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Influence of Infrastructure on Urban Food Access

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ABSTRACT

Globally, studies have attributed limited urban food access to infrastructural challenges that are critical in linking food surplus to food deficit areas like Cities. In the same breadth, trends by other studies show that in African Agricultural Growth Corridors and Kenya, urban dwellers who outsource 70% of their food lack access due to volatile and high food prices. Yet, the studies highlighted do not explicitly elucidate the relationship between infrastructure and urban food prices. The paper responds to this call by examining the influence of transport and its related costs within food transit corridors on Kisumu city's food prices. Focus Group Discussions and surveys were employed in establishing the location of infrastructure, cost of infrastructure and subsequent food prices. Findings show that cost of transport influences selling price at a P-value = 0.03350254 derived from regression analysis. A measure of how much the change in selling prices is driven by the changes in transport cost is further confirmed by an R Square of 94%. Study concludes that the relationship between cost of transport and food price as established in the study is positive and linear, thereby spiking food prices. Study recommends identification of food corridors that are critical to urban food access for upgrading and provision of better transitions from bulky transportation to less bulky transportation to reduced costs and ultimate food prices for increased urban food access.

Keywords: Food Corridor, Transport, Food Price.

INTRODUCTION

The Food and Agriculture Organization (FAO) [6] and the United States Agency for International Development (USAID) [20] posit that although enough food is being produced to feed the entire world; access to the food is hampered by problems of low income and

distribution. Consequently, food is still out of reach for one out of six people on our planet [18]. Despite this observation, studies by Africa Union [2] and FAO [6] show continued focus on upgrading infrastructure towards increased food production. In demurral to this approach, FAO [6] and climate change related studies [18] observe that increased food production does not equate to access to food. Yet, focus on food distribution to food deficit areas remains overlooked. As such, FAO [6] and [3] point out that infrastructure as a whole has influence on accessibility to food more so for food deficit areas. Policies [10] hold that improving infrastructure within Food Corridors is thus critical to urban food access; more so in deficit-producing parts of the Africa which lack sufficient infrastructure for effective transport, distribution, and marketing of staple food commodities [7]. Emphasis is laid on establishing the influence of infrastructure on food prices as both have been cited as key influencers of urban food access albeit in silos. In example, deficit producing parts of Kenya suffer more price fluctuations and higher prices which hampers food access [12] & [20]; yet no reference is made to infrastructure in the text. In a separate study of the food systems of Kisumu city, it is highlighted that only 30% of roads are maintained regularly in a city that suffers more price fluctuations and higher prices than the two cities preceding it [13]. There has been a call for studies to establish the influence of infrastructure on urban food access [10] which the study responds to by linking infrastructure to food prices in the bid to understand the options for increasing urban food access.

METHODOLOGY

Study Area

Western Kenya was selected as the study area where special focus has been paid to three food corridors serving the city. The Figure below showcases the food corridors transporting maize and kale to Kisumu city. They are Kisumu – Kitale, Kisumu – Meteitei and Kisumu – Kebenet food corridors as illustrated in Figure 1. They have been selected due to the fact that they bring the largest volumes of maize and kale into the city despite the fact that they originate from the western region of Kenya. This local nature affirms their position as critical resources for city resilience in food security [13].

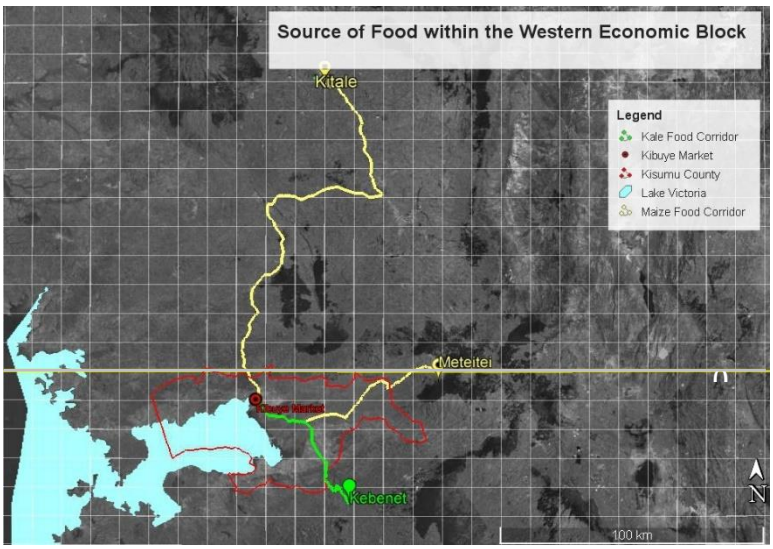


Figure 1: Study area

Study Design

In undertaking the study, cross-sectional research design has been employed targeting a population of 7480 business persons. A sample of 366 has been drawn from the study population and proportionately distributed amongst business persons trading in food from Kisumu – Kitale, Kisumu – Meteitei and Kisumu – Kebenet food corridors. Categorical, nominal and quantitative data was collected from secondary sources, key informants, drivers, middlemen, wholesalers and retailers. Semi-structured interviews and surveys have been employed in tracking the related cost required to trade along the corridors. Focus Group Discussions and surveys have aided in mapping the location of infrastructure. From the data regression analysis. A measure of how much the change in selling prices is driven by the changes in transport cost has been further confirmed by an R Square.

DATA COLLECTION AND ANALYSIS

The study looks at varying modes of transport i.e., lorries, pick-ups, matatus, motorbikes and others. The cost implications of the highlighted modes of transport form the basis of the analysis. Should the study results indicate that cost of transportation within the food transit corridors contributes to increasing food price in the city; then it is a point of intervention for increasing urban food access. The study pays special attention to transportation of food more so to draw a direct link between its cost and food prices at the end of the food corridor. As the link between food surplus and food deficit areas, transport infrastructure is important for moderating price levels and price volatility in food markets more so when it is associated with provision of safe, reliable, and affordable transport services. For urban areas which rely on hinterlands for over 70% of their food demands, the infrastructure supports flow of food from hinterland to market place and is thus critical for urban food access [5]. The Figure 1 shows three food corridors that are the top suppliers of maize and kale for Kisumu city. These being the staples and most widely consumed food products in the city showcase the significance of the food corridors to the city's food access. Of greater significance is the fact that the Food Corridors emanate from the western block of Kenya and thus increase Kisumu's resilience from external shocks that could cut off food supply from other regions.

FINDINGS AND DISCUSSIONS



Plate 1: Transition from main route to access roads within the market

Condition of Roads in the Food Corridors of Western Kenya

Study findings illustrate the condition of the roads transporting food to Kisumu city. The condition of roads along Kisumu – Kebent Food Corridor is thus described herein as an example. This is showcased in the Plate 1 which shows roads transitioning from better conditions to worse conditions.

Kisumu: Kebenet food corridor commences from C19 which connects Kebent to Katito (a main shopping center). The road is in good condition before Katito. However, after Katito, the corridor connects to A1 which is plagued by potholes as indicated in Plate 1. The corridor eventually terminates at the market center which is Kibuye market. At the market, the corridor is reduced to a narrow dirt roads hosting motorbikes, pedestrians and vehicles.

The overview shows variations in the condition of roads within food corridors. As depicted, conditions vary from well-maintained road sections to sections that are run down and in need of repair. Overall, the transport system can be described as inefficient which can be attributed to increased costs that raise food prices according to [11].

Mode of Transport

There are different modes of transport used within the roads depicted in Plate 1 The modes of transport are illustrated in the Figure 2 and include; Lorries, pick-ups, matatus, motorbikes and others. Along the Food Corridors, the most popular mode of transport is Pick up at 33% while matatu comprises the least popular mode of transportation at 1%.

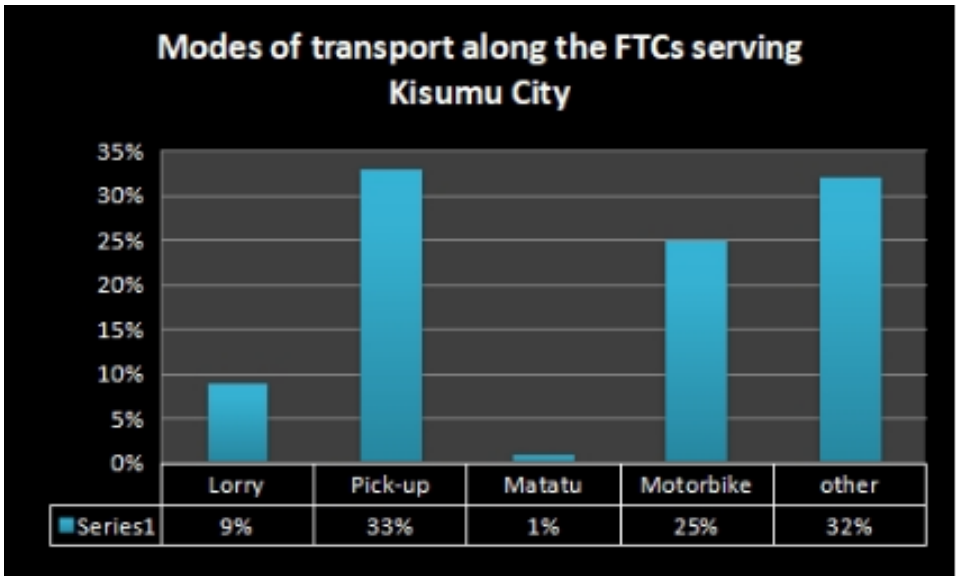


Figure 2: Modes of transport along the FCs serving Kisumu City

While in the FCs of Western Kenya Lorries are the largest in terms of capacity, the geography of transport systems shows that large transportation modes can include: rail carrying 100 cars, semi-trailer trucks and panama containership carrying up to 5000 tones in comparison to the max 10 tones ferried in the FCs of western Kenya (important for benefiting on economies of scale). In addition, a lot can be done to improve the transportation situation more so with regard to continuity of modes within the transport system. This refers to the transition from big to small, farm to retail and involves transfer from one mode to another often referred to as intermodal transportation [19].

This requires an interconnection where it is possible to transfer from one mode of transport to the other. Such focus is important because the study has shown that in the FCs of western Kenya, transition happens from road transportation in bulk to transportation in smaller quantities within destination markets. The Table 1 below shows the preferred modes of transport across varying categories of traders clearly depicting the transition postulated by [1]. As highlighted in the Table 1, 75% of transporters use Lorries, 65% of wholesalers use pickups. This shows a clear transition in the quantities transported from producer to middleman i.e., from Lorry to Pick up. Wholesalers further step it down from pick up to motorbike used by 53% of traders in the category as the preferred mode of transport.

The term 'others' in the study implies head loads, wheel barrows and wheel carts donkeys. They are predo minant in the food markets found at the end of the Food Corridor marking transition from bulk transportation to retail at 40%.

Table 1: Preferred modes of transport across varying categories of traders

Category of business	Lorry	Pick-up	Matatu	Motorbike	Other	Total	
						%	Count
Drivers/transporters	75%	25%	0%	0%	0%	100	12
Middleman	10%	65%	0%	0%	25%	100	40
Wholesaler	12%	15%	0%	53%	20%	100	68
Retailer	3%	33%	2%	22%	40%	100	190
Total Count	27	102	2	78	101		310
Missing							56

The variation in quantities being transported by differing categories of traders has implications on the spaces required for circulation within the business persons' areas of operation. More so because road infrastructure is a large consumer of space [19]. An example from Kibuye market as illustrated in the Figure 3 highlights how Lorries lack adequate access to the market during drop off leading to obstruction and offloading in areas that can lead to contamination of food. In addition, access and circulation at the markets is tight considering that 9% (27) of respondents expect Lorries to be offloading at the market as the predominant mode of transport. Access roads showcased in the Figure 4 are inadequate in providing efficient accessibility to market core. This is due to inadequate transport infrastructure supporting transition from bulky modes of transport to less bulky modes like motorbikes and carts. Figure 3 Picture of access roads that do not support access of bulky modes of transportation to the market center



Figure 3: Picture of access roads that do not support access of bulky modes of transportation to the market center

Despite this setback, Kibuye market has many access points as indicated by the blue marks on the Figure 4. However, the access roads are crowded as shown thus hampering movement. Jubilee market also has inadequate transport infrastructure hampering transition from the main transport routes into the market as shown below. The inadequacy showcased calls for improvement of transport infrastructure supporting transition from bulky modes of transport to lighter modes. More so because studies postulate that the quality of road infrastructure can strongly influence food price [16].

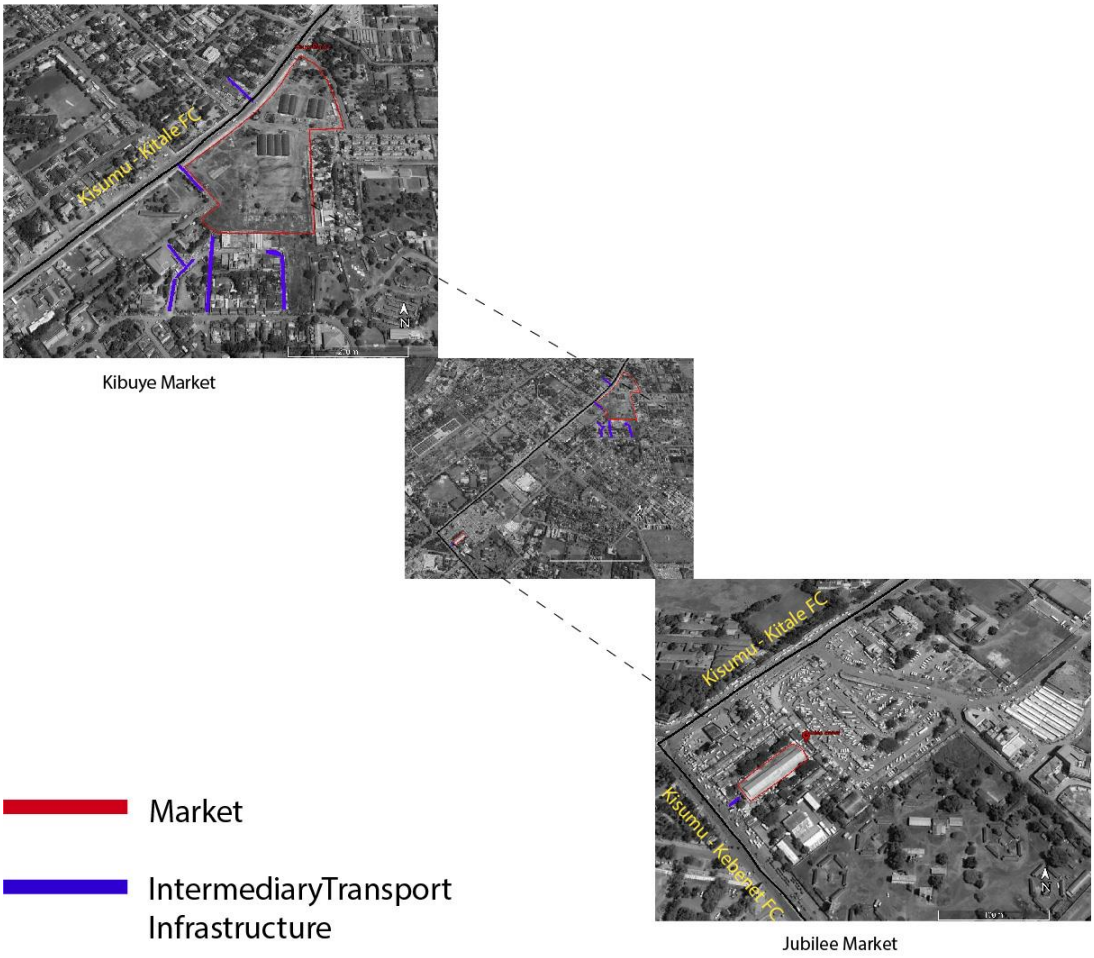


Figure 4: Transition from main routes in FC to access roads within the markets

The Geography of Transport Systems [19] reiterates that commodity prices are higher on bad roads. The author thus advocates for improvement of access as this will lower additional costs on traders thereby reducing food prices. The author further posits that Modes can compete or complement one another in terms of cost, speed, accessibility, frequency, safety, comfort. The significance of the connection between external and internal transport infrastructure is the cost implication on commodity/food prices. The study therefore further analyses the Cost of transportation across the different modes of transport for each food corridor as depicted below.

Table detailing the cost of transportation across each food corridor.

Maize from Kitale					
		Section_3/Cost_Of_Transportation 1 -UNIT COST	Daily Average Total Sales Per Category - Bags	Unit Cost by Average Total Sales Per Category	Transportation Distance-Km - Mode
Retailer	Lorry	100	3	300	30
	Pick-up	100	3	300	36
	Other	100	3	300	24
		100	3	300	30
Wholesaler	Other	300	11	3300	0.5
Middleman	Pick-up	500	12	6000	36
	Maize from Nandi				
Retailer	Lorry	150	3	450	42
	Pick-up	130	3	390	24
	Motorbike	166.6667	3	500	
		148.8889	3	446.6666667	
Wholesaler	Lorry	200	7	1400	0.05
	Pick-up	50	7	350	
	Other	100	7	700	0.05
		116.6667	7	816.6666667	
Kale from Kebenet					
		Section_3/cost_of_transportation1 -UNIT COST	Daily Average Total Sales Per Category - Bags	Unit Cost by Average Total Sales Per Category	
Drivers	Lorry	110	80	8800	51
Middleman	Pick-up	64	69	4416	50
	Lorry	125	69	8625	50.5
		94.5	69	6520.5	
Retailer	Matatu	50	4	200	5
	Motorbike	67.03704	4	268.1481481	2
	Other	26.55172	4	106.2068966	
		47.86292	4	191.4516816	
Wholesaler	Lorry	121.3333	18	2184	50.5
	Motorbike	50	18	900	1
	Other	50	18	900	1
		73.77778	18	1328	

Cost of Transport

The study findings show that along Kisumu-Kitale Food Corridor, Middlemen use pickups predominantly to transport maize. Distances covered by the pick-ups ranges from 24 kilometers to 36 kilometers as shown in Table 2. Wholesalers in the food corridor however use other modes of transport like carts though they cover less distance in terms of kilometers; as low as 0.05 kilometer as indicated in Table 2. Retailers on the other hand use pick-ups, other modes of transport as well as lorries. Distance covered by retailers range from 24 kilometers to 36 kilometers as indicated in the Table 2. Subsequent average costs of transportation range from KES 300 per day for retailers to KES 6000 per day for middlemen (Table 2.). According to the data displayed in the table, transportation cost within a particular food corridor seems to vary based on the quantities transported in terms of bags and not distance.

Along the Kisumu-Nandi Food Corridor, wholesalers use lorries, pick-ups and other modes of transport to get food to the market. The distance they cover averages 0.05 kilometers. Yet retailers in the same food corridor ironically seem to transport maize across longer distances (42 kilometers) than wholesalers who are often thought to supply retailers. This is displayed in Table 2. The following response from a retailer explains the anomaly.

> *"We as retailers no longer wait for maize to get to the market. Rather, hire a lorry as a group of retailers then call scouts on the ground to collect maize from farms and load onto a pooled transport. The transporter and scouts ensure goods well labeled for each retailer in the pool. We wait for the lorry to arrive with our maize in the market."*

Further analysis shows that transportation ranges from KES 350 per day to KES 1400 per day. Transportation of maize via pick-ups ranges from KES 350 to KES 390 per day based on the distance and quantity to be transported as shown in the Table 2. The statistics thus show that unit cost of transportation is influenced by distance travelled.

However, the observation contrasts with observations made in the Kisumu: Kitale food corridor where the unit cost of transportation was affected by quantities only.

Transportation along Kisumu-Kebenet is multimodal for drivers and middlemen transporting kale. The modes of transport used as found in the study are lorries, matatus, motorbikes and other modes of transportation like carts. They both use lories to transport kale while only middlemen use pick-up as an additional mode of transport. According to the respondents, distance covered by the drivers and middlemen rage from 50 kilometers to 51 kilometers as shown in Table 2. Wholesalers in the food corridor register travel distances ranging from 1 kilometer to 50.5 kilometers as shown in the Table 2. Further, distance covered by retailers during transportation along the Kisumu-Kebenet food corridor ranges from 2 kilometers to 5 kilometers.

Cost of transportation along the food corridor via lorries ranges from KES 2184 per day by retailers to KES 8800 per day by drivers. The difference is due to quantities sold which range from 18 bags per day to 80 bags per day respectively. Cost of using motorbikes which are used by wholesalers and retailers ranges from KES 900 per day to KES 268 per day respectively.

Overall, the findings in the table show that the unit cost of transport increases with distance and quantities transported. This is clearly shown by the unit cost of transportation which ascends from Kisumu- Kebenet food corridor, to Kisumu – Meteitei to Kisumu – Kitale. The average unit cost for the food corridors highlighted range as follows: KES 47 to KES 110 for Kisumu- Kebenet, KES 116 to KES 148 for Kisumu – Meteitei and KES 100 to KES 500 for Kisumu – Kitale. Due to the variations in comparing transportation cost for each food corridor against category of traders and mode of transport, an overall analysis was done irrespective of the food corridors to clearly highlight existing relationships in the data. As such, the Figure 5 displays the cost of transportation on average for the different modes of transport discussed herein.

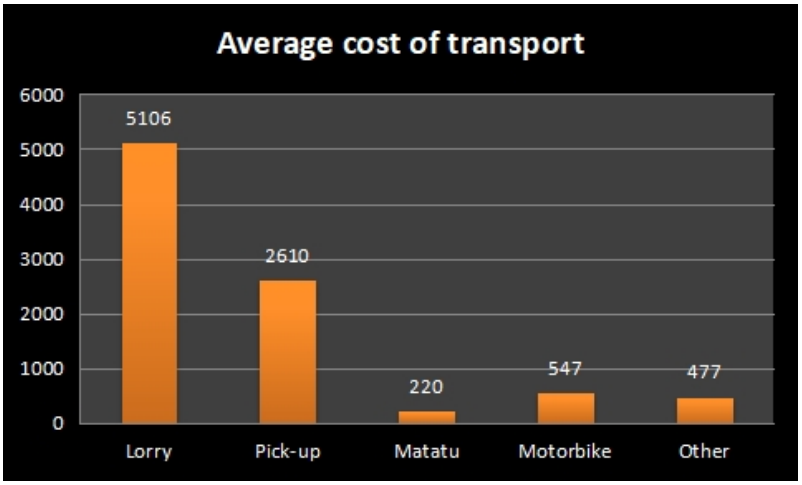


Figure 5: Average costs of transport

As displayed in the Figure 5, the study finds that on average, the cost of transportation across the different modes of transport ranges from 5000 to 200 approximately for Lorries and Matatus. The range is big but most important is to note that the additional costs are all transferred to the selling price. Consequently, transportation costs make up a larger share in the price of produce, so that an increase in the transportation cost will raise the price of goods proportionately [3].

FAO [8] reiterates the position of [3] positing that there exists a positive relationship between transport cost and food prices.

In Lieu of these suppositions, the study analyses findings to establish whether transport costs highlighted in the study influence food prices. This is done via regressions analysis. The analysis confirms that transport cost significantly influences selling price as displayed in the output below. The study finds that transportation costs positively influence food prices so much so that food prices increase with transport costs as depicted in the Figure 6.

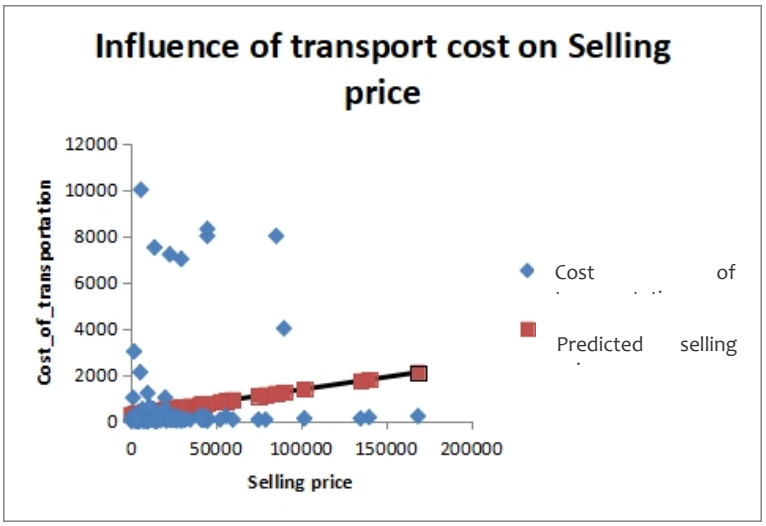


Figure 6: Influence of transport cost on selling price

The study finds that cost of transport influences selling price at a *P-value = 0.03350254. A* measure of how much the change in selling prices is driven by the changes in transport cost is further confirmed by an R Square of 94%. A significance F = *0.03350254* ratifies the strength of the relationship between costs of transport and food prices. The relationship is positive due to the positive coefficient (259.4905287) implying that food prices increase in time with increases in transportation costs. The finding affirms the position that there exists a positive relationship between transport cost and food prices [19]and [15].

Table 3: Table showing Regression analysis

Regression Statistics								
Multiple R	0.973586239							
R Square	0.947870164							
Adjusted R Square	0.946955605							
Standard Error	5484.971672							
Observations	175							
ANOVA								
	df	SS	MS	F	Significance F			
Regression	1	11666157.38	11666157.38	4.592874944	0.03350254			
Residual	173	439429606	2540055.526					
Total	174	451095763.4						
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	259.4905287	155.3100701	1.670790108	0.096571222	-47.05603594	566.0370933	-47.05603594	566.0370933
Selling price	0.010872631	0.005073321	2.143099378	0.03350254	0.000859056	0.020886207	0.000859056	0.020886207

Studies from Zaire on food security and poverty [16] shed more clarity on the finding by observing that poor transport infrastructure raises the cost of transaction higher thus impacting more severely on commodity selling prices. Such information can be very critical to urban planning in designating routes to be dedicated as critical food corridors by factoring in the transportation costs along different routes. Further, food corridors characterized by poor transport infrastructure can be mapped for upgrading as a strategy for reducing food prices for increased access to food in urban areas.

The success of such an approach is highlighted in Sweden where it was observed that the greatest logistical inefficiencies occur at the beginning and end of the supply chain, where

numerous short but indirect first/last-mile hauling routes increase the per-unit hauling cost [17]. Interventions thus targeted specific areas of need. The findings are in line with Von Thunen's deduction that transportation cost should be kept at a minimum as it has a direct influence of food prices [9].

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The study concludes that food price is ultimately affected by cost of transport. The relationship between cost of transport and food price as established in the study is positive and linear, thereby spiking food prices. The findings can help identify potential areas for injecting intervention e.g., areas of interconnection where transfer from bulky transportation to less bulky transportation occurs resulting in additional transportation costs ultimately transferred to food prices thereby hampering food access. Currently, the planning provisions have guidelines on markets and guidelines on roads separately and this could be the reason for the disconnect seen in terms of transport.

Recommendations

Study recommends identification of food corridors critical for food security more so for urban nodes. Focus should be laid on local food networks as these are critical for a community's resilience and ability to withstand shocks from external sources. The exercise should be part of the county spatial planning endeavor as a policy intervention addressing urban food access head on. This will ensure plans are specific to the food demands of the area and can guide proposals on which areas to link better by proposing for shorter routes, upgrading of roads and provision of better transitions from bulk transportation to less bulky transportation in food markets for increased urban food access.

References

[1]. Adero, N. (2015) 'Challenges Facing Transport Infrastructure', (December 2012), pp. 1–21.

[2]. Africa Union (2005) 'T RANSPORT AND THE MILLENNIUM DEVELOPMENT GOALS', (February).

[3]. Dombroski, S. (2017) Rising Transportation Costs in Food Manufacturing: A Problem or An Opportunity? Available at: https://www.foodlogistics.com/transportation/blog/21018195/qad-inc-rising-transportation-costs-in-food-manufacturing-a-problem-or-an-opportunity (Accessed: 15 July 2022).

[4]. Fan, S. (2008) 'Accelerating Africa' s Food Production in Response to Rising Food Prices', (November).

[5]. FAO et al. (2021) The State of Food Security and Nutrition in the World 2021, Transforming food systems for food security, improved nutrition and affordable healthy diets for all. Rome. doi: 10.4060/cb5409en.

[6]. FAO. (2012). 'Analysis of incentives and disincentives for maize in Uganda'. Monitoring African Food and Agricultural Policies, (December), pp. 7–9.

[7]. FEWS NET (2013) 'Food Security Brief', (September 2009), pp. 1–52.

[8]. 7Food and Agriculture Organization. (2017). 'Trade and Food Standards'. Doi: 10.30875/77a6eb25-en.

[9]. Fujita, M., and Krugman, P. (1995). 'When is the Economy Monocentric?'. Von Thunen and Chamberlin Unified.', Regional Science and urban Economics, 25(4), pp. 505–528.

[10]. Gilmore, P. and Chasomeris, M. (2015) 'An evaluation of the Umbumbulu Agri-Hub as a model to support small-scale farmers', Local Economy, 30(4), pp. 421–434. doi: 10.1177/0269094215586154.

[11]. Gómez, M. I., & Ricketts, K. D. (2013). 'Food value chain transformations in developing countries: Selected hypotheses on nutritional implications. Food Policy, 2013, vol. 42, issue C, 139-150

[12]. Hardman, M. et al. (2018) 'Landscape and Urban Planning Guerrilla gardening and green activism : Rethinking the informal urban growing movement', Landscape and Urban Planning. Elsevier, 170(August 2017), pp. 6–14. doi: 10.1016/j.landurbplan.2017.08.015.

[13]. Hayombe, P. and Omondi, F. (2019) 'Planning and governance of food systems in Kisumu City'. doi: 9781138726758.

[14]. Hendrickson, M., Massengale, S. and Weber, C. (2015). 'Introduction to Local Food Systems'. Available at: https://extension.missouri.edu/publications/dm271 (Accessed: 15 July 2022).

[15]. Lipinski, B, Hanson, C., Lomax, J., Kitinoja, L., Waite, R., & Searchinger, T. (2016). 'Toward a sustainable food system Reducing food loss and waste'. World Resource Institute, June, 1–40. http://unep.org/wed/docs/WRI-UNEP-Reducing-Food-Loss-andWaste.pdf%5Cnhttp://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/130211

[16]. Minten, B., and Kyle, S. (1995). 'The Effect of Distance and Road Quality on Food Prices, Marketing Margins, and Traders' Wages: Evidence from Zaire'. Food Security and Poverty Labor and Human Capital. 10.22004/ ag. econ. 121304 Marketing

[17]. Mittal, A., Krejci, C. and Craven, T. (2018). 'Logistics Best Practices for Regional Food Systems: A Review'.

[18]. Reddy, P. (2014) Climate Resilient Agriculture for Ensuring Food Security. Bangalore, Karnataka, India: Springer New Delhi Heidelberg New York Dordrecht London.

[19]. Rodrigue, J-P., and Slack, B. (2020). 'The Geography of Transport Systems'. Fifth Edition. New York: Routledge, 456 pages. ISBN 978-0-367-36463-2

[20]. USAID. (2013). 'Kenya Food Security Brief'. Retrieved April 5, 2018 from http://fews.net/sites/default /files /documents/reports/Kenya_Food%20Security_In_Brief_20 13_final_0.pdf.