions in the cotton sub-sector (1999 to2005), and the "emergent Benin" period (2006 to 2012) characterized by trans-sectoral and usually shaky reforms. Data used in this paper cover the first three periods. Figure 2 illustrates the changes that occurred in the cotton sub-sector management, that is, how the state marketing board organized input supply and cotton export services before liberalization, and what happened later when the new market institutions/organizations took over. Actually, there has been a substitution of state agencies by an association of private traders' organizations and FOs', without the dedicated transfer of know-how, and monitoring and accountability mechanisms.

AIC and the rules of the game

Before 1992, input procurement and supply to farmers as well as seed cotton assembly and processing, and cotton lint export were done by the state monopoly (SONAPRA) under an integrated input-output chain management. But operations management was too costly with poor service delivery to farmers. Private traders were therefore invited to enter the cotton-and-input value-chain. The rules of the game, as set by the licensing system operational guidelines, were elaborated officially "to avoid traders' cheating/abuse on farmers, most of whom are illiterate".

With the licensing system, the government continued to control marketing flows and prices, and to set entry rules and market shares for traders from 1992 to 1999 (Adegbidi et al., 2000). The state monopoly withdrew from input supply by the end of 1999, as a result of farmers' claims in 1997 for more transparency. Then SONAPRA transferred its role to private traders' and FOs but the licensing system was not abandoned; it rather moved into the hands of some new hybrid market institutions (private sector/government/FOs) coordinated by the cotton inter-professional association (AIC). They were set up to intermediate between farmers and the international market under the same argument of farmers' illiteracy and low capacities in domestic and international business negotiations. With an overarching supervisory role, AIC was established to implement the cotton inter-professional agreement and advise the government on the cotton sub-sector policy. This agreement was the new

business regulatory framework for the sub-sector stakeholders (input importers, cotton ginning companies, farmers, government).

The licensing system prescribes the types of inputs and conditions of service delivery to farmers (pan-territorial cotton input and output prices and uniform marketing services). After liberalization, input traders who apply for a license were requested to prove that their bids meet new specifications and that they are capable of supplying timely the desired amounts of inputs on credit to cotton farmers at farm-gate.

AIC officials alleged that farmers would not accept other inputs or nutrient combinations from free riders and that no foreign factory would be willing to manufacture such new products. This had two important consequences for the distribution channel: no foreign suppliers were attracted to produce inputs in Benin; a standard package of inputs was prescribed for the whole country.

Another important licensing condition is the prescription of credit delivery on the basis of the former state controlled distribution network. This network includes village-level and district-level farmers' organizations, together with central input warehouses that belong mostly to the state district extension offices and FOs' village-level storage huts. That network was "transferred" to private traders through the inter-professional agreement, leading them to accept the compulsory credit

Descending arrows indicated agricultural inputs flows and ascending arrows are meant for cotton flows. Coordination information flows go along with products' flows, while overall supervision was ensured by MAEP via SONAPRA before 1992, and by AIC via CSPR after 1999.

Other prescriptions of the licensing system that affect costs and farm gate prices (the fifth performance criterion of operations management) include: Restriction of input bids to national importers, and the rule of "the unique lowest CIF (cost insurance and fret) price bid per product". With that rule, international reference CIF prices are ignored and only a few local firms which are tied to foreign manufacturers of the approved cotton inputs can bid the presumed lowest prices.

1. Only one distributor to supply a given district, and submission of distribution plans together with other import bid documents.
2. Compulsory whole package supply. The licensing system prescribes that input tenders should concern whole packages (fertilizers and pesticides) for which separate product-wise offers from different traders are not accepted, since only one importer/distributor is authorized each year to supply inputs to farmers in a given district. AIC officials pretended that whole packages or compulsory product association was necessary to ensure that all inputs are jointly delivered so as to avoid delays, given rainfall constraints.
3. Costs of "critical services" (rural roads works, improved seeds/crop research, agricultural extension) are relatively high. They are provided to farmers by state district extension offices under new negotiations with AIC.

Organizational arrangements for the play of the game

AIC was the main institution established to define the rules of the game and also to oversee the play of the game by private companies and FOs. Its technical branches for field operations supervision included CAGIA for agricultural inputs' distribution to farmers and CSPR for seed cotton assembly and sale to ginning companies. The inter-professional agreement specified that these operations should be conducted in collaboration with technical services of the ministry of agriculture (MAEP) in order to ensure farmers' satisfaction, that is, equitable product quality control and timely credit dispensation.

The input credit system, which is operated by the state monopoly since the 1980s, relies on forecasts of seed-cotton harvests, the latter serving as collateral for input debts. After liberalization, the credit system was maintained, officially to help farmers get timely the desired inputs on credit. The mechanism was managed via bank loans to traders, using future cotton harvests as collateral. In the past, the state monopoly was a broker in this financial arrangement with the banks. After state withdrawal from input procurement in 1999, a new governance structure for credit provision had to be developed.

A central bureau of payment security and debt recovery (CSPR) was therefore created to handle input debts' repayment through the registration of seed-cotton purchases by ginners. It was a kind clearing house for all financial transactions in the sub-sector.

Analysis of the system and test of hypotheses

Cotton institutions' dynamics and its impact on fertilizer supply chains

Group segregation among partners of the cotton inter-professional agreement: The so-called "transfer of skills to FOs", which occurred in 1999 and is materialized by the vertical braces in Figure 2, was a transfer of roles without technical and management skills for cost-effective input procurement. It concerned only local distribution (district and village level FOs) and not importation which was transferred to private import companies only. Officials (MAEP and AIC) argued that FOs are untrustworthy, most of them have illiterate leaderships and are non-registered cooperatives, and financially weak to deal with international trade; therefore, they should not be transferred the responsibility of importation, as this request world market negotiation skills. As a result, in a distorted application of the "agreement", these capacities were kept centralized within new cotton authorities (AIC,

CAGIA, CSPR), thereby keeping FOs in their blindness about the international market while the licensing system also limits their negotiation window on the domestic market.

The licensing system implicitly limits market access for non-cotton fertilizer importers

Actually, although not designed to regulate input supply for other crops, the licensing system implicitly forms the core regulatory framework for input trade in Benin, as the prescriptions on input quality refer to existing crop health regulations and affect all agrochemicals (fertilizers and pesticides altogether). Should such institutional arrangement be allowed in a liberalized fertilizer market? That is a critical question, considering the debate on the post structural adjustment failures in sub-Saharan Africa. One of the major factor constraining transparency in input tenders was that one or two importers have monopoly over 78 to 100% cotton insecticides (Bidaux and Soule, 2005), whereas the licensing system requires whole package delivery of inputs (fertilizers-and-pesticides). So, traders willing to supply fertilizers alone on more competitive prices are not allowed to bid for the tenders, unless they "negotiate" with that monopoly.

Like under the state monopoly, the new rules of the game after liberalization did not allow for any direct contractual arrangement between traders and farmers and exclude a flexible delivery of marketing services based on farmers' choices for basic utilities (form/assortment, time, place and possession). The above-discussed product quality and network prescriptions oppose operations management on the ground of four performance criteria: quality, fertilizers (and pesticides) are imposed and do not reflect the needs of farmers in different agro-ecological zones; flexibility, traders are not able to change the operations, for example. if weather predictions indicate risks for crop failure; speed, bureaucratic procedures lead to delays in product delivery to farmers; reliability, farmers and traders have to await the government's communiqué on approved pan-territorial prices before input procurement and distribution operations can start. Sometimes, inputs are already imported (because of the time pressures of rain-fed agriculture) before official prices are announced, which means the latter are irrelevant in the reality. Dedehouanou (2002) and Minot and Daniels (2002) observed that the new hybrid organizational structure seems to have been established as a shadow-cover for resisting the changes which were recommended by liberalization think-tanks (the World Bank namely).

Market entry control by CSPR and credit dispensation to fertilizer importers

Huge amounts of money are required to import fertilizers whilst farmers' purchasing power is low. Most cotton farmers also produce food crops and have relied until then on a state-controlled country-wide credit system to get fertilizers. Apparently, the licensing system aimed not only to guarantee credit-based access to agricultural inputs, but also food and income security for farmers, most of whom are presumed to be poor, and have limited cash to buy inputs (Minot et al., 2000) nor have they collateral to get loans from formal banks. Therefore, since the time of the state monopoly, future seed cotton harvests were used by the government as collateral for bank loans for fertilizers importation. After liberalization, the licensing system kept this arrangement, and managing business ties with seed cotton buyers (ginners) became critical for private fertilizer importers to enter the market. But such ties were artificially regulated. Indeed, CSPR went beyond a simple registration of private ginners for adequate bank loans dispensation, and requested that they should deposit 40% of their future purchase value before they would be allowed to buy seed-cotton on farmers' fields.

AIC officials defended the new institutional arrangement (especially the seed-cotton purchase regulation) based on the following grounds: (a) the 40% deposit is a partial guarantee for bank loans without which there would be no input available and no seed-cotton produced; (b) most ginners can't pay cash the total value of their orders; (c) they also don't have any purchasing infrastructure in the field (warehouses, equipment and trained buying agents) and then have to rely on farmers' organizations for collecting the produce in thousands of scattered farms (the same apply for input traders); (d) farmers are illiterate and are unaware of international market conditions, and have therefore "delegated" the management of their business relations to the new market institutions through the inter-professional agreement.

However, as one may expect, many ginning companies and input trading companies protested against this new rule of seed-cotton market access regulation. Indeed, the deposit condition was perceived as a strategy to protect a few major fertilizer importers by indirectly refusing market access to their competitors. Righteously, unless a ginner/cotton buyer has some particular ties with an input trader, why should he favor the latter to obtain bank loans for his commerce? Provided that cotton harvests serves as collateral for bank loans for inputs' importation, normally only input traders and farmers should be bound by such credit arrangement, not ginners. Otherwise, direct contracts have to be drafted among trade partners separately: 'input sellers to cotton buyers' for seed cotton to be used as collateral, 'input sellers to farmers' for amount of inputs to be supplied on credit, and 'cotton buyers to farmers' for amount of seed cotton to be purchased at harvest (and therefore dedicated area cultivation).

Definitely, the inter-professional agreement was not clear on the advance payments obligations for ginners.

Table 1. Average fertilizer prices in the survey districts (communes) of Benin, 2003/04-2004/05.

Districts / regions	Import price[a] (CIF, Fcfa/kg)	Applied farm gate price[b] (Fcfa/kg)	Official farm gate price[c] (Fcfa/kg)	Estimated farm gate price[d]
Sinendé	154.5	215.9	197.5	212.0
Bembéréké	154.5	205.9	197.5	206.6
Gogounou	154.5	203.6	197.5	210.7
Kandi	154.5	215.5	197.5	213.3
Banikoara	154.5	215.5	197.5	215.1
Segbana	154.5	215.0	197.5	223.6
Borgou-Alibori (northern region)	154.5	211.8 (6.5)	197.5	213.5 (7.3)
Dassa-Zoumè	154.5	203.6	197.5	177.1
Djidja	154.5	204.5	197.5	175.3
Glazoué	154.5	197.9	197.5	179.3
Ouèssè	154.5	208.6	197.5	187.1
Ouinhi	154.5	198.1	197.5	174.6
Savalou	154.5	201.2	197.5	182.9
Za-Kpota	154.5	208.6	197.5	172.4
Zogbodomè	154.5	208.6	197.5	170.6
Zou-Collines (central region)	154.5	203.8 (6.4)	197.5	177.4 (6.5)
Both regions	154.5	207.8 (7.6)	197.5	193.7 (19.3)

[a and b], ON; [c], CAGIA, [d], Estimated using the formulae : $P_{re} = 1.02*P_{caf} + 1.96*C_t + 2.22$, where: P_{re} is the estimated farm gate price, P_{caf} the CIF, import price and Ct the total transport cost from the port to the village. The numbers in parentheses are standard deviations.

In the reality, none of such direct business contracts existed in the institutional arrangement or were disclosed to farmers (SNV, 2005). The upshot was a sharp decline in fertilizer consumption as a result of organizational confusion and disorders, including non-payment of cotton revenues to farmers, unpaid previous input debts, and non-availability of further credit for input supply. The foregoing shows that the new governance structure implemented after liberalization by new cotton domestic market institutions was poor. The vacuum of the state monopoly's withdrawal remained unfilled, or artificially so.

The test on operations management from an institutional perspective

Price setting and distribution costs

Official input prices jointly set by AIC and the government are based on a theoretical cost price estimation using technical coefficients that are linked to the official seed-cotton purchase price. In spite of several revisions, namely through the WADDELL formulae (MAEP, 2004), official prices bear two drawbacks: (a) temporal and spatial variations of cotton yield and world market price fluctuations were ignored; (b) it is not clear how all private importers, supplying inputs to different zones and operating at different real costs, could sell inputs at a same pan-territorial farm gate price.

While little attention was paid to problem (a), on the other hand pan-territorial pricing policy involved a discrete subsidy administration through a mechanism of internal costs' transfers from cotton farmers in remote regions to those in regions relatively near the port. Some gaps exist between the estimated farm gate price (Table 1) and the price on the basis of which traders were actually paid by the licensing authority (Table 1). Differential transport costs and related operational capital costs (interests on bank loans) should have been enough to explain the gaps. But they also include rents and subsidies. The gaps between applied and estimated fertilizer farm gate prices amounted in average to 14.1 CFA/kg during the '2003 to 2005' period. They were larger in the central region (26.1 CFA/kg) than in the northern region where traders would rather experience losses. "Fortunately" for the approved traders' alliance, the licensing system compensates them for these losses through high prices of pesticides and the attribution of distribution zones mostly in the central region. Therefore, they get perverse incentives when they are discretely and inequitably "helped" by the licensing system to target such zones. In the practice, through a complex pricing system whereby differential grades are applied on seed-cotton purchased from farmers, subsidy is discretely administered by the government and is converted to occult profits via selected traders' networks.

Obviously, the intertwining cotton/input pricing mechanism is an obstacle to transparency (cf. MAEP, 2004) and an instrument for distributing rents. It supports the subsidy-and-credit scheme, but also a rent-seeking practice. Between 2005 and 2011, following complaints of collusion between the fertilizer market regulation authority

Table 2. Evaluation of fertilizer quality-related marketing services.

Elementary quality-related variable	Borgou-Alibori (N=258)		Zou-Collines (N=319)	
	n	Yes (%)	n	Yes (%)
Positive impact of liberalization on fertilizer quality	258	28.3	319	17.2
Demand for new cotton fertilizer types	258	12.0	317	32.2
Demand for appropriate fertilizers for other crops	258	69.0	317	84.5
Reception of adulterated fertilizers[a]	10	90.0	98	20.4
Reception of unfilled bags[a]	10	60.0	98	58.2
Poor storage conditions[a]	10	0.0	98	20.4

[a].For these sensitive questions, the numbers of valid observations were very low (compared to sample sizes) because most farmers did not to reply in order to secure their access to cotton input credit controlled by the licensing system.

Table 3. Evaluation of fertilizer availability-related marketing services.

Elementary availability-related variable	Borgou-Alibori (N=258)		Zou-Collines (N=319)	
	n	Yes (%)	n	Yes (%)
Positive impact of liberalization on availability	258	41.5	316	42.7
Physical conditions of warehouses*	86	86.8	77	80.4
Non-removal of delivered products	221	13.6	316	21.5
Procurement through informal traders	219	18.3	319	12.9
Existence of other farmers' groups willing to do retailing	258	30.6	319	8.5
Convenience of privately-owned stores for fertilizer retailing in the village	258	5.0	289	23.9

* Total number village warehouses assessed and proportion of warehouses with concrete walls and zing roofs.

and main importers, the CAGIA was dissolved and its services were brought under AIC's direct control at its headquarters. Sinzogan et al. (2007) have already felt this need through a "perspective of breakaway network" in the functioning of cotton institutional linkages.

The foregoing discussion indicates that hypothesis 1 is rejected. But it was made clearer with the quantitative analysis following, which shows the most specific value-added this paper brings to other studies (Minot and Daniels, 2002; Sinzogan et al., 2007; Kpadé, 2011; Hougni, 2009) on the analysis of cotton sub-sector's institutional settings in Benin.

The test on operations management from a quantitative perspective

Previously an assessment of the supply chain performance from an institutional perspective was given. Here, a marketing perspective is used to test hypothesis 1 which states that "there is a positive correlation between the service quality index and profitability". In order to understand the calculation of the service quality index, the results of the marketing survey are presented first.

Farmers' evaluation of marketing services

Fertilizer marketing services pertain to fertilizer quality, availability and accessibility. Tables 2 to 4 summarize the most relevant results of that survey and indicate that farmers' needs for many critical marketing services were not met. Future improvements in service delivery should address poor quality of, and accessibility to fertilizers.

The service quality index

The service quality index was computed using original binary response scores (0/1) for some selected elementary marketing services. This selection was based on the uniqueness of expression or relative independence among the variables in each group of services, and taking into account the number of responses per variable, which should be representative enough, that is, higher than half of total sample size. This means that some variables in Tables 2 and 4, not obeying to this double condition, were dropped. Then the responses were converted to the corresponding values on a positive gradient, in order to calculate the partial indexes: index of quality (IQ), index of availability (ID), and index of accessibility (IA), and a composite 'service quality index' (ISV) (Table 5). The main result is that the quality of marketing services offered by all "competing" private traders was found to be just average or quite poor. On a '0 to 1' scale, the mean value of the service quality index was only 0.518. The lowest index values were observed in Ouessè, a food crop-dominated district

Table 4. Evaluation of accessibility-related marketing services.

Elementary accessibility-related variable	Borgou-Alibori (N=258)		Zou-Collines (N=319)	
	n	Yes (%)	n	Yes (%)
Positive Impact of liberalization on fertilizer prices (reduction)	258	1.6	319	6.3
Demand for other methods of input credit reimbursement	258	3.5	316	6.0
Demand for technical advises	258	57.4	316	65.5
Demand for small-size bags	258	1.2	316	3.5
Demand for improved seed varieties	258	62.8	316	69.3
Demand for new pesticides and spraying equipment	258	52.3	317	74.8
Demand for oxen-driven equipment	258	39.2	317	50.8

Table 5. Method for calculating fertilizer marketing service quality index at village level.

Elementary service quality variables	Values / scores (farmer's satisfaction on a positive scale, 0 - 1)
Positive impact of liberalization on fertilizer quality	No=0 Yes=1
Demand for new cotton fertilizer types[a]	Yes=0 No=1
Demand for appropriate fertilizers for other crops[a]	Yes=0 No=1
Index « Quality of fertilizers » (IQ)	*(Sub-total)/3*
Positive impact of liberalization on availability	No=0 Yes=1
Physical conditions of warehouses	Zing-roof & concrete wall=1 Otherwise=0
Non-removal of delivered products	Yes=0 No=1
Index « Availability » (ID)	*(Sub-total)/3*
Positive Impact of liberalization on fertilizer prices (reduction)	No=0 Yes=1
Demand for other methods of input credit reimbursement	Yes=0 No=1
Demand for technical advises	Yes=0 No=1
Index « Accessibility » (IA)	*(Sub-total)/3*
Service quality index at village level[b] (ISV)	ISV = (IQ + ID + IA)*/3*

[a]These demands concern the quality of fertilizers, in terms of appropriate nutrient contents. [b]The composite and partial indexes are calculated as the village-level averages of values at individual farmer level.

in the central region (Table 6).

In each region, the differences between districts for the partial and composite service quality indexes respectively are very low (coefficient of variation of 0.10 to 0.20) because the licensing system prescribes standard services. However, the difference between the two regions is significant at a 1% level. Although total service delivery obeys to the same AIC-prescribed pan-territorial standards, farmers in a region, compared those of the other region, perceived differently the fertilizer quality-related service delivery on the ground of criteria such as priority crops (cotton vs. food crops) and diversity of fertilizers types needed. Some of these criteria were not necessarily disclosed.

The 'service quality index – costs – profitability' relationships

Farm gate prices paid by farmers (fertilizer consumers) or actual costs should be congruent with the service quality farmers receive from the supply-chain. Table 7 shows the gaps in profitability between the oligopoly alliance (favored by the licensing system) and non-alliance competitors, and Figure 3 displays the relationships between service quality, costs (applied versus estimated) and profitability.

The 'service quality index: applied cost' relationship is backward (zero correlation in the left-side graph at the top), compared to the 'service quality index: estimated cost' relationship (positive correlation in the right-side graph at the top). The left-side graph illustrates an abnormal relationship, where farmers perceive large variations in service quality, whereas they actually bear an average fixed high cost through applied prices paid to traders by the licensing authority. This confirms the perverse incentives for oligopolies (protected market clusters). The right-side graph at the top illustrates what the normal relationship should be, that is, service quality is congruent with estimated costs, indicating good prospects for cost-effective optimal service when the previously described standard prescriptions will disappear. The third graph at the bottom finally shows the observed negative correlation between service quality index and

Table 6. The service quality index of fertilizer supply-chains in the surveyed cotton zones of Benin.

Districts / regions	Fertilizer quality index	Availability index	Accessibility index	Service quality index
Sinendé	0.380	0.704	0.537	0.540
Bembéréké	0.652	0.748	0.600	0.667
Gogounou	0.452	0.770	0.484	0.569
Kandi	0.430	0.685	0.459	0.525
Banikoara	0.472	0.611	0.333	0.472
Ségbana	0.540	0.703	0.420	0.554
Borgou-Alibori (N = 86)	0.491 (0.204)	0.702 (0.159)	0.469 (0.145)	0.554 (0.110)
Dassa-Zoumè	0.226	0.676	0.357	0.420
Djidja	0.341	0.534	0.422	0.432
Glazoué	0.382	0.806	0.458	0.549
Ouessè	0.242	0.586	0.373	0.400
Ouinhi	0.457	0.729	0.420	0.535
Savalou	0.420	0.662	0.516	0.533
Za-Kpota	0.324	0.722	0.472	0.506
Zogbodomè	0.317	0.619	0.532	0.490
Zou-Collines	*0.337*	*0.666*	*0.446*	0.483
(N = 105)	*(0.178)*	*(0.210)*	*(0.146)*	(0.128)
T of Student	5.494**	1.347	1.087	4.122**

N = number of villages. Figures in parentheses are standard deviations. The T of Student refers to the statistical test of difference between means of the two regions: ** difference significant at 1% level.

Table 7. Profitability ratios (% of applied farm gate price) [a] in fertilizer trade for different groups of traders in Benin.

Variable	Traders' distinction using market shares			Traders' distinction using presumed alliance		All traders
	Leaders	3rd place competitors	Irregular traders	Oligopoly alliance	Non alliance competitors	
Borgou-Alibori						
Minimum	-8.5	-5.0	-7.5	-8.5	-7.5	-8.5
Maximum	12.1	1.3	-1.1	12.1	-1.1	12.1
Mean (SD)	2.0 (3.8)	-1.9 (1.7)	-4.5 (1.8)	1.3 (3.8)	-4.5 (1.8)	0.8 (4.1)
Zou-Collines						
Minimum	13.4	7.1	4.8	9.8	4.8	4.8
Maximum	29.8	22.0	17.0	29.8	22.0	29.8
Mean(SD)	25.0 (4.8)	16.5 (4.1)	12.0 (3.3)	21.0 (6.1)	13.3 (4.5)	16.8 (6.5)
Both Regions						
Minimum	-8.5	-5.0	-7.5	-8.5	-7.5	-8.5
Maximum	29.8	22.0	17.0	29.8	22.0	29.8
Mean (SD)	8.6 (11.2)	11.8 (8.8)	8.6 (7.5)	8.8 (10.7)	11.2 (7.3)	9.6(9.7)

a. Profitability ratio = 100*Profit/(CIF price + estimated direct local costs) ; Profit = Applied farm gate price – (CIF price + estimated direct local costs); Applied farm gate price = Cost price, as the minimum selling price which forms the basis for paying traders (joint ONS/CSPR estimations). Estimated direct costs = Sum of intermediary costs from the port to farm gate, according to normal rates and cost calculation (field survey). From the formulae below table 2, intermediary costs are: f = 1,927*(C_t+ε), where C_t stands for transport cost and ε, for handling and storage costs. Therefore: Profitability ratio (%) = 100*[Applied farm gate price/(CIF price + 1,927*(transport cost + 1,1352)) – 1].

actual profitability ratio, illustrating once more the perverse incentives for traders, especially for the oligopoly alliance that gets huge profits whereas farmers rate low the quality of their service.

These findings indicate that the expected positive relationship between service quality (resulting from

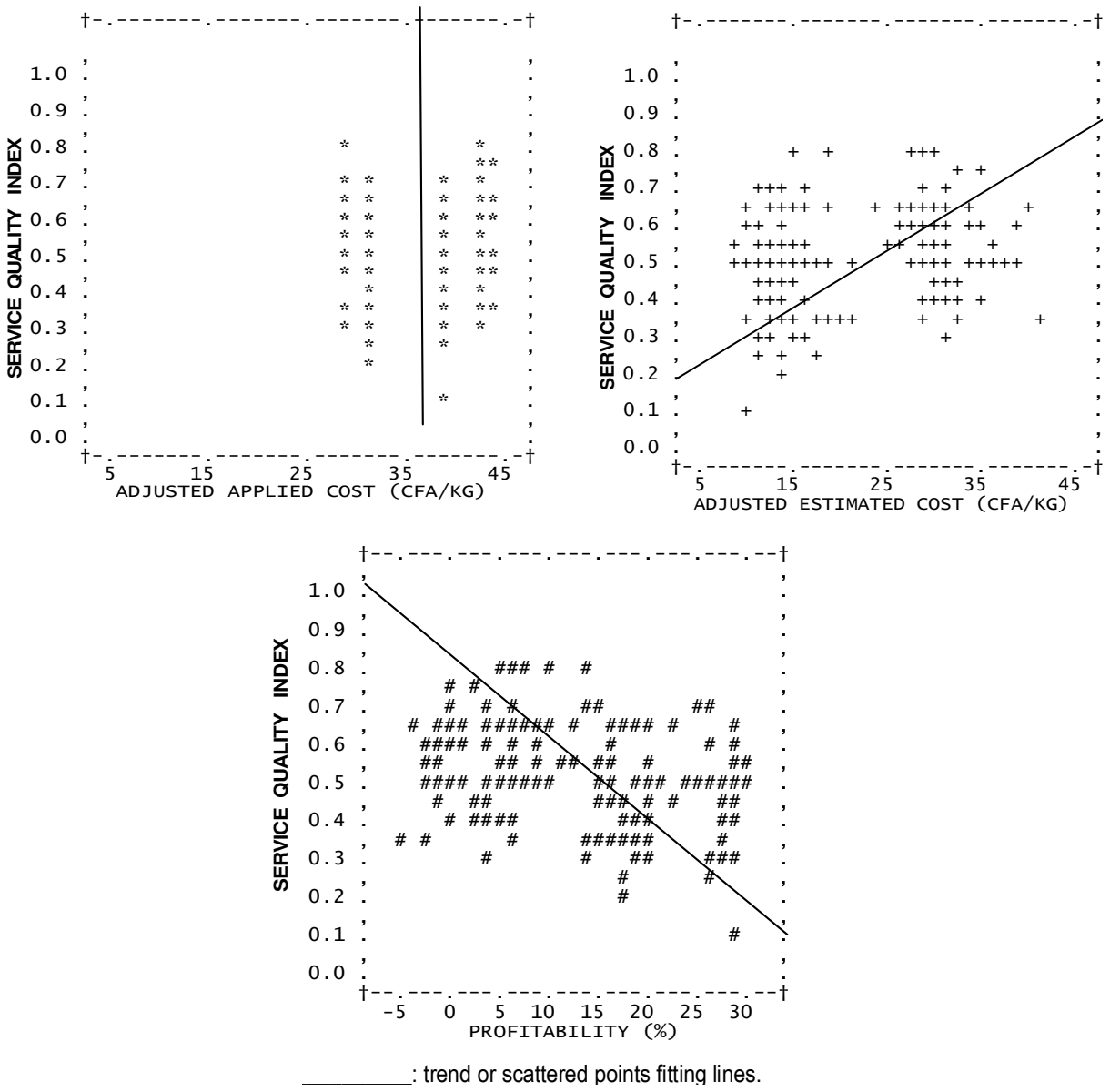

Figure 3. 'Service quality index – costs – profitability' relationships in the fertilizer market in Benin, 2003-2004. In the top two graphs, transport costs were deducted from total costs to avoid the regional bias.

operations management in the private supply-chains) and profitability is not observed. The rejection of hypothesis 1 is therefore confirmed by means of quantitative assessment.

The tests on competition and entrepreneurship

Although the concerns for equitable credit supply and delivery of good quality of fertilizers and marketing services by private traders may call for a market control/regulation system, the latter should avoid rules that hamper competition and entrepreneurship. The licensing system in Benin does not encourage competition because the rules therein are not meant to legitimize the issuing of import licenses to traders on a transparent basis. Formal rules of the game are designed to protect private business clusters rather than promoting market transparency and competition. The system indirectly confers a strong market power to private oligopolies. Its legitimacy is contested, as non-alliance competitors (many small and medium – size input / output trade businesses) suspected the former state monopoly (with seed cotton market share of 53%) to having introduced the new rule of "40% deposit" to indirectly eliminate the competitors of the private oligopoly. Indeed, only the ginners who have special ties with that input oligopoly were prompt to comply with the 40% rule in order to

eliminate other input traders from the competition. For example, purchase intentions (probationary input orders) approved by farmers' leaders are vital for input traders to get the license because banks request those documents before delivering credit letters, and both documents are required to support import bid files. Yet, obtaining the purchase intentions does not always result from normal direct business negotiations between traders and farmers. They rather involve corruption of farmers' leaders and discrete negotiations with the leading importers.

Available data on imports figures indicate that there has been a decreasing competition since 1999. The Herfindahl-Hirschman Index (HHI), which is a market concentration index, was 0.1808 over the 1995 to 1999 period, indicating a monopolistic competition (Besanko et al., 2000:235-237). HHI was 0.2008 over the 2000 to 2004 period, which indicates a higher monopolistic competition. Corresponding values of the C4 index (market share of the first four importers) were respectively 73 and 77%. The situation has worsened since then, as a private monopoly has completely arraigned market regulation institutions. As a result farm-gate service has become poor. In a liberalized market, competition among traders should be allowed to create relevant utilities for consumers using transparent pricing and innovative contracting strategies.

The licensing system impedes competition and entrepreneurship. It gives private oligopolies abnormal advantages, which constitutes perverse incentives at the expense of farmers. Indeed, oligopolies get huge profits and are officially warranted stable business relationships with clients (farmers) in the central region, while not making any difference in the quality of prescribed marketing services. The system discourages dynamic efficiency as it involves higher transaction costs and discourages innovation to harness profitable business opportunities for optimal service delivery (Figure 1). Cheating or abuse of farmers through a non-transparent pricing policy is also demonstrated. Hypothesis 2 on competition is therefore rejected, that is, there is very little competition on service quality and prices, due to the lack of transparency in the institutions. The same also applies for hypothesis 3 on entrepreneurship, as the system limits fertilizer traders' innovative propensity.

These findings are supported by Sinzogan et al. (2007) who pointed out that "the stakeholders in the cotton inter-profession have become partners in a game that was previously run by a monopoly. It was assumed that farmers' organizations and the private sector were capable of assuring the coordination and the execution of the required activities, motivated by potential for increasing their profits. But the assumption that competitive pressures would lead to more efficient input markets also has not been confirmed; rather, there is evidence that collusion among institutional stakeholders has thwarted competition". With empirical data, our paper confirms this. The impact of arraignment of institutions by a private oligopoly on the quality and costs of distribution service has been demonstrated.

On a final note, it is worth reporting that in April to May 2012, a nationwide crisis exploded about input subsidy mismanagement by AIC and was officially presented to the public as wrong cotton statistics estimation, the debate being about who (between AIC and the government/MAEP) should take the lead in disclosing such statistics. Actually the underlying issue is "who captures input subsidies destined to farmers and why?" Statistics were an alibi to finally discard a private oligopoly which has become a public malaise since 2000 and a political fear as from 2005, considering the relationship between votes of rural populations and their satisfaction about agricultural input supply. As the crisis was getting bitter, the government declared the dissolution of AIC and decided to put in place an ad hoc committee to examine the conditions for implementing reforms which would bring back the state monopoly to control the market. Obviously, as our research revealed, this is not the right solution. It is disappointing that politics in Africa does not tap from research findings for wise policy decision-making, and the same mistakes are repeated over several years.

CONCLUSION AND POLICY RECOMMENDATIONS

The paper provides an empirical evidence of the relationships between the theory of institutions and transaction costs, and its application in supply chain management where operations management and entrepreneurship are constrained by the nature of competition set by the institutions. The licensing system in Benin is a case that illustrates distorted rules of the game and market authorities' arraignment by traders in the play of the game. Notwithstanding the cotton world market crisis, several institutional drifts have characterized the partially liberalized input market in Benin, where the state still controls market entry under a hidden agenda managed by some hybrid organizations. The test on operations management showed that present private traders confined themselves to the cotton sub-sector and pursued the perverse incentives created by the licensing system rather than improving market service delivery. There, compulsory alliances generate high transaction costs and low quality of marketing services to farmers. The negative relationship between service quality and distribution costs has been dedicatedly illustrated and hypothesis 1 was rejected. Market failure occurred because the new institutional arrangements (mainly the licensing system) were built on unwanted residuals of the failed state monopoly. The lack of motivations of the new institutions to foster competition and entrepreneurship (innovative propensity) among traders was also evidenced on empirical grounds, leading

to rejection of hypotheses 2 and 3 in the context of Benin's liberalized fertilizer market.

Monopoly power is a permanent characteristic of fertilizer trade because of the huge capital required, especially at importation level. Yet, this paper provided evidence of the need for competition with a minimum regulatory framework to avoid some traders' delinquency and farmers' abuse. The government should relax entry restrictions to enable medium- and big-size importers to target different market segments according to crop zones, considering their own differential ability to flexibly handle credit dispensation to farmers and other client approach mechanisms. This means that such traders would build their own distribution networks and design appropriate service delivery to different client groups or sub-sectors. The government should also encourage competition at local distribution level where flexibility is particularly required in operations management. The private sector should work with a greater propensity for entrepreneurship, by tapping from business opportunities arising from new crop markets. Competition, which is a pre-requisite for quality management in supply-chains and entrepreneurial attitude among traders, needs to rely on a transparent market information system. A "fertilizer market observatory" where government would contribute to buffering the costs and hold the system accountable for all stakeholders' timely access will be key to an efficient fertilizer market in Benin and elsewhere in West Africa.

Finally, we formulate a few specific policy recommendations:

(a) Credit system liberalization: The issue of credit for traders and farmers remains a major concern. It needs to be addressed thoughtfully. Many formal banks are still reluctant to finance the agricultural sector because of high risks in rain-fed agriculture. The government should bring all stakeholders to re-organize the cotton sub-sector through transparent market institutions and a genuine participation of private businesses. In this regard, Benin may need to learn from some Asian countries how they succeeded in linking their financial markets to food crop sub-sectors, to make the latter profitable for farmers and local traders.

(b) Capacity-building: In order to harness the benefits of such a perspective, all partners of liberalized input markets in Benin should emphasize the diversification of supply-chains through the value-chain approach in order to enable innovations among actors. In particular, traders should avoid pursuing perverse incentives, if they would commit themselves to fostering agricultural intensification through viable markets. Their organizations should seek assistance from government and development partners, to enhance their capacities for efficient operations management and optimal service delivery to farmers.

(c) Agricultural trade and market development policy: All stakeholders should work towards improving the institutional setting of market conquest in the cotton sub- sector so that better services could be offered to farmers without being hampered by a regulatory framework which overemphasizes environmental protection. For the sake of tax revenues that accrue from agricultural trade for public welfare, innovation is also required from public trade and fiscal authorities in the design of appropriate tax collection systems that would avoid physical or rent-seeking interventions of a central bureau in the fertilizer market.

ACKNOWLEDGEMENTS

This paper is an output of a PhD research financed by the University of Groningen (RuG, The Netherlands) and the International Foundation for Science (IFS, Sweden).The author thank both institutions for their support. His recognition goes particularly to Prof. Caspar Schweigman and Dr. Clemens Lutz, who were the promotor and copromotor of the thesis. Thanks also goes to Dr. Henk Breman who facilitated access to IFDC knowledge resources and provided sustained technical advises. Anonymous referees of an earlier version of the paper are kindly acknowledged.

Abbreviatations: AIC, Association Interprofessionnelle du Coton (Cotton Inter Professional Association); **AProCA,** Association des Producteurs de Coton en Afrique; **CAGIA,** Coopérative d'Achat et de Gestion des Intrants Agricoles (Cooperative for Input Purchase and Management); **CFA,** Communauté Financière Africaine (French-speaking Africa Monetary Community); **CIF,** Cost Insurance and Fret; **CNPC,** Conseil National des Producteurs de Coton (Cotton Producers' National Council); **CSPR,** Centrale de Sécurisation des Paiements et de Recouvrement (Cotton sub-sector's Central Bureau for Securing Payments et Debts Recovery); **FOs,** Farmers Organizations;FUPRO,Fédération des Unions de Producteurs (Federation of Producers' Unions); **MAEP,** Ministère de l'Agriculture, de l'Elevage et de la Pêche (Ministry of Agriculture, Animal Husbandry and Fisheries); **ONS,** Office National de Stabilisation (National Bureau for Agricultural Produce Price and Income Stabilization); **SONAPRA,** Société Nationale pour la Promotion Agricole (Cotton Input and Output Marketing Board); **SAPs,** Structural Adjustment Programs.

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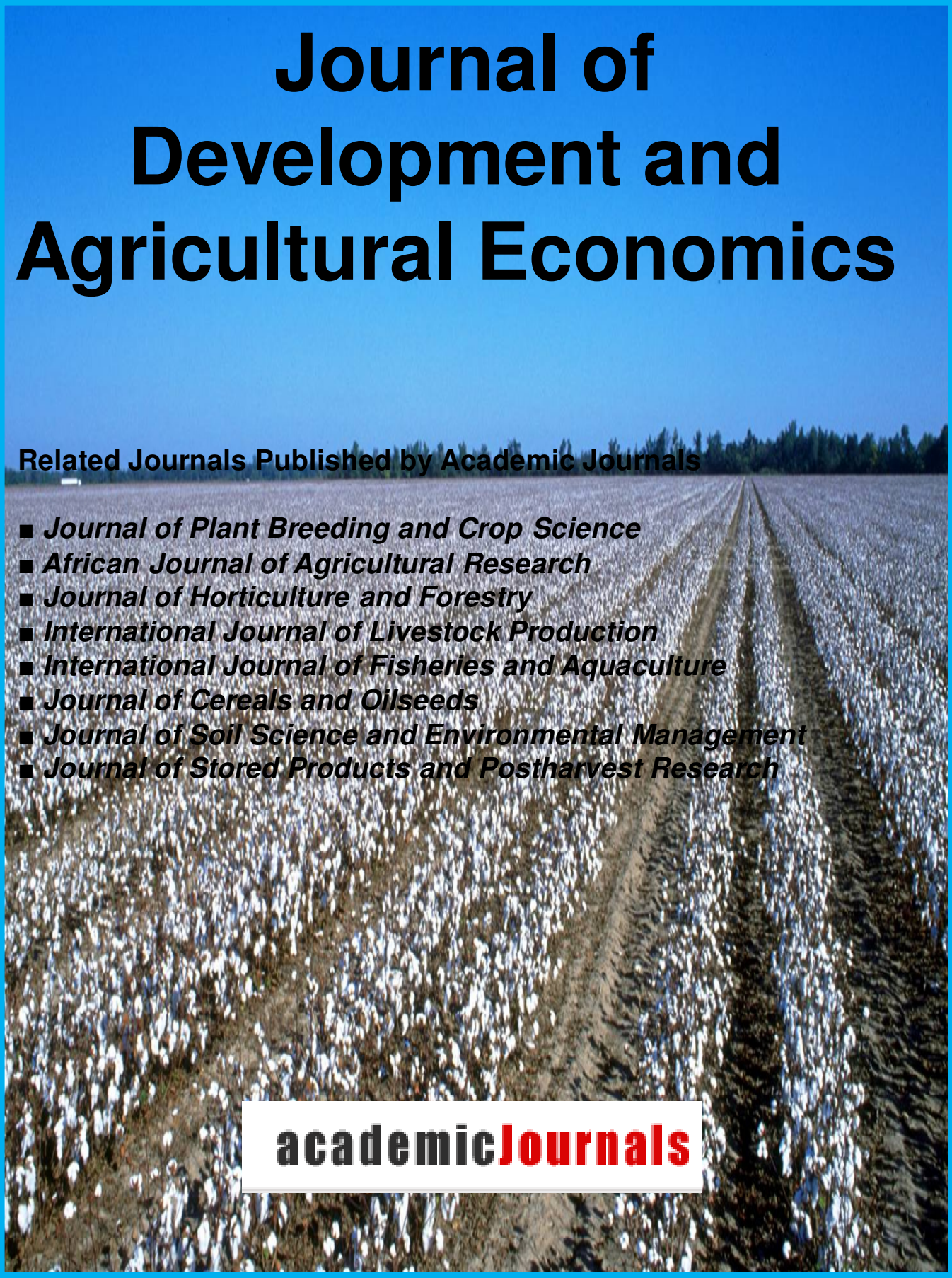

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