



## Value Chain Analysis of Tomatoes Production and Marketing in Khartoum State, Sudan

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### Abstract

The study conducted at Khartoum State-Sudan, aiming to evaluate the economics of tomatoes value chain analysis. The study mainly depended on primary data obtained from stratified random sample of 169 respondents composed of 8% traditional farmers, 5% drip irrigation farmers, 28% wholesalers, 44% retailers and 15% consumers selected from the localities of the State. The data collected subjected to descriptive, budgeting, and value chain analysis. The mapping results showed that the wholesalers received tomatoes (50%, 40%, and 10%) from the States of Khartoum, Gazira, and White Nile, respectively. All retailers get tomatoes from central markets of Khartoum State. The results of the budget analysis showed that traditional farmers were able to produce 11 tons of tomatoes per feddan while the drip irrigation farmers were able to produce 25 tons per feddan. Those farmers scored high benefit/cost ratio of 1.16 and 1.96, respectively. The greenhouses produced 5 tons of tomatoes every 2-3 months and scored a benefit/cost ratio of 5.6. The value chain analysis showed that wholesalers scored a benefit/cost ratio of 1.23 after paying the zakat, while the retailers scored a benefit/cost ratio of 1.75 after paying the locality fees, the price share of the traditional and drip irrigation farmers accounted to (16 - 19)% of the consumer price compared to the wholesalers share of (32-36)% and the retailers share of (38 - 41)%. The traditional farmers had 31% as added cost compared to 15% by traders and 54% by retailers. The study recommended the encouragement of production and marketing cooperatives for farmers and traders under close supervision and management of concerned institutions, ministries, national and commercial banks, and introduce adequate and appropriate transportation vehicles and packaging material for tomatoes.

**Keywords:** Value Chain; Tomato; Budget; Marketing Channels; Khartoum State

### Introduction

Tomatoes production is a winter crop which yields bounty quantities at low prices while production shrinks during the rest of the year associated with exceedingly high prices during summer and autumn. Though the crop is a winter crop, it has been widely cultivated as a summer crop in many areas of the country. Sudan grows different varieties including the preferred early maturing Beto 86 and Setrin B, the Gazira open pollinated type as they are tolerant to the heat of summer and the Omdurman open pollinated variety which is tolerant to leaf curl disease.

[1] indicated about 74% of the Gezira tomatoes were channeled to markets of Khartoum (46.7%) and Wad Medani (27.3%). Almost all produced tomato is consumed fresh in large towns and cities,

namely in Khartoum State. Per capita consumption of tomato in Khartoum State is estimated at 30 - 35 kg per annum (State Ministry of Agriculture, Animal Wealth and Irrigation, 2020). The State has the largest consumer market for vegetables and fruits. The population of the State is estimated round 8 million. Based on this data, the annual consumption of tomatoes is estimated at 240,000-280,000 tons which reveals a big gap to be filled by more production.

The selling price during off season however, remained very high, and warranted the need for looking for alternative solution. The introduction of the green houses for producing tomatoes in Khartoum was attempted for many years but was not sustainable due to high cost of production and high risk of infestation of pests and diseases.

In 1980s, Sudan introduced greenhouses to increase the production of tomatoes to bridge the gap between the increasing demand and the fluctuating seasonal supplies of the crop. The use of greenhouses resurged again by the beginning of the millennium in Khartoum, Gezira and Kassala States. Khartoum State has more than 350 greenhouses to grow vegetables mainly tomatoes, cucumber and green pepper.

The marketing of tomatoes takes place largely in the three central markets of Khartoum State. The marketing of tomatoes comes in many forms including direct sale of the crop in the field to middlemen or traders and as transported to the central markets in small and large vehicles. This diversity in marketing opens the question of the most suitable method of marketing vegetable crops in Khartoum State.

Available studies on tomato marketing in Sudan and elsewhere revealed high prices obtained by early grown tomatoes harvested in late September in Khartoum markets [2]. In the same pattern, tomatoes prices tended to move up from May to peak in July-August, and drop down slowly by September in Omdurman Central Market of Khartoum State. The supplies of tomatoes start to increase from November and peaked in December-January. July-August scores the highest prices. Omdurman market receives most of the inflow of tomatoes supplies during autumn.

Despite production efforts, a high shortage keeps occurring during summer months of each year from April to September, with resultant high prices to consumers. The selling price during off season however, remained very high, which warranted the need for looking for alternative solution.

The exact date of the introduction of tomato into Sudan has not been recorded. However, it is possible that the tomato was first introduced by Egyptians in 1821 [3]. It became a popular vegetable crop ranking second to onion in terms of cultivated areas.

Tomato is grown all over Sudan and extensively produced in agricultural areas around cities. The main production areas are concentrated in the northern part of Gezira scheme, southern part of Khartoum State [4,5]. The main production areas are Gezira scheme (more than 16000 feddans), the river banks in Gezira (about 1847 feddans) especially in Botana province, South Blue Nile State, Kassala and Khartoum States [6].

A value chain can be defined as the full range of activities which are required to bring a product or service from conception, through

the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final customers, and final disposal after use.

The chain actors who actually transact a particular product as it moves through the value chain include input (e.g. seed suppliers), farmers, traders, processors, transporters, wholesalers, retailers and final consumers.

Value chain analysis overcomes a number of important weaknesses of traditional sectoral analysis which tends to be static and suffers from the weakness of its own bounded parameters. For restricting itself to sectoral analysis, it struggles to deal with dynamic linkages between productive activities that go beyond that particular sector, whether they are of an inter-sectoral nature or between formal and informal sector activities. Value chain also goes beyond the firm-specific analysis of much of the innovation literature. By its concentration on inter linkages, it allows for an easy uncovering of the dynamic flow of economic, organizational and coercive activities between producers within different sectors even on a global scale. An approach used in value-chain analysis depends on the research question [7]. Accordingly, four aspects of value-chain analysis have been applied in agriculture.

#### The market map.

The market map is a conceptual and practical tool that helps identifying policy issues that may be hindering or enhancing the functioning of the chain and also the institutions and organizations providing the services (e.g., market information, quality standards) that the different chain actors need in order to make better informed decisions.

The Market Map is useful to understand more about the rationale behind farmers' decisions such as the types of seeds that farmers purchase. It also helps to know about the extraneous factors that influence the way that the value chain works.

The value chain concept entails the addition of value as the product progresses from input suppliers to producers and consumers. A value chain, therefore, incorporates productive transformation and value addition at each stage of the value chain. At each stage in the value chain, the product changes hands through chain actors, transaction costs are incurred, and generally, some form of value is added. Value addition results from diverse activities including bulking, cleaning, grading, and packaging, transporting, storing and processing [8] as shown in the figure below for the case of a typical agricultural value chain.

### The problem statement

Tomato is a nutritious winter vegetable crop that has secured a high demand in the Sudanese food menu. In Sudan, seasonality and perishability are two main problems affecting tomato marketing in terms of quantity supplies and price fluctuations.

Tomatoes are produced under irrigation in open fields and in green houses. Tomatoes production and marketing face several problems. One of the problems is the increased diversity of tomato production in autumn and summer in the different parts of Sudan which could not solve the marketing seasonality problem in the central markets of Khartoum State. Another problem relates to the inadequate supplies due to shortage of cool storage and proper transportation facilities and there high costs.

The tomatoes perishability characteristic creates a peculiar problem to the marketing process as it relates to the low elasticity of supply and high elasticity of demand which forces producers and traders take rapid decisions on selling the crop at enforced prices in an extremely short-run market channel process.

The main objective of the study was to map the value chain of tomatoes crop production and marketing process.

### Methodology

The value chain approach provides a comprehensive framework to identify the main constraints and linkages among producers, traders and processing industries and final consumers. It describes the full range of activities through which tomatoes crop passes. The chain starts from the crop production farm and crosses into markets (and processing plants) and finally into the hands of the consumers. Thus, the chain includes activities of production, marketing, distribution and support to the final consumer.

The study examined the value chain that links and relates between the different actors engaged in the production, trade and consumption of tomatoes product in Khartoum State. This entailed, especially, the link between farmers and middlemen, transporters, wholesalers, retailers and consumers. The main actors and their functions are discussed briefly below

- **Producer/Farmer:** A farmer is a person who takes the responsibility of producing the crop,
- **The middleman/Commission agent:** A middleman is a person who gathers the produce and sells them to large-traders, processors, retailers [9].

He looks for buyers, negotiates appropriate prices, sells the tomatoes, collects the money and hands it over to the farmer, accordingly he receives a commission.

- **Wholesaler:** He is a person who purchases large quantities of the products given his better financial position and information capacity. He buys large volumes of the product at the farm gate and from assemblers [10].
- **Retailer:** A retailer is a small trader who buys and sells small quantities of tomatoes to the consumers. The function of retailing is undertaken by a large number of actors depending on the point of sale along the supply chain. They can be found on the roadside and in the market places, groceries and in supermarkets.
- **Consumer:** A consumer is the final receiver of the product. He purchases the product for consumption.

The key steps of the value chain analysis involve

- Mapping the farmers, traders, processors and others in the value chain,
- Identifying the distribution of benefits among the chain participants,
- Examining the role of grading within the chain,
- Understanding the role of governance in the chain.

The study carried out the analysis of the value chain from the perspective of the producers through two dimensions

- Increase total amount and value of products of the producers in the value chain, thus increasing their incomes.
- Sustaining the share of the producers' income from engaging in the market.

### Method of data collection

To achieve the objectives of the study, the following methods of data collection and data analysis were followed

- **Primary data:** The tomatoes producers' responses to the detailed questionnaire are the main source of the primary data in this study. The producers were selected from two different localities in Khartoum State representing a wide area and capture possible impacts that may arise from geographical locations of producers. The other types are informal interviews with community leaders, village traders, wholesalers, in the market, secondary data were collected from relevant sources.

### Sample size

The design of sample was stratified random sample with the following strata sizes, 30, 40, 24, 50) for farmers, wholesalers, retailers, and consumers, respectively.

The study employed two analytical methods, namely descriptive analysis, and budgeting analysis. The descriptive statistical method aims to analyze socio-economic characteristics of tomatoes producers, traders and consumers in Khartoum State. The descriptive analysis used frequencies, means and cross tabulation analysis describes, evaluates and analyzes the variables used to study the producers’ marketing behaviors.

Budget analysis was used to calculate the profitability of producing tomatoes in the State. The budgeting method gives estimates of receipts (income), costs (spending) and profits associated with the production of agricultural products. Costs are divided into variable and fixed costs. Variable costs are production costs that take place during production stage while fixed costs are imposed whether production takes place or not. The budget in this study is based on tomatoes crop production and shows how an optimal production system contributes to the profit.

The Marketing margin analysis was used to estimate the margin in terms of revenue and profit that accrue to the tomato marketers. Marketing margin can be estimated as

- **Marketing Margin:** Selling Price - Cost Price
- **Net marketing margin:** Marketing margin-marketing cost.
- **Net Marketing Margin for Wholesaler:** Wholesale marketing margin - Wholesale marketing cost.
- **Net Marketing Margin for Retailer:** Retailer marketing margin - Retailer marketing cost.

**Marketing efficiency:** shall be measured as

- Marketing efficiency:  $(\text{Gross marketing margin} / \text{marketing cost}) \times 100$

Also, Shepherd formula technique shall be used as follows

- Marketing efficiency:  $(\text{Consumer price} / \text{Total marketing cost}) - 1$ .

Results and Discussion

Mapping the tomatoes value chain in Khartoum State

From discussion with farmers and traders, it was indicated that producers sell their tomatoes crop to primary traders in the production area who act as agents for larger traders in Khartoum markets or sell directly to market agent in Khartoum State. About 60% of the famers sell tomatoes to the wholesalers while 30% prefer to sell to middlemen and 10% prefer to sell to retailers.

The market agents in turn sell tomatoes through different channels. They sell directly to consumers or to wholesale traders, who in turn sell to retail traders.

About 50% of the wholesalers prefer to sell their tomatoes to retailers while 30% prefer to sell to middlemen and 20% prefer to sell directly to consumers. There were few middlemen who purchase from two channels. About 30% prefer to buy from wholesalers while another 30% prefer to buy from the famers. Almost all middlemen sell directly to the consumers while only few sell to traders or to other middleman. The retailers sell directly to consumers.

The field survey results showed that the wholesalers received tomatoes from Khartoum (51%), Gazira (40%) and the White Nile (10%) States (Table 2).

Wholesalers				
Market	Bahri	Khartoum	Omdurman	Total
	25%	42%	33%	100%
Source of market received from				
Khartoum	13%	21%	17%	51%
Gazira	8%	17%	15%	40%
White Nile	4%	4%	2%	10%
Total	25%	42%	34%	101%

Table 2: Distribution of wholesalers by the source of tomatoes markets.

Source: data of survey 2020-21.

The value chain analysis

The value chain describes the full range of activities which are required to bring a product from conception through different phases of production in order to deliver a valuable product to market.

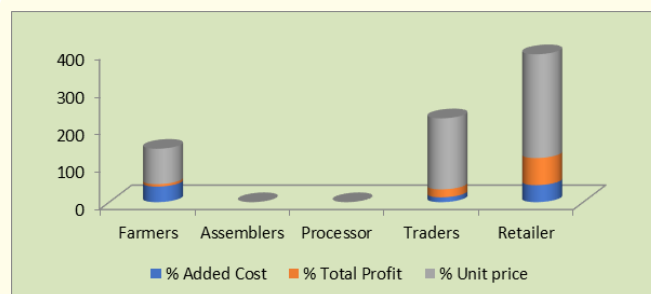
Traditional farming system

For tomatoes produced under traditional farming system, as shown in table (3) the farmers add 47.5 unit-cost while the traders add less unit cost, about 24, and the retailers add more unit cost, about 84. The added cost for farmers was estimated at 31% of total added cost compared to 15% for traders and 54% for retailers in the chain. The farmer gets 203 as a unit margin compared to 80.5 units for wholesalers and 277 for retailers. The small unit cost of the traders is paid on larger amount of traded tomatoes which rewards extremely high returns.

The traditional farming system shows that the farmers incur high cost and relatively high profits (Figure 1). The traders have less profits while the retailers have relatively high profits. Transportation costs are high and are increasing with time. This suggests that the costs and margins are shared unequally in the value chain and there must be an intervention. One of the interventions may be of scaling up the business of actors in the chain to make the business more attractive for the actor.

#### Drip irrigation system

For tomatoes produced under drip irrigation farming system as shown in table (4), the farmers add 76.9 unit-cost while the traders add less unit cost, about 24 and the retailers add more unit cost,



**Figure 1:** Value Chain Margins for Each Actors in each level of the value chain as a percentage of the overall value added, traditional system.

Value chain Actors	Cost			Revenue	Profit		Margin
	Unit total cost	Added unit total cost	% Added cost	Unit price	Unit profit	% Total profit	Unit margin
Farmers	47.5	47.5	31	203.5	156	38	203.5
Assemblers	-	-	-	-	-	-	-
Processers	-	-	-	-	-	-	-
Traders	227.5	24	15	284	56.5	14	80.5
Retailers	368	84	54	561	193	48	277
Total	-	155.5	100	-	405.5	100	561

Serial	Where	Cost SDG
A	Framers unit total cost	47.5
B	Assemblers added cost	
C	Processors added cost	
D	Traders Added Cost	24
E	Retailer added cost	84
F	Total cost of all actors	155.5
G	Farmers Unit price	203.5
H	Assemblers Unit price	
I	processors unit price	
J	Traders unit price	284
K	Retailers unit price	561

**Table 3:** Calculation of Value Chain Marketing Margins.

**Source:** data of survey 2020-21.

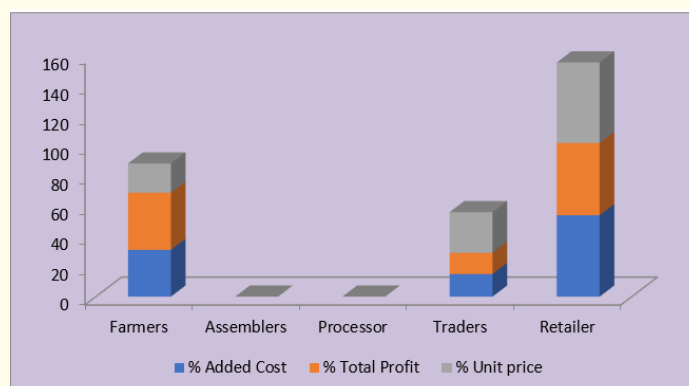
about 84. The added cost for farmers was estimated at 42% of total added cost compared to 13% for traders and 45% for retailers in the chain. The farmer gets 94.4 as a unit margin compared to 189.6 units for wholesalers and 277 for retailers.

Figure (2) indicates that drip irrigation farmers incur high costs and have little profits while the traders and retailers have less costs and relatively higher profits. The costs and margins in drip irrigation farming system are shared more equally in the value chain

Value chain Actors	Cost			Revenue	Profit		Margin
	Unit total cost	Added unit total cost	% Added cost	Unit price	Unit profit	% Total profit	Unit margin
Farmers	76.9	76.9	42	94.4	17.5	7	94.4
Assemblers	-	-	-	-	-	-	-
Processors	-	-	-	-	-	-	-
Traders	227.5	24	13	284	56.5	21	189.6
Retailers	368	84	45	561	193	72	277
Total	-	184.9	100	-	267	100	561

Serial	Where	Cost SDG
A	Farmers unit total cost	76.9
B	Assemblers added cost	
C	Processors added cost	
D	Traders Added Cost	24
E	Retailer added cost	84
F	Total cost of all actors	184.9
G	Farmers Unit price	94.4
H	Assemblers Unit price	
I	processors unit price	
J	Traders unit price	284
K	Retailers unit price	581

**Table 4:** Farmers using Drip water Irrigation system.



**Figure 2:** Value Chain Margins for Each Actors in each level of the value chain for drip irrigation system.

contrary to the traditional farming system. This could be an intervention point for the business to be more attractive for the actors by scaling up through introducing agricultural products processing.

## Conclusions

The study concludes that reliable statistics on tomatoes area and production in Sudan are lacking. Even though, the study con-

cludes that tomato is becoming an important crop grown in many parts of Sudan. Seasonality and perishability are very important factors limiting the regular supply of the crop all year round. The poor transportation and packing of the crop results in high waste and spoilage of the commodity especially when transported from remote areas. Absence of appropriate harvest and post-harvest practices also lead to more crop loss and damage.



Processing into dry and canned tomatoes are the only alternatives for permanent supply of tomatoes in Sudan. Greenhouses system is another source for supplying fresh tomatoes all year round but is expensive and faces a lot of technological problems.

Supplies of tomatoes come in most cases from proximate areas (Khartoum, Gazira and White Nile) while tomatoes produced in other areas (Red Sea, Kassala, Gdarif, Kordofan and Darfur) find difficulty in arriving central markets in fresh and good conditions. This could be related to the type of vehicles used in transportation, the type of containers used in packing the crop (tins).

The study recommended the encouragement of production and marketing cooperatives for farmers and traders under close supervision and management of concerned institutions, ministries, national and commercial banks, and introduce adequate and appropriate transportation vehicles and packaging material for tomatoes.

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