

Modelling the Domestic Supply Chain Strategies of Moringa Oleifera Trade within Local Context of Niger State, Nigeria

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Abstract

The supply chain of Moringa Oleifera, one of the Vegetable and Traditional Herbal Medicine (V-THMs), produced for the confined and broader domestic markets of Bosso and Chanchaga Local Government Area of Niger State, Nigeria was explored together with the current practices of the supply chain actors. The confined and broader domestic supply chain involved growers, pickers, wholesalers and retailers who participate in the growing, harvesting and marketing of the vegetable using the chain of Beji growing fields-Maikunkele market-Bosso market-Kasuwan Gwadabe vegetable market Minna-Kure market-Kasuwan Tunga. Post-harvest loss was about 32.6% in the confined supply chain and 42.7% in the broader domestic supply chain. In both chains, growers suffered the highest loss of about 52% due to temperature, decaying and shedding. Damages incurred by pickers in the confined supply chain was 9% while in the broader domestic supply chain, the loss was 14%. Price irregularity was also obvious in both confined and broader domestic chains. To develop the livelihood of growers, a merging system that synchronizes and unswervingly link production activities and post-harvest procedures to regularly meet product capacity and value requirements of the domestic market required. It is therefore, recommended that reducing product damage requires production and post-harvest interpolations, which includes proper pest control, proper harvesting procedure, proper pruning procedure, improved packaging and logistics.

Keywords: Moringa Oleifera, domestic supply chains, Bosso, Chanchaga, Nigeria

JEL Classification: Q11, R31

1. Introduction

Niger state economy deeply depends on agriculture which contributes about 14% to GDP as 53% of the population actively participates (Mukhtar, 2019). The state is located in the north central geopolitical zone of Nigeria. It is bordered by five other states with high level of involvement in agricultural value and supply chains (Kwara, Kebbi, Kaduna, Kogi and the FCT), the state plays a tactical role in inter-regional trade as well as cross-border trade between Nigeria and Benin Republic. The total land area is 76,363 km² and about 18% of the total population of over 3.9 million is engaged in farming and livestock keeping, with vegetables being one of the most important plants grown for transaction and consumption. Moringa Oleifera is one of the agricultural flowering plants, though a Vegetable and Traditional Herbal Medicine (V-THMs) among many others such as sugar cane, sorghum, cassava, maize, melon, shea butter

etc. which are being listed for technological interventions and market support to strengthen production, marketing and consumption of agricultural products as a way to attain food security, alleviate poverty, and develop the rural economy as discoursed by Muhammed et al., (2021) in their study while assessing the economic relevance of Moringa Oleifera.

Moringa Oleifera is a flowering plant cultivated by smallholder farmers and it is mostly produced in many local government areas of Niger state with *Bosso* and *Chanchaga* L.G.As are part of it, in the context of this study, the supply chain flows from *Beji* growing fields-*Maikunkele* market-*Bosso* market-*KasuwanGwadabe* vegetable market *Minna-Kure* market-*KasuwanTunga*. To improve production and marketing efficacies and to improve the presence of agricultural produce in the confined and broader domestic markets and create competitiveness, a supply chain strategy to product quality control is imperative. This control mechanism should target smallholder farmers who are the main actors at the base of supply chains; if not, they would become more susceptible to relegation in the face of global supply chains (GSC) due to their low output, poor productivity, and limited market access (Eyinda et al., 2008; Reinecke & Posthuma, 2019). Analysis of supply chains is important in the quest for developing sustainable and responsible supply chain management systems that create opportunities for the rural poor to take part in domestic, regional and international trade (Woods, 2003; Wali et al., 2021). Creating a market-oriented supply chains is precedence for rural agricultural development in Niger state. Previously, the state confined supply chains for certain vegetables such as (pepper, tomato, spinach and cabbage) which have been categorized to be comparatively multifaceted involving several actors like pickers, suppliers and retailers. Comparable condition existed for food flowering plants such as (yam and cassava) produced in Niger State (Tsavhembra, 2021). For Moringa Oleifera produced in *Bosso* which is the main growing area, the confined and broader domestic supply chains have not been evaluated, hence this research was steered with a view to developing improved and sustainable supply chain management within the rural context.

Many researchers have documented problems related to domestic supply chains, most especially problems faced by growers, pickers, wholesalers and retailers dealing in Vegetable and Traditional Herbal Medicine (V-THMs) in different areas of the world. Muhammed *et al.* (2021) wrote on the specific cases of Moringa Oleifera in the context of Northern Nigeria. For growers and suppliers, the problems include: lack of access to swift market information and supply chain management in relation to quantity and quality demanded in various domestic open markets, poor knowledge of how the innovative modern wet markets function, lack of adequate sorting and packaging skills, low yield, profit and return margins expected and received by growers and poor negotiation skills by suppliers. Actors of Global Supply Chain asserted that to achieve sustainability, frameworks of the numerous combination of capital assets need to be sustained (Singh & Srivastava, 2020). In practical reality supply chains are followed, overtly and often subliminally, predominantly in the short term. In circumstances where populations where there are opportunities such as arable land, cultivable, such as in North-Central Zone of Nigeria (Mukhtar, 2019) and availability of cheap labour, optimization in asset use especially between natural and capital asset can lead to decrease in poverty and increases in wealth creation in the long term. Much discussion has concentrated on how to limit poor supply chain networks whilst increasing interconnections or at least not compromising sustainability of ethical supply chains

within the rural context (Zaku *et al.*, 2015). Studies on the relationships between supply chain management and development based on V-THMs have emphasized that it is extremely problematic to achieve a balance within complexes of supply chain networks (Chiu *et al.*, 2021). The indicators and variables used in Muhammed *et al.*, (2021) study offers a clear theme for exploring the connections between supply chain actors and supply network. It is this assertion that the research is building on to explore moringa oleifera supply chain within the local context of Niger state Nigeria.

2. Literature Review

Nature of V-THM Trade

Mapping supply chain and the nature of trade and value can be unknotted using different perceptions. V-THMs had multiple values. Commercial metrics are one of the most shared perceptions. However, the value of an agricultural product can also be seen in its socio- cultural or environmental views and can be holistically implicit in terms of its impact on people's means of livelihoods and wellbeing. The Sustainable Supply Chain Framework (SSCF) provides a structure clarifying the provisioning purposes of networking in supply chain and how these are linked to improved trade and integrates many of the source of the capital assets utilized. The SSCF posits that societies are fundamental in trading and that a vibrant communication exists between supply chain actors and society. The fluctuating trading condition determines, directly and indirectly, supply chain changes and thereby causes deviations in business. In comparable circumstances, social, economic and cultural factors unconnected with trading modify the business condition and many unusual forces impact trading. Despite this unambiguous relationship between agricultural products such as V-THMs and other commodities, the SSCF does not provide approaches for appraising these, in relation with economic values, although essential, socio-cultural influences are revealed. It does however promote non-market standards which are incorporated into supply chain networks.

Various types of V-THM markets in Northern Nigeria have been categorized. Prices are essential economic measures, nonetheless, may say more about specific market underlying forces than the product or its significance to livelihoods. Additional ways of valuing harvests include consumer inclinations (Ayeni *et al.*, 2016), replacement alternatives (Yaseen & Hajos, 2020) and access to substitutes to control the safety-net purpose (Keatinge *et al.*, 2015). Market values can be implicit not merely as transitory quantifiable dimensions of opportunity costs, but then again also as social procedures in which supply chain actors incessantly assess existing situations and options in relations to the considerations of the past. As historical evidences can be declaimed in more than one approach, market values can be uncertain. This can however be used to register the reactions to domestic and global forces of demand over time.

3. Methodology

The methodology used in pulling together information and analysis of data were funneled by the Sustainable Supply Chain Framework (SSCF). These combine network relationship with value chain development (Keatinge *et al.*, 2015). This implies that an analysis of actors along the moringa oleifera supply chain (growers, pickers, wholesalers and retailers), control measures for sustainability, acknowledging that multiple market governance structures set their own standards (Maroyi, 2009). Correspondingly that fusion activities (supply chain platforms and supply networks) develop from collective action. The Methodology innate in supply chain analysis include content analysis of literature, semi-structured interviews and overt observations

of supply network arrangements; and the influences of fluctuations in the supply chains. The research themes were selected by defining the actors involved, their location and networks as well as temporality of the period they network.

Moringa Oleifera Supply Chain Mapping

Confined and broader domestic supply chains for *Moringa Oleifera* produced in *Bosso* and traded up to *Chanchaga* L.G.A, Minna, were identified and mapped following the actors to the base of their livelihood between March-April 2022. *Beji* town is the central production site being the main *Moringa Oleifera*-growing area in the L.G.A. The supply chains for *Moringa Oleifera* were identified through the key local government extension officer who gave us the key contact points in the both supply chains. These actors were interviewed to define the key growers, pickers, suppliers and retailers in the confined and broader domestic supply chains as dependable reference points. Short emersion visits were conducted to interview the important supply chain actors, plan the supply chains for identification via mapping, and gather preliminary information on current practices and constrictions.

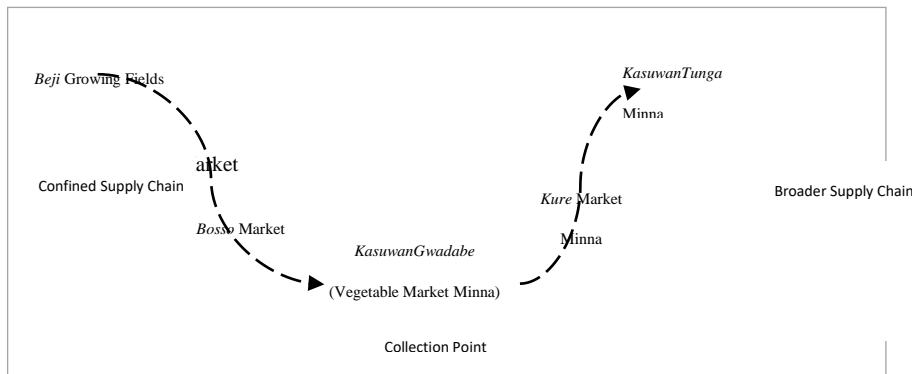


Figure 1: Mapping *Moringa Oleifera* Supply Chains in *Bosso* and *Chanchaga* L.G.As of Niger State, Nigeria. Source: Research findings

Current Harvesting Practices

Subsequently, the supply chains were mapped and an in-depth investigation was conducted in mid-April 2022 to register the current postharvest practices and acquire postharvest damage estimation at diverse stages in the confined and broader domestic supply chains. A questionnaire was developed, placed under pre-test, and refined prior to conducting the survey. Utilizing the sample size principle in shaping the suitable number of respondents. 40 respondents were selected randomly from the confined supply chain (from *Beji* to *Maikunkele*) comprising of 20 growers, 6 pickers, 4 suppliers and 10 retailers. For the broader domestic supply chain (from *Bosso* to *Chanchaga*), 55 respondents comprising of 25 *Chanchaga* suppliers, 15 *Maikunkele* pickers and 15 *Beji* wholesalers were covered in the survey. More so, activities in each supply chain were documented by discerning numerous activities from the farm through the supply chain network. The outcome was analyzed using SPSS, frequencies and averages were capitalized upon.

4. Results

With reference to Figure 1, the confined and broader domestic supply chain plots the chain for *Moringa Oleifera* produced in *Beji* town, *Bosso* L.G.A and transported to and

retailed at *Maikunkele* and *KasuwanGwadabe* fresh vegetable wholesale market respectively. The confined supply chain involved four players; growers and pickers in *Beji*, suppliers in *Maikunkele* Vegetable Wholesale Market to *KasuwanGwadabe*, and retailers in *Kure* Market. Growers brought the collected *Moringa Oleifera* to the market square, about 3 km away on average. After settling order from the *KasuwanGwadabe* wholesaler, the pickers arranged transport for packed *Moringa Oleifera* usually by commercial bus from *Beji* market to the wholesale market in *KasuwanGwadabe*, about 25 km away or 30 minutes' travel. Upon arrival at *KasuwanGwadabe* wholesale market, the *Moringa Oleifera* packs are distributed to retailers within the same market and nearby *Kure* and *Tunga* markets in *Minna* city.

On the other hand, the broader domestic supply chain had three main players; growers and pickers from the *Beji* side and *Maikunkele* suppliers who are also suppliers and retailers. As in the confined supply chain, growers delivered the *Moringa Oleifera* to the market square over an average distance of 4 km and directly loaded to the pickers' tricycle. After combining about 7 tons produce per truck load, the pickers transported the *Moringa Oleifera* unpacked to *New Bosso* Market, a semi-urban trading center under *Bosso* L.G.A, it is nearer to the *Gwadabe* and *Kure* markets, about 3 km away or 10-12 minutes' drive on average. The *Maikunkele* suppliers transported the packed *Moringa Oleifera* using their own truck (10-wheeler truck, tricycle or pick-up) to the wholesaler's shops at *Kasuwan Gwadabe* fresh vegetable wholesale market. Upon arrival, the *Moringa Oleifera* are spread and re-packed for retail or distribution base on request to other retailers within and outside the market.

Demographic Analysis of Moringa Oleifera Supply Chain Actors

Men dominate the entire supply chain, growers in both confined and broader domestic supply chains have an average farm size of 2.4-10.6 hectares producing more than 1300 tons of *Moringa Oleifera* per annum (see table 1). Growers in the confined supply chain are older in age and had more farming experiences in *Moringa Oleifera* planting and harvesting than those in the broader domestic supply chain. On the other hand, pickers, suppliers and retailers in the confined supply chain were mostly females with children

Table 1: Demographic Representation of Confined and Broader Domestic Supply Chain of the Study Area

Categorization of Supply Chain (SC) Actors	Gender Ratio	Age	Duration of Participation	Farm Size	Quantity of Output
Confined SC					
<i>Growers</i>	63.62	33.6	14.6	2.4ha	58.9ton/p.a
<i>Pickers/harvesters</i>	27.19	43.3	12.7		
<i>Suppliers</i>	1.76	39.2	12.8		
<i>Dealers</i>	20.35	27.3	10.3		
<i>Retailers</i>	83.26	42.1	12.2		
Broader SC					
<i>Growers</i>	66.71	33.6	14.6	10.6ha	1300ton/p.a
<i>Beji harvesters</i>	49.17	21.2	6.3		
<i>Maikunkele harvesters</i>	62.10	22.1	6.4		
<i>Suppliers</i>	52.32	39.2	12.8		
<i>Retailers</i>	48.23	23.4	10.8		

Source: Author's Computation

also participating, they are relatively younger, and had been in the business for about 12-14 years. Pickers who are mostly family member with few hired workers traded the

largest volume of produce while retailers have the smallest quantity to sell to consumers as expected because pickers relate directly with a number of suppliers before transporting the produce from *Beji* to *KasuwanGwadabe*. In the broader domestic supply chain, *Maikunkele* pickers are mostly male whilst some of them are also transporters in this regard. The *Tunga* market retailers are mostly women and had extensive business experience than their male counterparts. Sometimes, they boycott the normal supply chain and mopped the Moringa Oleifera from different suppliers before transporting it to *KasuwanGwadabe*; as a result, the traded capacity was about four times higher than that of sub-linkages.

Postharvest practices

In both confined and broader domestic supply chains, growers collected the Moringa Oleifera based on freshness, the number of days from the period of previous harvest to the new one matters a lot to the pickers. When matured and Moringa Oleifera is not collected right away it may lead to shedding of leaves and subsequently change in colour instead, majority of the growers would plug the leaves after every 2-4 days as a routine. Delaying harvest could lead to drying and weakening, which is a typical indicator of shedding, and subsequently, loss of quality. A significant number of growers (60%) in the confined supply chain collected the Moringa Oleifera after getting order from the buyers. This wouldn't cause ripeness problem if the buyers' ordered on timed when Moringa Oleifera reaches its proper maturity stage. Otherwise, complications with over-stay (e.g. yellowish colouring and shrinking weight) could be noticed. Harvesting was usually done by cutting the stock of the Moringa Oleifera branch using an ordinary small knife, which is a good method compared to the conventional practice of deracinating the whole stem of the plant.

Pruning, arranging, wrapping, storage and logistic were the usual tasks following harvesting. Differed with supply chain. In the confined supply chain, growers brought the Moringa Oleifera usually unpacked (loosely managed) to the wholesalers using an open-body pickup truck where both growers and pickers plugged the Moringa Oleifera of their stock leaves with sharp knife. The plugged Moringa Oleifera were then placed in a jute sack. In this context, weighing is not a prerequisite for determining quantity or as basis for payment to growers. Moringa Oleifera is removed from the jute sack and placed on a bare sandy floor. Moringa Oleifera is then sorted based on bulkiness and restrictions from insect invasion despite being on the ground covered with sewed shred sacks to prevent dryness. The twine wrapping practice is a form of adapted air wrapping (AAW) that could lessen excessive shrinking during transportation to other collection points especially to *KasuwanGwadabe*. Nevertheless, disadvantages of its use include insufficient fortification against physical destruction and the likelihood of generating warm and humid conditions inside the package during elongated stocking which could promote bacterial tender decay development. This is a serious concern in view of that packed Moringa Oleifera is may lost stock leaves as protective stock layer.

The bags of Moringa Oleifera transported to *KasuwanGwadabe* by commercial truck by stacking the bags on top of the truck and covering them with tarpaulin. Upon arrival in *KasuwanGwadabe*, the Moringa Oleifera were again striped of damaged leaves and protruding butt by both suppliers and retailers and sorted based on the same criteria as that of pickers. Suppliers then distributed the Moringa Oleifera mostly unpacked to retailers using tricycle. Retailers transported the Moringa Oleifera to the market by commercial transport using mostly *Keke-Napep* which is like a cabin compartment attached to a motorcycle. In retail markets, Moringa Oleifera were usually displayed

unpacked. In the broader domestic supply chain, the buyers implement value addition activities, which includes pruning the stem and all stock leaves, arranging based on bulkiness, and packing in polythene bags for domestic or commercial cooking

Postharvest damages

In both confined and broader domestic supply chains, growers incurred the maximum loss of slightly over 40%. Main causes were discolouration, insect and pest damage, decaying and shedding which were principally of pre-harvest source. From the supplier to retailer level, damages differed with supply chain. In the confined supply chain, the pickers incurred about 8% loss due to physical damage as a result of careless management during pre-packing procedures. Suppliers sustained much higher loss of 12.6% on regular basis as a result of bacterial tender decay that usually developed on the damaged parts of the *Moringa Oleifera* stock. The temperature conditions inside the twine wrap during the 30 minutes' journey from *Beji* to *KasuwanGwadabe* possibly delivered unsatisfactory circumstances that can result into rot. At the retailers' level, projected loss was about 2% due to shedding and pruning of floppy stock leaves and dehydrated parts caused by bacterial tender decay. In total, *Moringa Oleifera* damages from growers to retailers were about 38.9%.

In the broader domestic supply chain, the *Maikunkele* pickers had a post-harvest loss of about 11% due to leaf shredding consequent to loose management of *Moringa Oleifera* from *Beji* to the open market trading centers. Decaying due to bacterial tender decay caused additional damages when there were delays in marshalling the produce to the buyers. Damages incurred by *Maikunkele* suppliers of about 17% were gathered only on arrival of *Moringa Oleifera* at *KasuwanGwadabe* market where they also accomplished wholesaling and retailing activities. Main causes of loss were bacterial tender decay. In total, the broader domestic supply chain had a total product loss of 42.5%.

Product damages added to price discrepancies along the chain. In the confined supply chain, the farm-gate price begins from 50 naira which is twice lower than the pickers' price which starts from 100 naira offered to suppliers. Cost of logistics was the main contributor to price increment since it was assumed by the pickers. Other contributing factors to the pickers' price were the costs of bagging and packing operations. The wholesale and retail prices was pegged as from 100 naira but with lower quantity than what was obtained under farm-gate and direct supply.

Table 2: Operations of the Confined and Domestic Supply Chain of the Study Area

<i>Categorization of Supply Chain (SC) Actors</i>	<i>Postharvest losses in kg</i>	<i>Causes of Damage/Loss</i>
Confined SC		
<i>Growers</i>	19	Bacterial tender decay
<i>Pickers/harvesters</i>	43.5	High temperature, decay and shedding
<i>Suppliers</i>	13.2	Mishandling, drying and rot
<i>Retailers</i>	21.2	Mishandling, drying and rot
Broader SC		
<i>Growers</i>	18.4	Bacterial tender decay
<i>Beji harvesters</i>	43.7	High temperature, decay and shedding
<i>Maikunkele harvesters</i>	32.10	High temperature, decay and shedding
<i>Suppliers</i>	22.52	Mishandling, drying and rot
<i>Retailers</i>	18.24	Mishandling, drying and rot

Source: Author's Computation

Implications for Responsible Supply Chain

Moringa Oleifera loss decreased along the confined and broader domestic supply chains apparently needs both value chain and supply chain intervention. At the farm stage, applicable pest management approaches and harvesting techniques need to be introduced. Proper production and postharvesting programming should be accomplished also in order to place a time-line on production and harvesting capitalizing on market requirements. Throughout the postharvest period, up to logistics stage, transportation seems to be the main logjam with recent crisis relating to fuel scarcity where transporting farm produce became almost impossible throughout the country. Factors leading to damages of Moringa Oleifera leaves include loose management from *Beji* to *Tunga* Market (broader domestic supply chain), removal of stock leaves, use of twine wrapping as wrapping jute sack, and poor management and transport conditions. Innovative and technological driven measures that could curtail these problems includes careful handling of stock leaves, use of innovative sealing bags to complement or replace the use of twine wrapping, and usage of safe antibacterial treatments for flowering plant protection (Sudheer & Indira, 2007). These methods were applied before, during, and/or after harvesting but need to be scrutinized to suit limited circumstances and resources.

Disproportionateness in business opportunities was evident in both confined and broader domestic supply chains, with the growers who were all smallholders getting the least of demands as shown by the great discrepancy in farm-gate, blanket wholesale networks and retail prices. Approaches to increase the economic opportunities dictates cooperative action by small growers to gain economies of scale and negotiating skills, do value addition activities, and participate directly with other supply chain actors (Aubree et al., 2013; Tomorri et al., 2022). This can be done by supporting small growers to develop and accomplish a partnership center with stuffing facilities. The partnership center can serve as a direct link of growers to market on condition that such market with stable supply of produce that meets standards, value for money and volume requirements. If properly controlled, the partnership center could enable participation of small growers in synchronized supply chain networks to come together to upload value chain development where standards will be met with labeling, branding, and ensuring that it gets to the international market (Meemken et al., 2021).

5. Conclusion

Moringa Oleifera supply chains for confined and broader domestic markets differed but shared collective constrictions and challenges in the aspect of product damages. Refining and expanding the current supply chain networks for enhanced regulation on product handling by unqualified participants in the supply chain network go a long way in having a sustainable business and for more reasonable sharing of opportunities among supply chain actors requires innovative technological and focused interventions. A partnership system that synchronizes value and supply chain activities linked as the crow flies to rationing market necessities is an imminent challenge to improve the socio-economic welfare of small-holder Moringa Oleifera growers.

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