Journal of Economics and Sustainable Development
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.3, No.13, 2012

Analyzing the Economic Benefit of Fresh Tomato Production at the Tono Irrigation Scheme in Upper East Region of Ghana

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Abstract
The cultivation of fresh tomatoes at Tono irrigation scheme by mostly the lowly educated youth is bedeviled by so many challenges. However, even though the full cost of producing fresh tomato at Tono appears to be increasing rapidly over the years under review, the venture is still economically beneficial but with decreasing profitability by using conventional statistics. The average return on investment for 2006 dry season was 4.22 while that for 2010 dry season was 2.34. Thus, there was a general decline in profits over the years. Time series analysis was therefore, carried out to forecast for the next five years which confirmed the declining profits nature of the industry. It was realized that, various interventions from government and policy makers were needed to arrest the appalling situation and make the industry one of the keys to alleviating the chronic poverty in the Upper East Region of Ghana.
Keywords: Time series model, Tono irrigation scheme, Ghana, Tomato production

1. Introduction

Agricultural activities are the main driving forces behind Ghana's economy, accounting for approximately 42 percent of the country's Gross Domestic Product (GDP) and employing 54 per cent of its work force (GIPC, 2001). These activities play vital roles through employment generation, poverty alleviation, food security and enhancing the standard of living by increasing income levels of the rural population. Fresh tomato production is one such significant agricultural activity in Ghana especially in the Upper East Region where conditions are suitable for its all – year – round cultivation. Among the vegetables, tomato is one of the most important vegetables in terms of acreage, production, yield, commercial use and consumption. It is cultivated all over the country due to its adaptability to a wide range of soil and climate (Ahmed, 1976). Ghana has the natural potential and competitive advantage to produce this commodity in commercial quantities for export.

Even though Ghana has the right topographical and agro – ecological conditions and one of the biggest agricultural dams (Tono Dam) in West Africa, the country seems increasingly incapable of producing enough fresh tomato for canned tomato products. In addition, the availability of tomato processing factories for processing the excess tomatoes produced and most importantly, the high unemployment rates in the country has failed to lure the energetic youth into this agribusiness. Available statistics indicates that Ghana is the second largest importer of tomato paste, only second to Germany, consuming an average of twenty five thousand (25,000) tonnes of tomato paste in a year at a total cost of about $25 million dollars (Aryeetey, 2006). Ironically, tomato traders from the Southern Ghana dubbed "market queens" often refuse to purchase fresh tomato directly from tomato producers in Ghana but rather cross into Burkina Faso to purchase the produce.

The "finger pointing" flies in many directions for these depressing developments, but some available literature (Clottey et al., 2009; Yeboah, 2011; Anonymous 2012 a) suggest the following as root causes;

- Major privatization, deregulation and liberalization programmes embarked upon by the Ghanaian government as part of policy conditions of the World Bank and International Monetary Fund (IMF) during the 1980s and 1990s,
- Lack of a secured ready market for fresh tomatoes produced at dam sites,
- Import surge from highly subsidized and under – invoiced tomato paste from Europe thus flooding the Ghanaian market with various brands of tomato paste and
- Post harvest, processing and storage losses by farmers, traders and consumers etc.

In this paper, we evaluated the current state of affairs in the fresh tomato industry at the Tono irrigation scheme, by financially analysing each of the major steps in the production process using conventional statistics. Statistics of the pricing of the commodity was also done in other to determine the economic benefit of this produce. Through a combination of field survey and secondary information from Irrigation Company of Upper Region

(ICOUR), we predicted the trends in this industry for the next five years, provided all things being equal, using a regression analytical model.

2. Methodology

The present study was conducted at Tono in the Kassena – Nankana District within which the catchment of the Tono irrigation project is located. It covers an estimated land mass of 1,674 kilometres square. 80 percent of the land is arable while the remaining 20 percent is covered by forest, rivers, hills and eroded areas. The District falls approximately between latitude 11 °10 ´and 10 °3 ´North and longitude 10 °1 ´West (KNDA, 2006; Anonymous, 2012b) as shown in figure 1. The study area was purposively selected by considering the higher concentration of fresh tomato cultivation during dry season using formal survey methods.

2.1 Sampling

A combination of field survey and literature review was conducted. The primary information (obtained from farmers and "market queens") served as the critical framework for analysis while the secondary information (obtained from ICOUR archives) provided important inputs for understanding the context and rationality behind the status of the fresh tomato production. This combination provided rich context-bound information that lead to explaining the situation more concretely. As a result, both qualitative and quantitative investigation was done (Flyvbjerg, 2004). This has resulted in providing meaningful insights into how the producers and traders perceive various issues and deal with specific business situations. A structured format, therefore, was not used.
A list of 50 "market queens" and 150 tomato farmers were chosen randomly to collect information regarding tomato cultivation and pricing at various intervals. The sampled farmers were not classified due to the non-existence of identifiable categories of farmers in this area. Data were collected through pre-designed interview schedules, questionnaires (semi-structured with probing guidelines) and discussions with ICOUR technical support team.

2.2 Analysis

Conventional statistical analysis using average, percentages, ratio etc. were applied to derive meaningful findings in this study. A discrete time series analytical model was also used to analyse the data obtained. This model was used because of the best fit of the sample data and its versatile component of being able to forecast future observations. In addition, the robust nature of the model being capable of describing, explaining observations and predicting future values made it the model of choice for this work.

3. Results and discussion

The results of personal data of respondents in this research are shown in Table 1 and Table 2 for farmers and market queens respectively. A perusal of Table 1 reveal that majority of the tomato farmers are in their energetic and productive years (20 -39) which was an indication that, tomato production in this area should be more promising with the potential for expansion. However, the educational levels of these farmers were rather low. This high illiteracy rate might have resulted in their inability to adopt improved variety of seeds and improved farming practices leading to the use of wrong dosages and unapproved chemicals, wrong application rates etc. This thus, confirmed earlier report of Bull (1989).

Table 2 shows the age distribution of local market queens who purchase most of the fresh tomatoes cultivated in the study area. Unlike the farmers, majority of the "market queens" had basic or secondary education. They therefore might have had basic knowledge about the dynamics of the market forces that determines the demand for fresh tomatoes and the benefits of being in groups (strong bargaining power). They were therefore aware of times of excess supply of the product coupled with the lack of storage or processing facilities in the area, to offer low prices for the commodity to their advantage. Hence, the farmers were also at the mercy of the "market queens".

3.1 Cost of fresh tomato cultivation

In this study cost of production was calculated on the basis of variable inputs like seed, fertilizer, human labour, agro - chemicals, pesticide, irrigation cost by taking averages. A careful scrutiny of Table 3 revealed that total variable cost (Full cost basis) of fresh tomato cultivation during the dry season was about Gh ¢711.8 per hectare in 2006 to about Gh ¢1830.23 per hectare in 2010. This was an increase of approximately 157.13% within the years under review. Similarly, considering the wet season for the same years under review, the total variable cost was about Gh ¢630.36 in 2006 and Gh ¢1738.5 in 2010. Again, this was an increase in over 175%. When only cash costs was considered, the cost per hectare in dry season was Gh ¢645.8 which was about 91% of the total cost in 2006. Likewise for 2010, cash costs per hectare was Gh ¢1568.23 representing 85.68% of the total cost

of producing fresh tomato. Similar trends were observed in the wet season. Among the different cost items for the various years, human labour cost was the major cost items which accounted for an average of about 46% of the total cost for both seasons. The second highest (13.99%) cost item was fertilizer followed by land preparation (10.94%) with the least cost item being seed (3.80%).

Broadly, there was a steady increasing trend in the full cost of producing fresh tomato at Tono in both dry and wet seasons (Table 3). This trend was attributed to the ever increasing cost of inputs i.e. human labour, land preparation, cost of chemicals etc. In 2009, there was reconstruction of the canals for better circulation of the irrigation water. Therefore, farming in the dry season was not done. Hence, the zero cost for that season.

3.2 Profitability of fresh tomato cultivation

Gross return was calculated by multiplying average marketed yield with the market value of an average unit price of fresh tomato. Return per hectare of tomato cultivation was shown in Table 4. The average yield of fresh tomato was 2.671 t/ha (wet season) which was found to be a bit higher for 2006 year. Hence year 2006 was termed "good year". The average gross return was found to be Gh ¢ 3,007.00 per hectare in 2006 dry season and Gh ¢4, 285.00 per hectare in 2010. The average price of fresh tomato up to the last week of December, 2010 was Gh ¢2.2 per kilogram. The average return over variable cost was observed to be Gh ¢2,455.00 on full cost basis and Gh ¢2,717.00 on cash cost basis for the same year. Corresponding values for the wet seasons for these periods were also shown in Table 4.

In general, considering the years under review, except for dry season 2009, there was an increasing trend in gross returns in fresh tomato production at Tono as shown in figure 2. This increasing tendency can, to a large extent, be explained by the ever increasing market value of the fresh tomato commodity on the market for each season.

Even though, there was a general, increasing trend in gross returns in fresh tomato production, one expected the returns on investments to also increase. On the contrary, there was a general decreasing trend in return on investment as depicted in figure 3. This decreasing propensity can mainly be justified by the continual increase in cost of production of fresh tomato at Tono and the general decrease in yield of the commodity as already shown in Table 3 and Table 4. Thus, the gross returns were increasing at a decreasing rate. This situation confirms other research works available (Bediako et al., 2007; FAO, 2006; Assuming – Brempong et al., 2006). Nevertheless, a return on investment as seen in figure 3 was always greater than unity for all the years under review. Hence, it was still economically beneficial to produce fresh tomato at Tono. However, the opportunity cost analysis of producing tomato at Tono was beyond the scope of this research and hence not considered.

3.3 Seasonal Indexes for the past five years and forecasting for the next five years

Table 5 – 7 show detail calculations of the time series model for Gross Return, Full Cost and Return on investment respectively for both dry and wet seasons using data obtained over the past five years. These calculations where done on semi quarterly basis with 1 and 2 representing dry and wet seasons respectively. In general it was found that the average seasonal index for the Dry season was much higher than the corresponding values of the Wet season. However, estimations for 2011 year showed higher values for the Wet season compared to the Dry season. Thus the average seasonal indexes for the past five years and estimations for the 2011 year were used to forecast for the next five years.

Table 8 shows the forecasting of Gross Return, Full Cost and Return on investment for the next five years. Surprisingly, even though Gross Return was predicted to increase yearly, Return on investment showed a declining tendency for the next five years for all seasons.

3.4 The way forward

Due to the highly perishability of this commodity, the Ghanaian government should regulate the prices during glut periods. Secondly, the country's legislature should apply Article 2 of WTO agreements (WTO, 1994) on safeguard measures in order to safe this industry from total collapse. Or better still the Nigerian example should be emulated by closing all Ghanaian boarders to the importation of tins of tomato paste from Europe altogether.

5. Conclusion

Even though, the market value of the fresh tomato commodity was increasing over the years (2006 -2010), the converse was not true for return on investment. The return on investment for year 2006 dry season recorded the highest value of 4.22 followed by the same year wet season of 3.82. There was a general decrease in these values which may be attributed to the ever increasing cost of production and decreasing marketed yield. Prediction of future values using discrete time series analytical model painted the same "picture". However, since return on investment is greater than unity, fresh tomato production at Tono irrigation scheme is still economically profitable but at a declining rate. The opportunity cost analysis of producing this commodity was beyond the

scope of this research.

Acknowledgement
We wish to express our sincere gratitude first to the management and technical team of Irrigation Company of Upper Region (ICOUR) for their expert advice at moments that we were apparently "lost at sea". Secondly, we are highly – indebted to Mrs Rose Mma Atidoo – a leader of the "market queens" for sharing we us in-depth knowledge about their operations in the market. Also, we are profoundly grateful to Mr. Fatai Usman – a financial analyst, for his proof readings of the financial computations, pieces of advice and constructive criticism that have greatly impacted on the outline of this article. We will be incomplete if we fail to acknowledge the financial support of Mr. Kwaku Appiah – Kubi and Mr. Mathias Akamba. Indeed we are very appreciative for their generous support for bringing this work to fruition.

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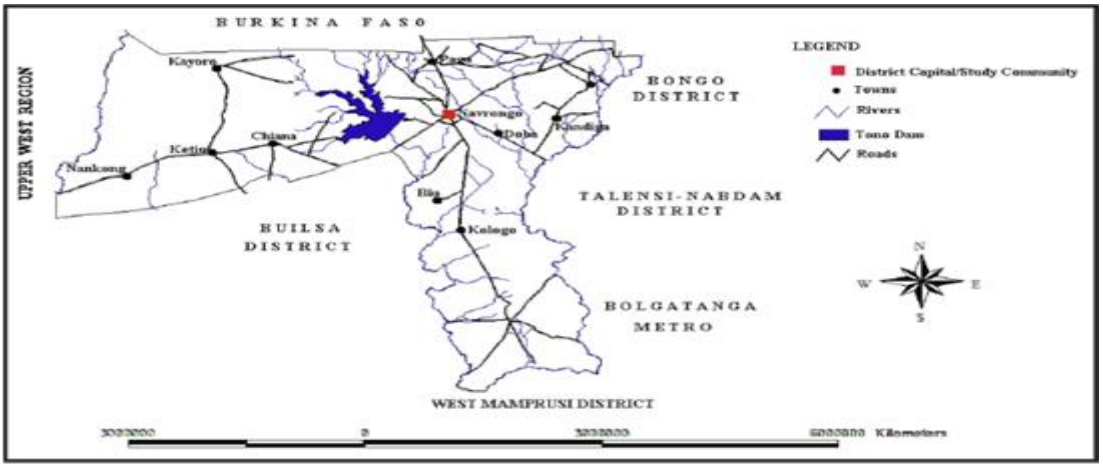

Figure 1. Map of Tono irrigation Dam in the District Context.

Figure 2. A diagram showing Gross Returns

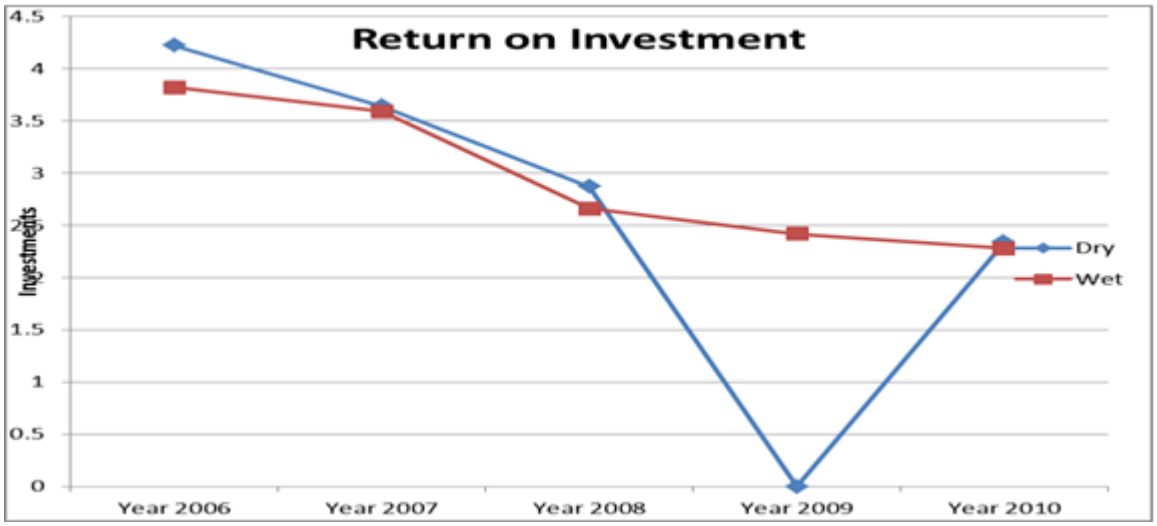

Figure 3. A diagram showing Returns on Investments

Table 1. Personal information on farmers sampled

Age groups (In years)	Frequency	Percentage	Educational level	Frequency	Percentage
10 – 19	17	11	Illiterates	82	55
20 – 29	61	41	Non – formal	18	12
30 – 39	40	27	Basic/ Sec. Sch	35	23
40 – 49	32	21	Dipl./graduate	15	10
Total	**150**	**100**	**Total**	**150**	**100**

Source: Field Survey, 2010

Table 2. Personal information on market queens sampled

Age groups (In years)	Frequency	Percentage	Educational level	Frequency	Percentage
10 – 19	0	0	Illiterates	19	38
20 – 29	7	14	Non – formal	11	22
30 – 39	31	62	Basic/ Sec. Sch	17	34
40 – 49	12	24	Dipl./graduate	3	6
Total	**50**	**100**	**Total**	**50**	**100**

Source: Field Survey, 2010

Table 3. Cost of fresh tomato cultivation on per hectare basis

(Gh ¢/hec.) Cost items	2006		2007		2008		2009		2010	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Human labour:										
Family	66	95	86	115	142	185	0	208	262	310
Hired	185	105	295.7	241.7	420.5	349.7	0	555.5	670	580
Total	251	200	381.7	356.5	562.5	534.7	0	763.5	932	890
Land preparation cost	85	88	100	96	130.56	126.5	0	166.5	205	213
Seed cost	45	45	47	47	48	48	0	48	51	51
Fertilizer N.P.K. (16/8)	120	120	156	156	170	170	0	208	225	225
Sulphur of Ammonia	55	55	63	63	88	88	0	108	126	126
Agro – Chemicals	60.55	60.55	88	88	118.5	118.5	0	126.6	145.5	145.5
Irrigation cost	35	0	45	0	51	0	0	51	60	0
Sundry	60.25	61.81	67.85	70	72.63	73.5	0	79.73	85.73	88
Total variable cost:										
Full cost basis	711.8	630.36	948.55	876.5	1241.19	1159.2	0	1551.33	1830.23	1738.5
Cash cost basis	645.8	535.36	862.55	761.5	1099.19	974.2	0	1343.33	1568.23	1428.5

Source: ICOUR archives and field survey, 2010

Table 4. Return from fresh tomato cultivation (Gh ¢/hec.)

Particulars	2006		2007		2008		2009		2010	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Market value (Gh¢/Kg)	1.2	0.9	1.5	1.3	1.8	1.4	0	1.8	2.2	2
Marketed Yield (t/ha)	2.502	2.671	2.3	2.42	1.974	2.051	0	2.085	1.945	1.983
Gross return	3007	2407	3455	3151	3558	2876	0	3758	4285	3972
Total variable cost										
Full cost basis	711.8	630.36	948.55	876.5	1241.19	1159.2	0	1551.33	1830.23	1738.5
Cash cost basis	645.8	535.36	862.55	761.5	1099.19	974.2	0	1343.33	1568.23	1428.5
Return over variable cost										
Full cost basis	2295	1777	2506	2274	2317	1716	0	2207	2455	2233
Cash cost basis	2361	1872	2592	2389	2459	1901	0	2415	2717	2543
Benefit cost ratio										
Cash cost basis	4.66	4.50	4.01	4.14	3.24	2.95	0	2.80	2.73	2.78
Cost per kilogram	0.28	0.24	0.41	0.36	0.63	0.56	0	0.74	0.94	0.88
Return on Investment	4.22	3.82	3.64	3.59	2.87	2.48	0	2.42	2.34	2.28

Source: ICOUR archives and field survey, 2010

Year	Semi Quarter	Actual Value	Moving Total	Moving Average	Centered Average	Seasonal Index	Average Seasonal Index	
	1	3007					1	2
2006			5414	2707				
	2	2407			2819	85.385	85.385	
			5862	2931				
	1	3455			3117	110.844		110.844
2007			6606	3303				
	2	3151			3328.75	94.660	94.660	
			6709	3354.5				
	1	3558			3337	106.623		106.623
2008			6639	3319.5				
	2	3081			2430	126.790	126.790	
			3081	1540.5				
	1	0			1709.75	0		0
2009			3758	1879				
	2	3758			2950.25	127.379	127.379	
			8043	4021.5				
	1	4285			4075	105.153		105.153
2010			8257	4128.5				
	2	3972					**108.554**	**80.655**
					Estimation for 2011		**5088.679**	**5426.571**

Table 5. Gross Return

Year	Semi Quarter	Actual Value	Moving Total	Moving Average	Centered Average	Seasonal Index	Average Seasonal Index	
	1	711.8					1	2
2006			1342.16	671.08				
	2	630.36			730.268	86.319	86.319	
			1578.91	789.455				
	1	948.55			850.990	111.464		111.464
2007			1825.05	912.525				
	2	876.5			985.685	88.923	88.923	
			2117.69	1058.845				
	1	1241.19			1129.520	109.887		109.887
2008			2400.39	1200.195				
	2	1159.2			889.898	130.262	130.262	
			1159.2	579.6				
	1	0			677.633	0		0
2009			1551.33	775.665				
	2	1551.33			1233.223	125.795	125.795	
			3381.56	1690.78				
	1	1830.23			1737.573	105.333		105.333
2010			3568.73	1784.365				
	2	1738.5					**107.825**	**81.671**
					Estimation for 2011		**2191.833**	**2343.253**

Table 6. Full Cost

Table 7. Return on Investment

Year	Semi Quarter	Actual Value	Moving Total	Moving Average	Centered Average	Seasonal Index	Average Seasonal Index	
	1	4.22					1	2
2006			8.04	4.02				
	2	3.82			3.875	98.581	98.581	
			7.46	3.73				
	1	3.64			3.673	99.115		99.115
2007			7.23	3.615				
	2	3.59			3.4225	104.894	104.894	
			6.46	3.23				
	1	2.87			2.953	97.206		97.206
2008			5.35	2.675				
	2	2.48			1.958	126.692	126.692	
			2.48	1.24				
	1	0			1.225	0		0
2009			2.42	1.21				
	2	2.42			1.795	134.819	134.819	
			4.76	2.38				
	1	2.34			2.345	99.787		99.787
2010			4.62	2.31				
	2	2.28					**116.246**	**74.027**
					Estimation for 2011		**2.825**	**2.985**

Table 8. Forecasting for the next five years

Years	Gross Return		Full Cost		Return on investment	
	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season
2011	5523.94	4376.80	2363.34	1913.75	2.34	2.29
2012	6257.53	4921.85	2689.87	2161.09	2.33	2.28
2013	6991.12	5466.91	3016.41	2408.42	2.32	2.27
2014	7724.71	6011.96	3342.95	2655.75	2.31	2.26
2015	8458.30	6557.02	3669.48	2903.08	2.31	2.26