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Development of a horticulture production chain in Western Africa: a case study of tomatoes in Burkina Faso and Ghana

by

C.F.A van Wesenbeeck, V. Venus, M.A. Keyzer,
B. Wesselman, and D. Asare Kye

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Contents

Abstract

High economic growth and rapid urbanization are changing the nature of food systems as traditional diets based on staple foods are being replaced by more diverse food baskets that include meat, dairy products, vegetables and fruits. Urban and peri-urban agriculture is developing rapidly in response to the consumers' new tastes and budgets, but there remains a challenge to involve more remote rural areas. Counter-seasonal production provides some of these areas with a window of opportunity to benefit from urban growth, if challenges related to quality, production costs and transport can be met. This study focuses on two production areas in Burkina Faso with a specific potential for counter-seasonal tomato production and identifies the main obstacles for the development of a horticultural chain. The two main challenges are the monopsony power of the Ghanaian traders, and insufficient road quality that leads to high losses of tomatoes due to mechanical damage. On the other hand, using a spatial-temporal simulation model to assess the effects of transport on quality, we conclude that refrigerated transport is not a necessary condition for successful trade, as climate conditions *per se* do not have a severe negative impact on quality. The paper reviews various options to improve the position of the Burkina Faso producers in the chain and concludes that regional diversification of exports offers the best opportunities.

Keywords: Burkina Faso, Ghana, counter-seasonal production, tomato trade, transport costs

Development of a horticulture production chain in Western Africa: a case study of tomatoes in Burkina Faso and Ghana[1]

C.F.A van Wesenbeeck[2], V. Venus[3], M.A. Keyzer[1], B. Wesselman[4], and D. Asare Kye[5]

1. Background and issues[6]

In the past decades, a transformation in the global food economy has been unfolding. High economic growth and rapid urbanization are changing the nature of food systems, as traditional diets based on staple foods are being replaced by more diverse food baskets that include meat, dairy products, vegetables and fruits. It has been amply emphasized that rural areas can benefit from this transformation, if urban-rural linkages or export-oriented chains can be established, where challenges include poor quality of infrastructure, low productivity (i.e. the potential of the hinterland to compete with imports) and linked to this, limited access to seeds, inputs and credit.

In this summary of challenges, infrastructural quality usually refers to the roads that link rural areas to urban centers. However, increasing urbanization also implies that urban congestion increasingly adds to the costs of linking rural producers and urban consumers. Urban agriculture presents an alternative, particularly for fresh and perishable products such as dairy, fruits and vegetables and meat (e.g. see FAO, 2011). Allotment gardens, family gardens, but also roof tops, balconies and even apartment rooms themselves can be used for small-scale agriculture, for own use, or to earn additional income from sale to neighbors and acquaintances. Producing within the city avoids the transport challenges, while it also allows consumers to exercise some control over quality as the producer is not an anonymous rural farmer, but a traceable supplier with whom regular interaction takes place.

Given these prospects for (peri)urban agriculture, it seems that more remote rural areas are fighting an uphill battle in linking up to the urban consumers. Yet, the poor in those areas, and particularly those in what Kuyvenhoven (2004) has labeled “less-favored areas”, have few other options - apart from migration - available to them to escape poverty, and hence, there remains a

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[1] This paper has been written in the context of the project “Trucks and Tomatoes: prospective development scenarios for Burkina Faso”, a joint effort of SOW-VU, ITC (University of Twente), and de l’Environnement et de Recherches Agricoles (INERA), Ouagadougou, Burkina Faso. This integrated research project looked into the prospects for improved performance of the tomato production in the Ouahigouya and Yako regions of Burkina Faso, and its synergies with the processing, transport and trade sectors. One element of the project was the gathering of information on the marketing and transport of tomatoes to domestic and foreign markets, specifically by joining truck drivers transporting the tomatoes, and the data collected during these journeys forms the basis of the estimations of costs and delays of roadblocks along the route. We further note that this paper is the second one based on the project findings. Venus et al. (2013) developed and validated a model to estimate postharvest losses during transport of tomatoes.

[2] Centre for World Food Studies, VU University Amsterdam, De Boelelaan 1105, 1081 HV Amsterdam

[3] Department of Natural Resources, Faculty of Geo-Information Science and Earth Observation (ITC), University of Twente

[4] International Centre for Integrated Mountain Development Khumaltar, Lalitpur G.P.O. Box 3226, Kathmandu, Nepal

[5] KNUST, P.O. Box UP 982, Kumasi, Ghana

[6] The authors thank A.N Halsema for helpful comments on earlier versions of this paper.

clear need to better understand which areas have a window of opportunity that with appropriate policies can be grasped to develop successful production chains. One of the obvious advantages of areas that are not directly located next to urban centers is the possibility to supply fruit and vegetables at times of the year when this is not possible in or around the city itself.

For regions such as Europe, where winter temperatures do not allow year-round production of many fruits and vegetables, high-tunnel cultivation (greenhouses) obviously compete with imports from regions where climatic conditions allow for open cultivation. Relatively high costs of protected cultivation are weighed against concerns on food safety and quality standards. An analysis of opportunities for high-value crop cultivation in the Near East and Northern Africa (IFAD, 2008) confirms that there are opportunities for open cultivation: the market for winter-tomatoes in France and Spain is almost exclusively supplied by Moroccan smallholders.

However, in a tropical or sub-tropical setting, year-round production of fruits and vegetables in urban and peri-urban conditions may be hampered by seasonal hot and humid conditions - as is the case in the urban centers of West Africa, predominantly located in the southern coastal areas. Here, foreign imports present the main competition for regionally sourced fruits and vegetables, where recent data suggest that the importance of regional trade is increasing: (in the period 2006-2010, the combined imports of vegetables of Benin, Côte d'Ivoire, Ghana, Nigeria and Togo doubled, with the share of imports from the region increasing from 8% in 2006 to 22% in 2010 (UN Comtrade, 2013).

Given the increase in regional imports of fruits and vegetables in West Africa, there seems to be a clear opportunity for counter-seasonal horticultural production in the region. As is well-documented, horticulture has the potential to reduce rural poverty, because of the high labor intensity and the high value added, which enables small-scale profitable production. There is a growing empirical literature that analyses the impact of the development of regional or international horticultural chains (e.g. see Schuster and Maertens, 2013 and Maertens and Verhofstadt, 2013 for recent contributions and literature review), and there is also a growing awareness among policy makers in developing countries that horticultural value chains can be important vehicles for growth in rural areas. For example, the government of Burkina Faso explicitly mentions fruit and vegetables as promising options for the development of regional chains (SCADD, 2010), and the same holds for Niger (Republic of Niger/IMF, 2007), Togo (Togolese republic/IMF, 2009), and Benin (MAEP, 2010). However, realizing this potential has proven to be difficult for various reasons, including political instability and economic crisis, insufficient quality of produce and losses during transport.

For Burkina Faso, (counter-seasonal) tomato cultivation qualifies as a clear niche within horticulture with high potential for poverty alleviation and rural development (SCADD, 2010), while at the same time improving the position of females (Maertens and Verhofstadt, 2013), and diet diversity (Gómez and Ricketts, 2013). The two production areas studied in this paper - Yako, in the province of Passoré and Ouahigouya, in the province of Yatenga - particularly have a clear window of opportunity to benefit from increased urban demand for tomatoes, as semi-arid climatic conditions, a relatively disease-free environment and availability of water resources can sustain stable tomato production, in particular also during the months January to May, before Ghana's Brong Ahafo and Ashanti regions take over the supply of tomatoes to the urban consumers in Kumasi and Accra/Tema.

Against this background, this study aims to identify the main constraints for the development of counter-seasonal value chain of tomatoes produced in Burkina Faso and exported to Ghana, and to review possible options to improve the position of the small farmers in this chain, in the two areas mentioned, both located in the Nord Region of the country. The Nord Region is among the regions with the highest rate of undernourishment (30% for children and 20% for adults against country averages of 25% and 15%, respectively, DHS, 2010), with above average rates of child mortality (153/1000 against a national average of 129/1000, DHS, 2010), while the poverty rate matches the average for the country (40%, again DHS, 2010). Literacy rates in Burkina Faso are low for men as well as women, with a clear disadvantageous position for women (on average, 38% of men and only 23% of women are able to read and write, DHS, 2010). In the Nord region, literacy rates are even below the country average, with only one in three men and one in six women being literate (DHS, 2010). In all, the Nord region is one of the more deprived regions in Burkina Faso, which is a further justification for the selection of the case study areas.

A final reason for selecting the two study areas is that cultivation of tomatoes typically is done by small scale producers, on parcels between 0.05 to 0.25 hectares (EasyPol, 2007), and for a family farm with 0.25 hectare of land, EasyPol (2007) estimates that the annual revenue from tomato cultivation lies between US$ 835 and US$ 1320, supporting the view that tomato production can indeed be a successful poverty reducing strategy in the Nord region.

2. Description of research

This paper presents an empirical case study of the value chain for tomatoes that links the production regions in Burkina Faso - Yako, in the province of Passoré and Ouahigouya, in the province of Yatenga - to the consumers in the Kumasi, Ghana. Following the traditional value chain analysis (e.g. see Kaplinsky and Morris, 2001), first, the actors in the chain are characterized and the institutional setting discussed. Next, a quantitative analysis is presented of the distribution of value within the chain. Finally, the study focuses on possibilities to improve the share of the total value that accrues to the tomato producers.

2.1 Actors and institutional setting of the tomato chain

The Burkina Faso - Ghana tomato marketing chain is organized much like any chain of a seasonal, perishable good. Typically, the producer (the farmer) has a fixed amount of the goods to sell and has to sell these in a (very) limited time span, while traders form the link between producers and consumers. These three characteristics of tomato production and marketing (perishability, seasonality and distance) combine to provide traders with a high degree of market power relative to the farmers. However, perishability and the need for transport also imply that traders carry risks associated to transport, including the possibility that their goods arrive at the retail markets in the middle of a glut. In Ghana, traders have responded by organizing themselves into associations (controlled by a Ghanaian “Queen Mother”), which regulate access to the retail markets, reducing the traders’ risks. In the past, attempts to break the power of the traders and provide direct access of farmers to markets by establishing special farmers’ markets in Accra were successfully blocked by traders threatening to boycott the city (Peppelenbos, 2005).

Traders do not transport the goods themselves, but hire trucks and drivers to physically transport the tomatoes. In Ghana, the transport sector is effectively controlled by the GPRTU - the Ghana

Private Road Transport Union that represents drivers and porters. The current era of political influence of this union started in the early 1980s and has increased ever since (Gyimah-Boadi, 1994), to the point where its operatives are collecting union dues, toll fees for the local municipality and income taxes for the Internal Revenue Service at lorry stations and along highways (Delaquis, 1993). The union controls approximately 80% of all lorry parks, and is responsible for vehicle registration on a large number of routes (Delaquis, 1993). Hence, the GPRTU exercises substantial monopoly power over the transport sectors, including the shipping of tomatoes: tomato traders are expected to work with drivers and trucks affiliated to the union (Ngeleza and Robinson, 2011). Along the route from the production areas to the retail markets in Ghana, truck drivers encounter many roadblocks, causing delays in transport and an increase of transport costs. Union officials, as well as customs officers, and (military) policy, collect duties and payments – according to official rules and regulations, or unofficially, to supplement their income.

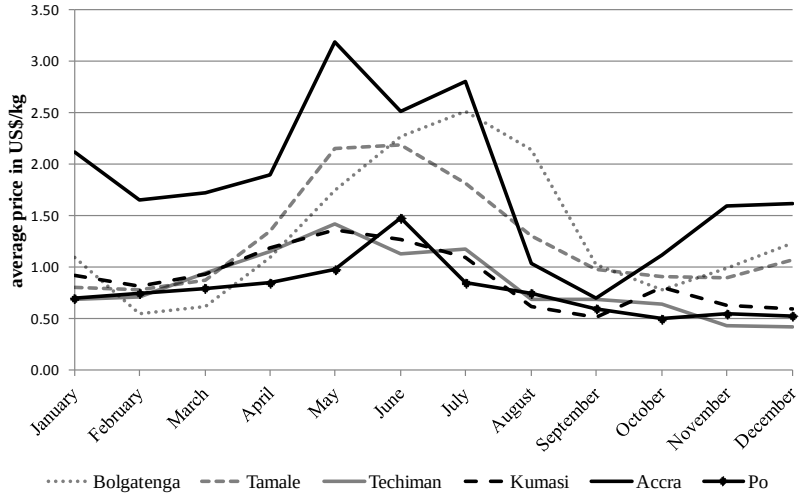
The partial overlap between tomato seasons between the Upper East region of Ghana and the main tomato producing areas in Burkina Faso presents a continuous source of tension. In 2006/2007, violent clashes and a two-week ban imposed by Ghana on the import of Burkina Faso tomatoes imposed great losses on Burkina Faso farmers. These events followed the closing down of the just re-opened tomato paste factory in the Upper East region (DG, 2007; GNA, 2007). Reports of suicides among farmers started to appear in the media (DGN, 2007; Knottnerus and Francisco, 2007), while others turned to violence and blocked roads. Since 2007, there have been recurrent reports on clashes between farmers in the Upper East and Ghanaian traders returning from Burkina, leading to an agreement between the Upper East Region in Ghana and the Central Province in Burkina Faso to enter into a tomato joint venture in June, 2010, with the objective to revitalize the Northern Star tomato paste factory by ensuring a continuous supply from both regions, but it is unclear if the joint venture has in fact been established, as the Northern Star facility is still reported to be ill-functioning in 2012, and no mention is being made of supplies from outside the Upper East Region (GBN, 2012). Therefore, the potential for conflict seems to remain high in the region.

2.2 Distribution of value within the chain: a quantitative analysis

Seasonal and spatial dynamics of prices

The Ghanaian Ministry of Food and Agriculture publishes weekly data on retail and wholesale prices in the major markets in the country, for a large number of agricultural commodities (MOFA, 2013), including fresh tomatoes. For our analysis, we used data published for the period between January, 2009 and June, 2012, converted to US$ per kg, and averaged over the years to obtain an indicator for the seasonal and spatial variety of prices. For Burkina Faso, no such dataset is available, and we use data from Amikuzuno and Donkoh (2012) for the wholesale prices in Po as indication of farm gate prices. For the markets on the transport route, Figure 1 presents these average wholesale prices. Seasonal patterns in prices can be recognized for all markets, with prices rising from October to January, falling slightly in February and then rising to reach a peak in May to July before falling again to reach their lowest values in September. On average, prices in Accra are twice those in Kumasi, with relatively small differences only in August to October, when tomato prices generally are low.

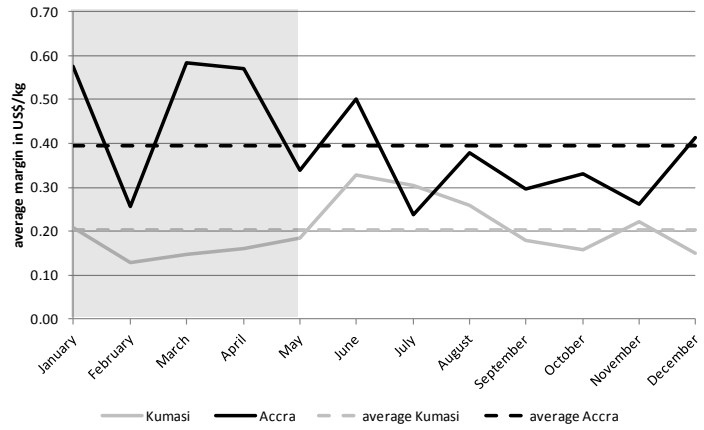
Figure 1 Wholesale prices for tomatoes in selected markets in Ghana and Burkina, averages for 2009-2011 and wholesale prices for Po, Burkina Faso, average for 2008-2010.



Sources: MOFA (2013) and Amikuzuno and Donkoh (2012).

The picture is confirmed when wholesale and retail prices are compared, for Kumasi as well as Accra. Figure 2 shows the average difference between retail and wholesale prices. The shaded area represents the season for Burkina Faso tomatoes to enter the markets in Ghana. Two observations stand out in Figure 2: (1) margins in Accra peak in the Burkina Faso season, especially after February, and (2) on average, margins in Accra are twice those in Kumasi. These results confirm that market power of cartels is particularly strong in Accra, with cartels being able to maintain margins on wholesale as well as retail trade, especially during the Burkina Faso season.

Figure 2 Average margins (2009-2011) in US$/kg



Sources: MOFA (2013) and Amikuzuno and Donkoh (2012).

The above prices refer to grade 1 tomatoes, and it may well be that not all tomatoes that reach the destination markets qualify as premium quality. Data on price differences between grade 1 and grade 2 tomatoes are scattered, however, and the only consistent database that reports on price

differentials related to quality is USDA (2013a), from which we conclude that, on average, prices for grade 2 tomatoes are approximately 80% of those for grade 1 tomatoes[7].

Transport costs

To assess the transport costs in the tomato marketing chain, two types of data are used. First, detailed data on transport costs from Delaquis (1993) are updated to reflect costs in 2008. Secondly, field data on official and unofficial payments are included to reflect the additional costs imposed along the route. As losses are reported to be a substantial source of additional costs underway - reportedly being as high as 50% of the total cargo (see Venus et al., 2013 for a discussion of estimates) - the study explicitly accounts for these losses in computing the effective transport costs per kilogram of tomatoes that qualifies for sale upon arrival.

The type of trucks used for tomato transport are large ones; for the estimation of transport costs, we therefore use the class that Delaquis (1993) classified as tractor semi trailers, 2-s2. These trucks have an official capacity of 10 MT, but were found to have an average payload of 35 MT. Table 1 summarizes the cost statistics and annual distance and quantity transported (reproduced from Delaquis, 1993, p. 153); costs are updated to 2008 and converted to US$/MTkm, under the following assumptions: fuel efficiency of the trucks has improved by 10% (based on average fuel efficiency improvements in trucks over that period as reported in US (2012); the official inflation rate (INSD, 2013) is used to estimate cost levels for repair costs and fixed costs; based on own observations of the price of tires (US$ 12) and diesel (US$ 0.9) for 2008, estimates of total costs for these items are made. The exchange rate used is that reported for July 1, 1008 (0.5 US$/GHS). As Table 1 shows, under these assumptions, the estimated total costs are 0.153 US$/MTkm. Given the large number of roadblocks, this "base" transport cost is increased through payments made along the way.

Table 1 Characteristics of the truck and fixed and variable costs, estimates for 2008

Characteristics tractor semi trailer 2-s2		***Costs (US cents/MTkm)***	
Tare weight (MT)	17	Fixed costs driver	0.61
Payload capacity (MT)	11	Fixed costs mate	0.06
Actual average payload (MT)	35	Fixed costs roadworthiness	0.01
Out-of-service (days/year)	39	Fixed capital costs	3.62
Annual distance (km)	19249	Fuel costs	8.23
Annual quantity (MT)	1305	Repair costs	2.28
Fuel consumption (km/l)	1.77	Costs of tires	0.34
Tires per year (number)	23	Loading costs	0.16
		Total costs	15.31

Source: Delaquis (1993) and own calculations

During March through May 2008, 15 transports of tomatoes from the production areas Yako and Ouahigouya to Kumasi in Ghana and vice-versa were documented. Of these 15 trips, 7 cover the complete route and back, 2 cover the trip to the border and back, 4 cover one way trips from Burkina to Ghana, 2 cover one way trips from Ghana to Burkina. Items included in the data

[7] Own observations on the market in Accra in December 2013 suggest that the price difference between grade 1 and grade 2 tomatoes may be larger, as grade 2 tomatoes sold for 65% of the grade 1 tomatoes. It is interesting to note that even tomatoes that were visibly damaged, and would classify as grade 3, were sold at this market, for one third of the price of premium quality.

are (1) the location of the stops, (2) their duration, (3) their cause, (4) and indication whether the stop was for official or unofficial reasons, (5) the amount paid at the stop in FCFA. In total 476 stops have been recorded in both countries at 60 individual locations.

The data set includes road blocks, but also stops to buy fuel, delay caused by accidents or mechanical problems as well as stops in Ghana where female sorters descend from the trucks and stops for which no cause is listed. In the analysis, only roadblocks are included. Table 2 provides an overview of the dataset with averages for payments made by cause. From this, we can conclude that in Burkina Faso, unofficial payments made to police and military police are higher than official ones, while in Ghana, unofficial payments to police are limited and much lower than official ones. We also note that the transport unions' right to stop trucks is not contested: all stops are labeled "official".

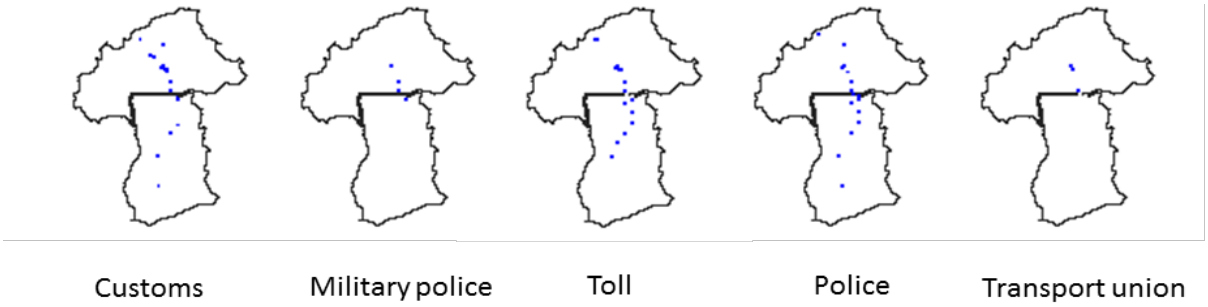
Table 2 Average payment by category and status

		Payment (US$)		
		Overall average	Average official	Average unofficial
Burkina Faso	Customs	17.34	35.56	11.63
	Forest police	2.14		2.14
	Military police	7.85	6.42	7.93
	Toll	4.54	4.51	6.42
	Police	8.27	6.15	8.95
	Transport union	8.13	8.13	
Ghana	Customs	4.19	7.85	1.23
	Forest police	6.42		6.42
	Military police	1.07	3.21	0.00
	Toll	0.11	0.16	0.00
	Police	0.70	2.33	0.43
	Transport union	4.28	4.28	
Total	Customs	12.76	25.91	8.01
	Forest police	4.28	0.00	4.28
	Military police	6.15	5.62	5.95
	Toll	2.29	2.30	3.16
	Police	2.91	3.45	2.92
	Transport union	7.49	7.49	0.00

Source: Own computation based on field data

In addition to the differences in payments made, the spatial dispersion also differs between stops. For categories included in Table 2, Figure 3 indicates the locations at which the roadblocks are located. Whereas customs, toll roads and police are scattered across the entire route, military police is only active in Burkina Faso and in the far north of Ghana, in accordance with the collaboration agreement between the Central South region of Burkina Faso and the Upper East region of Ghana on the fight against smuggling (fertilizer, fuel, small fire arms). Finally, the Burkina Faso transport union is active around Ouagadougou and close to the border with Ghana, presumably because it is easiest to collect fees and other payments there. The interpretation of roadblocks set up by the police and customs is less clear: one the one hand, it may be that officials are integrated within the chain to ensure that retail prices in destination markets remain high, but on the other hand, roadblocks may also be a means to extract additional revenue from transport, independent of the cargo (Koranteng and Abdulai, 2012).

Figure 3 Location of different types of roadblocks



Source: Own computation based on field data

Total average roadblock payments along the way from the production areas to the market in Kumasi equal US$ 133 (computed as the average of fines for the five categories described above for the 20 trips that cover a one-way complete route). Using the average load of 35 MT indicated in Table 1 and a distance between Yako and Kumasi of 862 km (computed in Google maps), the additional costs of roadblock payments equal 0.44 US cents per MTkm, increasing the transport costs by 2.8% to 15.75 US cents/MT.

However, these estimated costs of transport per MT refer to the quantity of tomatoes that is loaded in the production area. Venus et al (2013), among others, discuss the nature of the losses and conclude that these are caused predominantly by mechanical damage, e.g. impact injury due to inappropriate packaging, rough cargo handling at on- and offload points, and damage during transport due to poor road and truck conditions. Visual observations at destination points in Accra confirm that approximately half of the transported tomatoes were unacceptable for consumption, either as a result of being too soft or because of lacking some other important quality attribute (Venus et al., 2013). Hence, in the analysis of profitability of the tomato sector, an estimate of 50% is used as upper bound for losses occurring during transport.

Distribution of value within the chain

This section presents three scenarios that represent a range of circumstances varying from very favorable to very unfavorable. For all scenarios, a distance of 862 km between Yako and Kumasi is assumed (Google maps). As seasonal farm gate prices are missing, FAOSTAT (2013) data are used as estimate for the average yearly farm gate price in Yako, while the seasonal variation is based on wholesale prices in Po[8]. Minimum (maximum) wholesale prices in Kumasi are the minimum (maximum) prices recorded in the database of Ghanaian prices for the period January 2009-June 2012, while the average prices are used in the intermediate scenario. Minimum transport costs per MTkm are 15.31 US cents (costs without roadblocks), intermediate transport costs are 15.75 US cents (transport costs with average costs of roadblocks), and high costs are 16.13 US cents (transport costs with costs of most expensive one-way trip as costs of roadblocks). Under the optimistic scenario, the entire load can be sold as grade 1 tomatoes, while in the worst case, 50% of the cargo is lost. The intermediate scenario is that 25% is completely lost, while 25% can still be sold as grade 2 tomatoes, reaping a price that is 80% of the registered wholesale price. The different assumptions are grouped into 3 scenarios, where (a) represents the optimistic scenario, (c) the pessimistic scenario, and (b) an intermediate scenario (Table 3).

[8] FAOSTAT (2013) lists a farm gate price for tomatoes in Burkina Faso of 166.8 US$/MT for 2007.

Table 3 Scenario definition

	a	*b*	*c*
Transport costs (US$/MTkm)	0.153	0.158	0.161
Distance Yako-Kumasi (km)	862	862	862
Wholesale price Kumasi, January, US$/MT	1040	928	790
Wholesale price Kumasi, February, US$/MT	890	817	730
Wholesale price Kumasi, March, US$/MT	990	934	910
Wholesale price Kumasi, April, US$/MT	1350	1185	1000
Wholesale price Kumasi, May, US$/MT	1530	1366	1220
Farm gate price Yako, January, US$/MT	146	146	146
Farm gate price Yako, February, US$/MT	157	157	157
Farm gate price Yako, March, US$/MT	167	167	167
Farm gate price Yako, April, US$/MT	177	177	177
Farm gate price Yako, May, US$/MT	205	205	205
Share of grade 1 tomatoes upon arrival	100	50	50
Share of grade 2 tomatoes upon arrival	0	25	0

Table 4 presents the outcomes of the computations for these three scenarios. Even under the worst scenario (high transport costs, high losses, low wholesale prices in Kumasi), the minimum profit still is 69 US$/MT (in February), a profit margin of 24% over costs, and it seems that there is room for an increase in farm gate prices in the production regions.

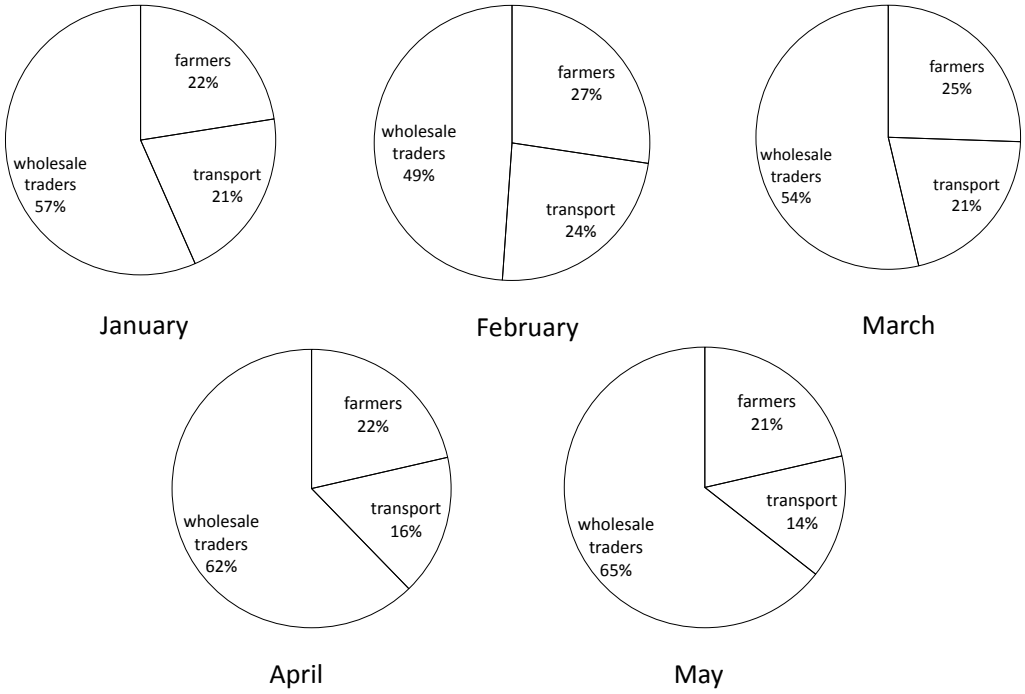
Table 4 Costs and revenues under different scenarios (all data in US$)

		January	*February*	*March*	*April*	*May*
Scenario a	Farm gate price per MT[a]	146	157	167	177	205
	Transport costs per MT[b]	132	132	132	132	132
	Effective wholesale price per MT[c]	1,040	890	990	1,350	1,530
	Margin per MT	762	601	691	1,041	1,193
Scenario b	Farm gate price per MT[a]	146	157	167	177	205
	Transport costs per MT[d]	136	136	136	136	136
	Effective wholesale price per MT[e]	650	572	654	830	956
	Margin per MT	368	280	351	516	616
Scenario c	Farm gate price per MT[a]	146	157	167	177	205
	Transport costs per MT[f]	139	139	139	139	139
	Effective wholesale price per MT[g]	395	365	455	500	610
	Margin per MT	110	69	149	184	266

[a]Farm gate price Yako, [b]0.1531*862 km, [c]Kumasi wholesale price, [d]0.1575*862 km, [e]0.5*Kumasi wholesale price+0.25*0.8*Kumasi wholesale price, [f]0.1613 *862 km, [g]0.5*Kumasi wholesale price.

Figure 4 summarizes the division of value in the wholesale chain for the intermediate scenario. In all months of the season, wholesale traders capture the highest share of the total value, varying from 49% in February to 65% in May. Particularly in April in May, the increase in prices in the destination markets is hardly transmitted to the farmers, while results in a decrease in the share of farmers in total value added per mt tomatoes sold from 25% in March to 21% in May.

Figure 4 Division of value within the wholesale chain, intermediate scenario



3. Options to improve the share of smallholders in the value chain

Starting from the lowest estimate of effective gross revenue (US$ 365/MT in February), using high transport costs and a lower bound on profits of 10%, the maximum farm gate price that can be paid to the producers equals US$205 per MT tomatoes ((US$365–US$139)/1.1). This price equals the highest farm gate price (in May), and is 60 US$ per MT higher than the lowest estimated farm gate price in January. To enable farmers in the production areas to raise the farm gate price also in January to April, outside options must become available that put a lower bound on farm gate prices. This section reviews the following options: (1) reviving the tomato paste joint-venture in the Upper East region of Ghana, (2) establishing conditional storage facilities for fresh tomatoes in the producing areas, (3) improving road quality to reduce losses underway and (4) diversifying exports to other markets, within the region or beyond.

Reviving the tomato paste joint-venture

The first option is to revive the tomato joint-venture in the Upper East region of Ghana (the Northern Star tomato paste factory) and to ensure that Burkina Faso farmers have access to this additional outlet for their produce. The tomato paste produced in this factory obviously would have to compete with imported tomato paste: in 2010, Burkina Faso imported almost 6000 MT of tomato paste, and Ghana 68000 MT (UN Comtrade, 2013). Import prices for Ghana in the years 2007-2012 varied between US$ 630 and US$ 855 (UN Comtrade, 2013), with an average of US$ 760. Table 5 summarizes the maximum farm gate price that could be paid under these import prices, allowing for transport costs from Accra to Ouagadougou, and assuming a conversion factor from fresh tomatoes of 16% (following the Food Industry Center, 2013). Under these assumptions, the maximum farm gate price would be US$ 161, which compares favorably to the

price paid to Yako farmers in January to March, but at *average* import price lower bounds on prices would be below current farm gate prices throughout the season. Hence, tomato paste production does not seem to offer a viable outside option at current import prices for tomato paste. Policy options could include imposing a tariff on imports of tomato paste, or, alternatively, introducing a floor price at which tomatoes are bought by the factory, with government covering losses if output prices are above the imported ones.

Table 5 Tomato paste production

	Low	***High***	***Average***
Import price Accra (US$)	630	855	760
Transport costs (US$/MT)	143[a]	151[b]	147[c]
Maximum production costs (US$/MT)[d]	773	1006	907
Maximum farm gate price (US$/MT)[e]	124	161	145

[a]935 km* 0.1531 US$/MT, [b]935 km*0.1613 US$/MT, [c]935km*0.1575 US$/MT,

[d] Import price plus transport costs, [e]using a conversion factor of 16%

Establishing storage facilities

A second option to improve the trading position is to establish storage facilities in the producing region to keep the tomatoes fresh for longer periods. This assumes a strong producer cooperative, including all farmers in the region: every individual farmer has an incentive to sell his produce directly given that the others keep their tomatoes off the markets through storage. Even if such a strong cooperative can be established, economic viability of the necessary investments has to be tested, focusing on the variable costs of storage, particularly the costs of electricity to keep the temperature at an optimal 12°C (USDA, 2013b). As an indication of costs, based on the electricity needs for a simple walk-in freezer, a reasonable estimate would be that cooling 1 MT of tomatoes requires approximately 5000 kWh per year, against estimated production costs of electricity in Burkina Faso of US$ 0.32 per kWh (African Development Fund, 2009). Table 6 summarizes the costs of storage under optimistic and pessimistic assumptions.

Table 6 Storage facilities

	Low	***High***	***Average***
Cooling 1 MT tomatoes (kWh/year)	4000	6000	5000
Electricity costs (US$/kWh)	0.25	0.40	0.30
Cooling costs per day (US$/MT)[a]	2.7	6.6	4.1
Maximum days cooling per MT (January)[b]	22	9	14
Maximum days cooling per MT (February)[c]	18	7	12
Maximum days cooling per MT (March)[d]	14	6	9
Maximum days cooling per MT (April)[e]	10	4	7
Maximum days cooling per MT (May)[f]	0	0	0

[a]use per year time costs per kWh/365, [b](US$205- US$146)/cooling costs per day, [c](US$205- US$157)/cooling costs per day, [d](US$205- US$167)/cooling costs per day, [e](US$205- US$177)/cooling costs per day, [f](US$205- US$205)/cooling costs per day.

As Table 6 illustrates, storage is potentially profitable in the period January-April under moderate or optimistic assumptions on costs. However, given that only variable costs are considered here, it remains unclear whether investments in storage capacity and maintenance would pay off. Here, policy options could include subsidizing electricity or funding the establishment of the storage capacity directly.

Improving road quality

Estimated losses during transport currently are very high, with 50% of the cargo being unfit to be sold as premium quality upon arrival, where the main cause of damage are the bumpy roads and inadequate packing of the tomatoes, causing bruising and other mechanical damage. However, the hot and humid climate itself also contributes to the decay in quality (in the absence of conditioned transport). To assess this effect, this section relies on the survey data collected in the field trips, since these do not only include the costs of roadblocks, but also delays incurred. In fact, the precise date and time of arrival and departure at each roadblock is recorded. In addition to estimating the total average travelling time needed to reach the retail markets, the survey data are combined with weather data for the time and place recorded to estimate the decay in quality of the tomatoes underway, where firmness of tomatoes is taken as proxy for quality and a spatial-temporal simulation model, developed by Venus et al. (2013) is used that links the prevailing outside weather conditions to the microclimate observed inside truck trailers to determine the deterioration in tomato quality during transport.

We list the most important characteristics of stops (Table 7), where we notice that in Burkina Faso, official delays usually are shorter than unofficial ones, while the reverse is true for Ghana. This suggests that there is little negotiation at unofficial stops in Ghana, and in the absence of red tape, stops are short, while in Burkina, negotiation on payments can last up to 10 or 15 minutes. For both countries, delays are substantial at border crossings (11 minutes on average), and lowest for transport union stops (1-2 minutes only). On average, the duration of transport without roadblocks equals 9.5 hours, and roadblock delays (computed as the average of delay for the 20 trips that cover a one-way complete route) add almost 2 hours (112 minutes).

Table 7 Average delay by category and status

		Delay (minutes)		
		Overall average	Average official	Average unofficial
Burkina Faso	Customs	11.19	1.76	14.15
	Forest police	3.00		3.00
	Military police	13.44	1.00	14.18
	Toll	6.93	6.88	10.00
	Police	6.36	7.50	6.00
	Transport union	1.20	1.20	
Ghana	Customs	11.04	22.38	1.88
	Forest police	1.00		1.00
	Military police	1.33	2.00	1.00
	Toll	13.51	18.05	4.86
	Police	4.26	1.18	4.75
	Transport union	2.00	2.00	
Total	Customs	11.14	8.94	9.88
	Forest police	2.00	0.00	2.00
	Military police	10.42	1.25	10.88
	Toll	10.28	12.56	7.39
	Police	4.88	3.03	5.12
	Transport union	1.33	1.33	0.00

Source: Own computation based on field data

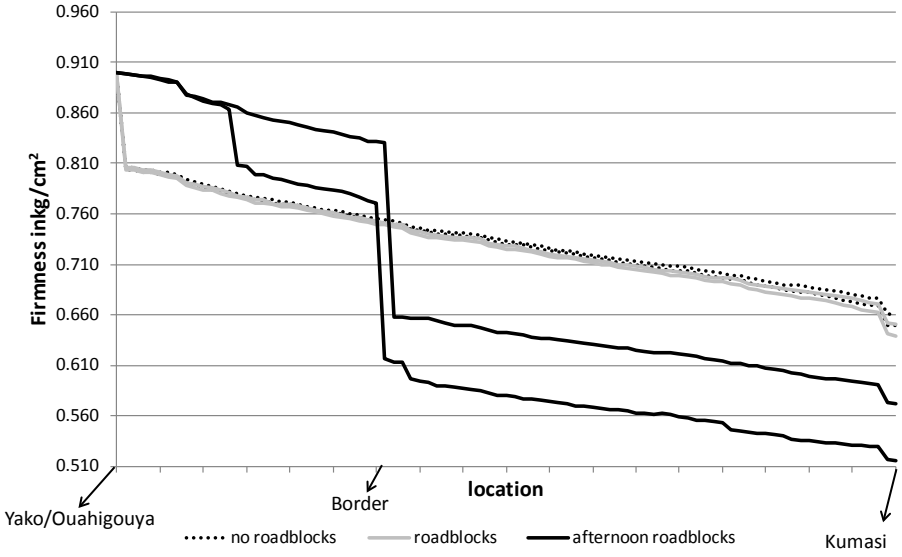
To assess the impact of temperature and moisture on the quality of the tomatoes during transport, we compute the decrease in firmness for the actual departure time (midnight, approximately 6

hours after harvest), with and without roadblocks, and also consider a counterfactual departure time immediately after harvest. According to anecdotal evidence, tomatoes are harvested red, and for the analysis, this visual information is converted to an indicator of firmness, drawing on Van Linden (2007, p. 37), where firmness measured in kg/cm^2 is related to fruit development stages, varying from immature green (firmness>4.0), via mature green (firmness between 3.5-4.0), breaker (firmness between 2.6-3.5), pink (1.6-2.6), light (orange) red (0.8-1.6), red ripe (0.3-0.8) to overripe (<0.3). For the simulations, it is assumed that the tomatoes are harvested in the riper stages of the orange red class (firmness of 0.9).

Figure 5 summarizes the results of the model computations for the decay of the tomatoes during transport for the three scenarios, measured as the decrease in firmness of the tomatoes. For the case without roadblocks, the total average decrease in firmness equals 0.25 kg/cm^2, 0.10 of which already occurs post-harvest before transport. Roadblocks add 111 minutes additional travelling time, with an associated average decrease in firmness of 0.01 kg/cm^2. Shifting the departure time to midday decreases the post-harvest, pre-transport decay, but the additional delay at the border decreases the firmness of the tomatoes (the border is closed at night). Jointly, less pre-transport deterioration and less decay during transport from the production areas to the border cannot compensate for the negative effects of this border delay, resulting in a total decay in this scenario of 0.38 kg/cm^2. The spread of the decay (the difference between the best and worst results for actually observed weather conditions along the route in the past 10 years) equals 0.06 kg/cm^2 for this scenario. For the actual observed departure time and taking into account the roadblocks, the firmness of the tomatoes upon arrival (0.64 kg/cm^2 under worst conditions) classifies the tomatoes in the middle of the red-ripe stage (the preferred quality for sale).

This result implies that much could be gained by improving road quality to prevent mechanical damage, as transportation over longer distances without refrigeration *per se* does not lead to a significant deterioration of quality.

Figure 5 Decay of tomatoes during transport



Source: Own computation based on field data

Diversification of exports

The previous section shows that transport over land over large distances is possible in principle. Based on the historical data on climate used in the simulation of the decay of tomatoes during transport from the production areas to Kumasi, we conjecture that a journey of 30 hours - equivalent to at 1500 to 1800 km - would lead to a decay of firmness of the tomatoes to 0.3, the lower bound of the red ripe stage (premium quality).

Exports to the EU could be one possible option. At present, Senegal is the only country in West Africa that exports fresh tomatoes to the EU, with a share in the total value of tomato imports that has been remarkably constant at about 2% over the past decade (Un Comtrade, 2013). However, Senegal has the advantage of having the port of Dakar, with no need for long overland transport. At an average speed of 12-15 knots (22-28 km/hr, the estimated speed range for conventional freight vessels, e.g. Martínez de Osés and la Castells, 2005), the 5526 km from Dakar to the port of Rotterdam can be bridged in 8-10 days. Under refrigerated conditions, tomatoes will be of optimal quality between 7 and 14 days after harvest, when harvested in the riper stage of the orange-red stage, which confirms that the Senegalese tomatoes arrive in the EU ready for consumption. For Burkina Faso, the relevant sea distance would be that between Tema and Rotterdam - a distance of 8148 km, bridged in 12-15 days by a conventional freight vessel. Adding to this the transport time from the production areas in Burkina Faso to the port of Tema - 9.5 to 11.5 hours - it is clear that without conditioned land transport along well-maintained roads, export to the EU will not be an option, even without considering the costs involved in shipping the tomatoes.

This leaves the option of regional trade to countries within the ECOWAS region, comprising Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo. According to UNCTAD (2013), "*Burkina Faso and Ghana have developed a significant trade in tomatoes, which after 14 years of effort has recently attracted Benin and Togo*." Particularly, there seems to be a market for counter-seasonal tomatoes in Togo and Benin: the West Africa Gateway (2013) reports flows of counter-seasonal tomatoes to Lomé and Cotonou (at present from the north of Benin). Côte d'Ivoire represents another potential option: Burkina Faso has exported tomatoes to this country in the past (up to 2008) and there is a strong demand for tomatoes, particularly in Yamoussoukro and Abidjan. The southern part of Niger could also be an option, especially the city of Maradi that is now provided by tomatoes from Nigeria (West Africa Gateway, 2013). Finally, in Nigeria, domestic production in the season when Burkina Faso tomatoes enter the market is sufficient to meet demand (in the Nigerian wet season, from July to October, imports of tomatoes supplement domestic production), but there still may be options for Burkina Faso producers to provide the Northern part of the country with tomatoes given the difficulties and high costs to transport the tomatoes within Nigeria itself (Vanguard, 2013).

Many of the urban centers mentioned here lie within the range of 1500-1800 km that could be covered under good road conditions. These include Yamoussoukro and Abidjan in Côte d'Ivoire; Porto Novo in Benin; Lomé in Togo, Kano in Nigeria and Maradi in Niger. Table 8 lists the distance to Yako (estimated using Google Maps), the transport costs if the roadblock-inclusive rate of 0.1575 US$/MTkm and a truck load of 35 MT are applied, and the margin if a farm gate price of 225 US$/MT and a wholesale price in the area of destination of US$ 900/MT (average wholesale price in Kumasi) are assumed. It seems that many destinations could, in principle, be profitable, even under less than optimal road conditions.

Table 8 Potential destinations for regional export

City	*Distance to Yako (km)*	*Transport costs (US$/MT)*	*Profits (a) (US$/MT)*	*Profits (b) (US$/MT)*	*Profits (c) (US$/MT)*
Yamoussoukro	970	153	552	252	72
Abidjan	1138	179	496	226	46
Porto Novo	1119	176	499	229	49
Lomé	1052	166	509	239	59
Kano	1592	251	424	154	-26
Maradi	1284	202	473	203	23

(a) No losses at arrival, (b) 50% grade 1, 25% grade 2 upon arrival, (c) 50% lost.

Policy options here include increased regional integration and joint efforts within the ECOWAS region to improve trade infrastructure. A more diversified trade pattern with associated higher prices for Burkina Faso tomato growers could also reduce the tensions between the country and Ghana, as tomato farmers in the Upper East region may be able to compete with the Burkina Faso producers through lower prices. Hence, the trade diversification option could not only benefit the farmers in the poor regions of Burkina Faso, but have wider regional impact.

4. Conclusion

This paper considers the main obstacles for the further development of the tomato sector in Burkina Faso. It combines general information on transport costs and prices with data collected during a field study in 2008 on roadblock delays and payments. The tomato trade within Ghana is highly regulated and the same holds for the transport sector that has the right to collect taxes at roadblock stops - the reason why all payments to transport unions are labeled “official” in our data set. The regulation - cartelization - of the tomato sector is one of the challenges the Burkina Faso producers face, as it keeps prices high in destination markets along the Ghanaian coast, while at the same time, farm gate prices for Burkina Faso producers remain low because of market power of traders and limited to no outside options for the farmers to sell their produce.

After reviewing the structure of the tomato trade between Burkina Faso and Ghana, the paper presented four options to improve the income of the farmers in Burkina Faso. Establishing a tomato paste factory was shown to put a floor in the price for fresh tomatoes, but for import prices equal to the average of recent prices, this floor price lies below the current farm gate price for the entire season. Even if historically high import prices for tomato paste are assumed, floor price levels would be above current farm gate prices only in the months January to March. Improvement of storage capacity in the producing area proved to be too costly at current electricity rates. Investments in road improvements reduce significantly the losses of tomatoes during transport, and hence increase the expected profits in the marketing chain, but there is no guarantee that farmers will benefit. This leaves diversification of tomato exports to regional urban centers other than those in Ghana as the only viable option, if social and political conditions permit, and if road quality is sufficient to prevent high losses due to mechanical damage of the tomatoes, as quality decay during transport caused by high temperatures and moist conditions is limited.

Generic lessons to be learnt from this case study include the importance of safe transport, as the high margins that now accrue to traders at least partly are necessary to cover the risks underway.

Secondly, the case study confirms the vital role for government investments in infrastructure, which not only include improvement of roads, but also the provision of electricity at reasonable rates, and investments in storage facilities. However, it seems that, at least for tomatoes, conditioned transport is not a precondition for further development of a tomato sector, as our analysis shows that mechanical damage rather than influence of climatic circumstances per se are the cause of the large losses. Finally, successful rural development requires that connections are being made between those areas and rich urban elites. In this, increased regional integration may offer specific opportunities, as first, transport costs usually are lower than for international trade with OECD countries or upcoming economies, and secondly, local tastes and preferences can be accommodated. However, realization of these potential gains requires regional efforts to reduce red tape, border controls and other tariff and non-tariff barriers to trade.

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Centre for World Food Studies
SOW-VU
De Boelelaan 1105
1081 HV Amsterdam
The Netherlands

Telephone (31) 20 – 598 9321
Telefax (31) 20 – 598 9325
Email pm@sow.vu.nl
www http://www.sow.vu.nl/