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Vegetable Handling, Distribution, and Wholesale Profitability in "Abinchi" Night Market, Kumasi-Ghana

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Abstract

The study was conducted on vegetable handling practices, distribution and wholesale haulage profitability in Abinchi night market Kumasi, Ghana. Focus group discussions were held for middlemen, market queens and men, and 150 market queens and men were randomly selected and interviewed to elicit prevailing handling practices. SPSS was used to analyze data obtained and financial analytical tools; profit margin, return on investment and benefit cost ratio were used to assess the profitability of the vegetable wholesale haulage. Open and closed trucks, mini vans and taxis were identified to be regular modes of transport of vegetables. Vegetables are packed and stored in jute sacks with shelf life ranging from 3 to 7 days with visible deterioration over days. The wholesale haulage of vegetable was viable in the months of July, August and September. In mid September 2013, a 150 Kg sack full of cabbage in Tepa, a major hub of vegetable production in the Ashanti region was selling for an average of GH¢15 on farm. This constitutes 39% of the total cost of a sack full of cabbage with about 61% constituting the cost of overheads and transportation at the wholesale centre. The sales price of an average sack of cabbage to middlemen was GH¢40, with a net revenue of GH¢ 1.20 on each sack of cabbage sold. A 40Kg jute sack full of carrot sold at GH¢20 on farm, representing 77% of the total cost per sack.

INTRODUCTION

Vegetables are essential food component of human diets and largely preferred in their fresh state (Drechel et al., 2010). In several African cities, about 50-90% of fresh vegetables are supplied from urban and peri-urban production systems (Cofie et al., 2003). In Ghana, the growing population and demand for fresh vegetables by consumers have stimulated vegetable production in urban and peri-urban areas too (Probst et al., 2010). The production and marketing of vegetables in Ghana provides alternative employment for many people (Obuobie et al., 2006). It also makes significant contributions to livelihoods and food security. It is estimated by Cornish et al. (2001) that, more than 12,000 smallholder farmers are involved in vegetable farming during the dry seasons in and around Kumasi.

Globally, there has been remarkable advancements in food production (FAO, 1989), however, post harvest losses are still estimated at between 20 and 100% (New Agriculturist, 2005; Wilson, 2013) with postharvest losses of perishable crops in Ghana estimated to be ranging between 30 and 80% (Kitinoja and AlHassan, 2012). These losses are often due to poor postharvest management systems as well as lack of appropriate processing and marketing facilities. Losses have several adverse impacts on farmers' income, consumer prices and nutritional quality of the produce. This disturbing trend of vegetable losses in Ghana often erodes substantial gains made in production.

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Generally, vegetables are transported from farm to urban markets for onward distribution across their value chain. However, limited availability of refrigerated transport and cool storage systems makes vegetable distribution cumbersome (Cofie et al., 2003). Poor handling contributes to postharvest losses using certain common practices or failure in adopting known useful practices that could reduce losses and help maintain produce quality and safety. Most of these improper practices and conditions cannot be labeled technical problems as they cannot be solved by initiating new research (Kitinoja and Kasmire, 2002). Horticultural produce is alive and has to stay alive long after harvest, once harvested and separated from its sources of water and nourishment, it must inevitably reach senescence (Jobling, 2002; Siddiqui and Dhua, 2010). The role of postharvest handling is to delay that death for as long as possible to extend shelf life and reduce loss. Often, postharvest losses take time to develop and the specific cause of quality problems may not be fully understood by produce handlers along the chain (Kader, 2002).

This study therefore explores the practices adopted by the actors in the "Abinchi" night market to reduce physical losses, protect produce quality, ensure food safety, and maintain economic value.

2.0 MATERIALS AND METHODS

2.1 Market history and size

Abinchi night market was established in June 2011 through a Build, Operate and Transfer (BOT) arrangement between a private company and the Kumasi metropolitan assembly. It occupies a total land size of 22.4 acres and serves as a modern market for urban dwellers of Kumasi and its immediate environs. The market even though originally intended to be a temporary holding place for traders and consumers has evolved to become a major vegetable wholesale distribution hub that serves parts of the country. Vegetables traded in the market are exotic and trading is done on Wednesdays and Sundays from dusk to dawn. Farmers, market queens, men and middlemen predominantly from parts of Ashanti and Brong Ahafo regions converge on these market days to trade in vegetables.

2.2 Market operations

There are trade associations in the market. These trade associations acquire pavilions and subsequently distribute sheds to their members. Each member paid a one term charge of GH¢200 (Exchange rate: GH¢2.10=US$1.00) for the acquisition of a pavilion. They also pay GH¢1 a week to these associations as welfare dues, out of which utility and market tolls are paid (personal communication, market manager). These associations are fully recognized by the management of the market. Persons who do not belong to any of these associations are not allowed to sell vegetables in the market but can only trade as middlemen who buy vegetables for onward transportation to various destinations. There are three (3) associations in the Abinchi vegetable night market, and these are the Ashanti Regional Vegetable Sellers Association, Mampong Vegetable Sellers Association and Dunkirk Co-operative Vegetable Sellers Association with a collective membership of about 520. Members of these associations are also trade partners; they access loans from banks as cooperatives and pool resources to purchase vegetables in large volumes. Within trade associations, groups formed revolve capital on market days, and may only haul one type of vegetable a day.

2.3 Research Design

Exploratory and descriptive research methods as recommended by Burns and Bush (2002) were employed. 150 market queens and men were interviewed, focus group discussions were held for farmers, middlemen and market queens. The manager of the market was also

interviewed. Out of about 520 wholesalers, 150 were randomly selected for the interviews. 5 leaders and 10 members each from the three (3) trade associations were part of the focus group discussions over a three (3) month period, July to September, 2013. A few of the urban farmers who haul their produce to the market were grouped for discussions fortnightly.

2.4 Profitability of vegetable wholesale haulage analysis

The profitability of wholesale vegetable haulage was evaluated using financial analytical tools, profit margins (PM), return on investment (ROI) and benefit-cost ratios (BCR). The analyses used income and expenditure of wholesale distributers for various batches of haulage in the months of July, August and September 2013 to determine the net returns on the wholesale distribution business. The net returns (NR) from the investment were calculated as:

$$NR = TR - TC$$

Where, $TR = P_i Q_i$, and $TC = \sum_{1=0}^{n} P_{Xi} X_i$

NR is the net return, *TR*, total revenue from sales of a batch, *Pi*, price per sack, *Qi*, quantity of sacks per batch. *TC*, total cost of a batch of vegetable, *Pxi* = the price of the *ith* input, and *Xi* is the *ith* input (Ross *et al*., 2001).

The Profit Margin, a financial ratio, was used to measure how efficiently the market queens and men managed their operation over a three month period (July, August and September). This was used to measure the proportion of income from every cedi in sales. The ratio is given by the net returns divided by sales, i.e. Net returns / Sales. The Benefit-Cost ratios (BCR) was also computed as BCR = TR/TC, where BCR ≥ 1 implies a viable business. The returns on every cedi of cost incurred were also measured for each month.

A standard scale of 250 Kg capacity was used to weigh and compute the average weight of a sack each of a vegetable; cabbage, carrot and green pepper. These weights have been provided as part of the results of the study.

2.5 Data analysis

Statistical analysis was carried out on data obtained from interviews conducted on market queens and men in the wholesale distribution industry. Using SPSS version 16, data was analyzed and discussed.

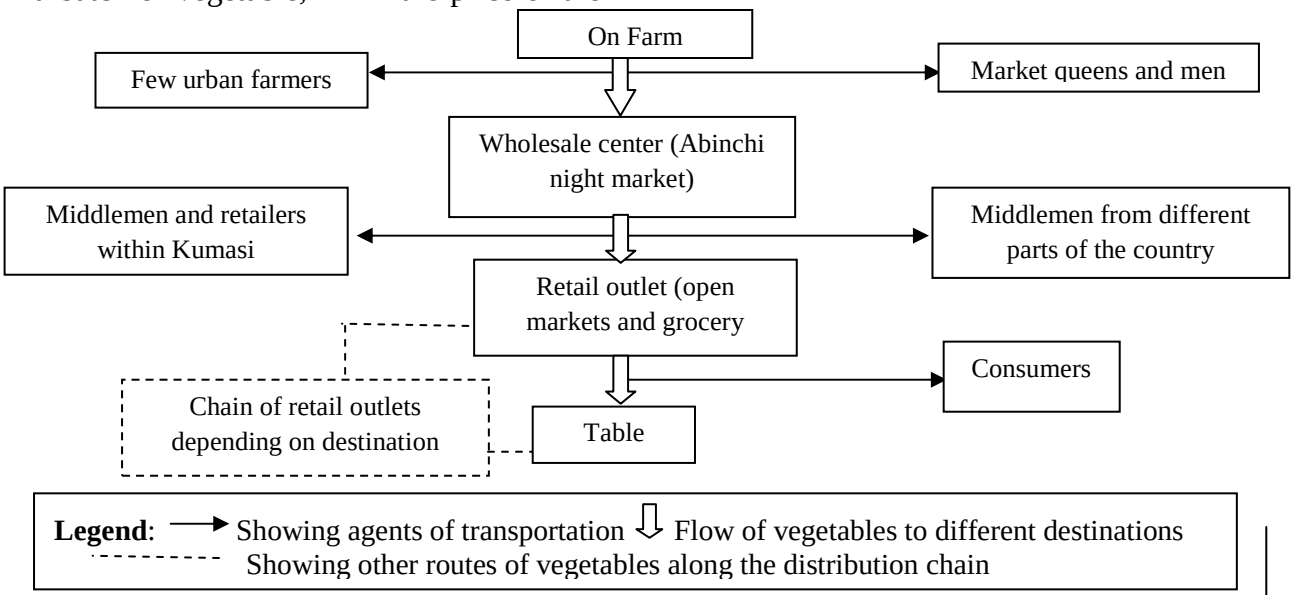

Figure 1: Channels and agents of distribution of vegetables "in" and "from" "Abinchi" night market

Table 1: Source(s) of production of vegetables supplied and distributed in 'Abinchi' night market.

Vegetable	Major area of production
Carrot	Asante Mampong Offinso Kekenso
Cabbage	Adeitum-Lake side (Bosomtwe)Tepa Urban and Peri-Urban Kumasi
Green Pepper	Techiman Bechem Abofuor Nsuta Kwamang
Green Beans	Sabrono Urban and Peri-Urban Kumasi
Cucumber	Urban and Peri-Urban Kumasi
Spring Onion	Urban and Peri-Urban Kumasi
Black Beauty (Aubergine)	Urban and Peri-Urban Kumasi
Lettuce	Urban and Peri- Urban Kumasi
Cauliflower	Urban and Peri-Urban Kumasi
Squash	Urban and Peri-Urban Kumasi

Source: Field survey, 2013

3.0 RESULTS AND DISCUSSION

3.1 Vegetable value chain

Farmers mostly assemble vegetables on farm. Market queens and men transport these vegetables from the farm-to-farm gate, and subsequently to the wholesale centre. Few urban farmers directly locate the Abinchi night market, where they transport their produce for sales (Figure 1). In Abinchi night market, vegetables brought in by farmers are bought by wholesalers (market queens and men) right in the presence of middlemen before being sold to the middlemen at an average determined price. Farmers are only compensated for their transportation cost but are not allowed direct access to middlemen to trade. After purchase, the middlemen transport vegetables to Takoradi, Obuasi, Koforidua, Accra and several other destinations. The presence of traders from beyond Kumasi can influence market prices as they make better offers (Cornish and Aidoo, 2000). The vegetables may go through a chain of retail outlets before finally landing on the consumers tables (Figure 1).

3.2 Gender and family size of vegetable wholesalers

Predominantly, women are the main actors in the vegetable distribution industry (93.33%). They often go to production villages, towns, urban and periurban areas to buy vegetables from farmers on farm. Only 6.67 % of actors in the wholesale distribution of vegetables are males. This compares favourably with Drechsel et al., 2006 and Cofie et al., 2005 who observed marketing of cabbage, carrots and lettuce among other vegetables to be dominated by women in Ghana and Burkina Faso.

Wholesalers generally have family sizes of less than four (69.33%) with about 30.67% having family sizes of four and above. This is opposite to that of their counterparts in rural Ghana, since according to MOWAC (2012), most rural women in agriculture and its related activities in Ghana have large family sizes of four (4) to six (6).

3.3 Types of vegetables and Major sources of production

Vegetables traded in Abinchi night market are mainly exotic. Different types and varieties of vegetables are produced in Ashanti and Brong Ahafo regions, however, Table 1 outlines where huge volumes of these vegetables are mainly produced. Urban and periurban Kumasi supplies significant quantities of these exotic vegetables to the urban market. Neighbouring towns like Tepa, Asante Mampong, Adeitum and some others in Brong Ahafo region also contribute large volumes of vegetables to the market (Table 1). Generally, leafy vegetables such as cauliflower, lettuce and spring onions

are mostly produced in scattered fields in urban and periurban areas of Kumasi (Table 1). Because of the high perishability of these leafy vegetables, it is feared that the distance from farm to the market centre may partly contribute to losses since market is not guaranteed after harvest.

Table 2: Handling systems of vegetables in Abinchi night market, Kumasi

Vegetable	Transportation method(s)	Type of packaging material	Storage method(s)	Expected shelf life/days
Carrot	Open and closed trucks/ Mini vans	Closed-ended jute sacks	Closed-ended jute sacks	7
Cabbage	Open and closed trucks	Closed-ended jute sacks	Closed-ended jute sacks/ open spaces	7
Green Pepper	Open and closed trucks/ Mini vans	Closed-ended jute sacks	Closed-ended jute sacks/ baskets	7
Green Beans	Mini vans	Closed-ended jute sacks	Closed-ended jute sacks/ baskets	7
Cucumber	Open trucks/Mini vans/ Taxis	Closed-ended jute sacks	Closed-ended jute sacks/ baskets	7
Spring Onion	Open trucks/ Taxis	Open-ended loosely tied jute sacks	Open-ended loosely tied jute sacks/ baskets	3-4
Aubergine (Black Beauty)	Taxis/ Mini vans	Open ended jute sacks/ baskets	Open-ended jute sacks/ baskets	7
Lettuce	Taxis/Mini vans	Open-ended loosely tied jute sacks	Open-ended loosely tied jute sacks/ bowls and baskets	3
Cauliflower	Taxis/ Mini vans	Open-ended loosely tied jute sacks	Open ended loosely tied jute sacks/ baskets	4
Squash	Taxis	Open-ended jute sacks	Baskets/ open-ended sacks	7

Source: Field Survey (2013)

Table 3: Cost and revenue analysis for cabbage, carrot and green pepper wholesale haulage on 29th September 2013 (average weight of a sack full in Kg)

	Cost /Revenue (Gh ¢)		
Item	**Cabbage W = 150 Kg**	**Carrot W = 40 Kg**	**Green Pepper W = 50 Kg**
Jute sack full of vegetable	15.00	20.00	60.00
Packing of vegetable into jute sack	2.50	1.00	1.00
Transport of vegetable from farm to farm gate	7.00	1.00	4.00
Loading of vegetable into truck	2.00	0.50	1.00
Transportation from farm gate to wholesale point	10.00	2.00	2.00
Off-loading at wholesale point	1.00	1.00	1.00
Packaging material (jute sack)	1.30	0.50	0.80
Total cost / per sack	**38.80**	**26.00**	**69.80**
Sales price/sack at wholesale point (**Revenue)**	40.00	60.00	100.00
Net Revenue per sack (NR)	**1.20**	**34.00**	**30.20**
Destination of farm / traveling distance	Tepa (78 Km)	Mampong (56 Km)	Bechem (74 Km)

*Distance from farm to farm gate does not readily influence cost of haulage by potters

(Exchange rate: GH¢2.10=US$1.00)

Table 4a: Total Cost, Total Revenue and Net revenue analysis of wholesale haulage of selected vegetables for the month of July 2013 with a standard open truck

	Cost /Revenue (Gh ¢)								
	Cabbage W = 150 Kg(N = 80)			Carrot W = 40 Kg (N = 140)			Green Pepper W = 50 Kg (N = 140)		
Item	**TR**	**TC**	**NR**	**TR**	**TC**	**NR**	**TR**	**TC**	**NR**
3rd	12000	11128	872	16800	11942	4858	21000	17948	3052
7th	12000	11128	872	16800	11942	4858	21000	17948	3052
10th	12000	11128	872	16800	11942	4858	21000	17948	3052
14th	12000	11128	872	16800	11942	4858	21000	17948	3052
17th	12000	11128	872	16800	11942	4858	21000	17948	3052
21st	12000	11128	872	16800	11942	4858	21000	17948	3052
24th	12000	11128	872	16800	11942	4858	21000	17948	3052
28th	12000	11128	872	16800	11942	4858	21000	17948	3052
31st	12000	11128	872	16800	11942	4858	21000	17948	3052
Total	**108000**	**100152**	**7848**	**151200**	**107478**	**43722**	**189000**	**161532**	**27468**

W is weight per sack of vegetable: N is total number of sacks loaded by truck

Table 4b: Total Cost, Total Revenue and Net revenue analysis of wholesale haulage of selected vegetables for the month of August 2013 with a standard open truck

	Cost /Revenue (Gh ¢)								
	Cabbage W = 150 Kg (N = 80)			Carrot W = 40 Kg (N = 140)			Green Pepper W = 50 Kg (N = 140)		
Item	**TR**	**TC**	**NR**	**TR**	**TC**	**NR**	**TR**	**TC**	**NR**
4th	12000	11128	872	16800	11942	4858	21000	17948	3052
7th	12000	11128	872	16800	11942	4858	21000	17948	3052
11th	12000	11128	872	16800	11942	4858	21000	17948	3052
14th	12000	11128	872	16800	11942	4858	21000	17948	3052
18th	12000	11128	872	16800	11942	4858	21000	17948	3052
21st	3200	2728	472	8400	3542	4858	14000	9548	4452
25th	3200	2728	472	8400	3542	4858	14000	9548	4452
28th	3200	2728	472	8400	3542	4858	14000	9548	4452
Total	**69600**	**63824**	**5776**	**109200**	**70336**	**38864**	**147000**	**118384**	**28616**

W is weight per sack of vegetable: N is total number of sacks loaded by truck

Table 4c: Total Cost, Total Revenue and Net revenue analysis of wholesale haulage of selected vegetables for the month of September 2013 with a standard open truck

	Cost /Revenue (Gh ¢)								
	Cabbage W = 150 Kg (N = 80)			Carrot W = 40 Kg (N = 140)			Green Pepper W = 50 Kg (N = 140)		
Item	TR	TC	NR	TR	TC	NR	TR	TC	NR
1st	3200	2728	472	8400	3542	4858	14000	9548	4452
4th	3200	2728	472	8400	3542	4858	14000	9548	4452
8th	3200	2728	472	8400	3542	4858	14000	9548	4452
11th	3200	2728	472	8400	3542	4858	14000	9548	4452
15th	3200	2728	472	8400	3542	4858	14000	9548	4452
18th	3200	2728	472	8400	3542	4858	14000	9548	4452
22nd	3200	3104	96	8400	3640	4760	14000	9772	4228
25th	3200	3104	96	8400	3640	4760	14000	9772	4228
29th	3200	3104	96	8400	3640	4760	14000	9772	4228
Total	**28800**	**25680**	**3120**	**75600**	**32172**	**43428**	**126000**	**86604**	**39396**

W is weight per sack of vegetable: N is total number of sacks loaded by truck

Table 5: Profitability of cabbage, carrot and green pepper wholesale haulage from July to September, 2013

Month	Vegetable	TR(GH¢)	TC (GH¢)	NR(GH¢)	PM	ROI	BCR
September	Cabbage	28800	25680	3120	0.11	0.12	1.12
	Carrot	75600	32172	43428	0.57	1.35	2.35
	Green pepper	126000	86604	39396	0.31	0.45	1.45
August	Cabbage	69600	63824	5776	0.08	0.09	1.09
	Carrot	109200	70336	38864	0.36	0.55	1.55
	Green pepper	147000	118384	28616	0.19	0.24	1.24
July	Cabbage	108000	100152	7848	0.07	0.08	1.08
	Carrot	151200	107478	43722	0.29	0.41	1.41
	Green pepper	189000	161532	27468	0.15	0.17	1.17

PM is profit margin, **ROI** is return on investment and **BCR** is benefit cost ratio

3.4 Handling practices of vegetables

Vegetables are mainly transported with open and closed trucks, mini vans and taxis (Table 2). The choice of type of transport is largely dependent on the size of the batch, financial strength of wholesaler(s), distance of produce from market centre and availability of means of transport. However, cabbage, carrot and green pepper which are mostly produced in large volumes relatively far away from Kumasi are mostly transported in closed and open trucks (Table 2). Most of the vegetables transported with taxis and mini vans are grown in urban and periurban Kumasi (Table 1). Transport of vegetables in open trucks exposes produce to sunlight, high temperatures, and low relative humidity. These conditions often cause rapid water losses and subsequent deterioration in vegetables (Suslow, 1997). The choice of transport is made with no technical considerations.

Vegetables are mostly packed in jute sacks (Table 2). They are roughly packed and stuffed to get as many into the jute sack as possible. This has resulted because the trading of vegetable is not done on weight basis but volumes. It is believed by wholesalers that this act of stuffing increases their gains; however, a careful evaluation shows that regardless of their efforts, a jute sack full of cabbage averagely weighs 150kg (Table 3). Admittedly, there are different sizes of these jute sacks, but for the purposes of this study, the standard sizes mostly used by wholesalers were adopted for each vegetable type throughout the research. Vegetables are very susceptible to mechanical injury (physical damage). Postharvest rots have been found to be more prevalent in bruised or damaged produce. Mechanical damage also increases moisture loss by as much as 3 to 4 times more than that of undamaged produce (Bachman and Earles, 2000). It is observed that these packaging practices adopted by wholesalers, predispose vegetables to mechanical injury which invariably reduces shelf life and causes postharvest losses.

Generally, vegetables distributed from the Abinchi vegetable night market do not suffer obvious physical losses. This is because vegetables are mostly bought by middlemen the very night they arrive from the farm. The methods of storage in Table 2 are therefore those adopted by middlemen. Vegetables usually last with deteriorating freshness for 3 to 7 days under the conditions of storage shown in Table 2. Spring onion, lettuce and cauliflower do not last beyond 4 days after harvest. Other vegetable types may last up to 7 days from harvest (Table 2) but with decreasing physical quality and reduced economic value.

3.5 Cost and revenue of a Jute sack full of selected vegetables

In mid September 2013, a 150 Kg sack full of cabbage in Tepa in the Ashanti region was selling averagely at GH¢15 (Exchange rate: GH¢2.10=US$1.00) on farm (Table 3). This constitutes 38.7% of the total cost per sack with 61.3% constituting the cost of overheads and transportation (Table 3). Transportation alone accounted for 43.8% of the total cost of a sack full of cabbage in mid September. Hine et. al. (1983) observed that as a proportion of final market price, wholesale transport to Kumasi were found to be between 3.5 and 5% for maize, yam and plantain with mean distances of the different crops of between 120km to 200km. However, cabbage with a haulage distance of 75Km recorded 43.8% transport cost out of the total cost just at the wholesale centre, awaiting movement across its value chain for a yet to be determined price at the consumer end. This also confirms Ahmed and Rustagi (1987) who found out that African farmer received only between 30-50% of final market prices with most of the difference going to transport costs.

A 40Kg jute sack full of carrot sold at GH¢20 on farm, representing 77% of the total cost per sack (Table 3). The overhead and transportation cost of a jute sack full of carrot is low compared to that of cabbage. Transporters and head porters believe cabbage is bulkier compared to carrot and green pepper, hence their decision to charge lower for the latter. Carrot attracted the highest net revenue per jute sack full of GH¢34 compared to that of cabbage and green pepper from mid September.

A 50Kg jute sack full of green pepper sold comparatively high (GH¢60) on farm, representing 86% of its total cost. A jute sack full of green pepper also sold GH¢100 at the wholesale centre and attracted a net revenue of GH¢30.20 from mid September as well. An increased fuel price and resultant transportation cost from mid September saw the prices of transportation, cost of jute sack and other overhead cost marginally up; however, this did not significantly affect the total cost and net revenue of a sack full of vegetable. The total cost per jute sack full of vegetable is largely affected by changes in

the cost of a jute sack full of vegetable on farm. In July, a jute sack full of cabbage sold on farm for GH¢120, but at only GH¢15 in August and September 2013. This sharp decline has invariably affected total cost and net revenue.

3.6 Financial analysis of cabbage, carrot and green pepper wholesale haulage (July-September 2013)

The cost and revenue from the purchase and sales of batches of vegetables is erratic between months but relatively stable within months (Table 4a, b, and c). In July 2013, the cost and revenue of vegetables (cabbage, carrot and green pepper) was stable (Table 4a). The cost per sack, transportation, overheard cost and material cost were stable in July 2013. However, cost of all vegetables decreased significantly from 21st of August, 2013. This stability was maintained through September, and marginally increased from the 22nd of September due to fuel price increases in Ghana. Net revenue has been unstable; this is because marginal increases in total cost have not triggered increases in total revenue (Table 4c). Total revenue has been driven by actual cost of batches of vegetables on farm rather than total cost of batches at wholesale centre (Table 4b and c). All auxiliary costs do not significantly move total revenue; except actual cost of vegetables on farm.

Generally, cost of land, labour, irrigation, equipment and tools and farm inputs drives the cost of vegetables, however, it has been observed by Cornish et. al., 2001 that cost of vegetables increases in dry seasons mainly due to cost of irrigation. Therefore, the inconsistent rains in May and June 2013 along the middle belt of Ghana could partly contribute to the high cost of vegetables recorded in July and early August (Table 4a and b).

3.7 Profitability and viability of selected vegetables wholesale

Cabbage, carrot and green pepper wholesale haulage from Tepa, Mampong and Bechem respectively to the Abinchi night market in the months July, August and September 2013 were financially viable (Table 5). The BCR indicated a comparatively high viability for carrot in the month of September (2.35) and indicated a low figure for cabbage for the month of July (1.08). Wholesalers made 12% gains on every cedi invested in the purchase of cabbage in the month of September, 11% profit on total revenue generated from cabbage sold in the same month. Carrot recorded 135% on every unit of investment (Table 5). Cabbage in all months has not been as profitable as carrot and green pepper, but carrot has been highly profitable in all months (Table 5).

4.0 Conclusions

Generally, handling practices in Abinchi vegetable night market do not promote food safety, availability, quality and security. Stacking of vegetables into jute sacks, storage of vegetables in open spaces and transportation in open trucks predispose vegetables to physical damage, high temperatures and senescence. Wholesale haulage of cabbage, carrot and green pepper was viable from July to September 2013. Wholesalers made astronomical gains on haulage of carrot and green pepper, with transport, overhead cost constituting a significant component of total revenue of vegetables at the wholesale-middlemen level. Farmers are mostly disadvantaged since many wholesalers collude to determine prices that may not be favourable to them. The cost of vegetables have been observed to be very erratic, this often erodes capital of wholesalers and contributes to losses too. Over reliance on rain, with supplementary irrigation of vegetables has been identified as a major driver of cost of vegetables. The rental of pumps by farmers and labour for irrigation has adversely contributed to pricing of vegetables. Interventions from relevant stake holders such as the Ministry of Food

and Agriculture (MOFA), Crop Research Institute (CRI) of the Council for Scientific and Industrial Research (CSIR) and others to mitigate the impact of these cost fluctuations by researching and adopting cost efficient methods of irrigation could help stabilize vegetable prices. The adoption of weight based (scales) sales of vegetables instead of selling by volume could also help reduce mechanical damage and help extend shelf life of vegetables.

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