International Food and Agribusiness Management Review
Volume 12, Issue 3, 2009

Commodity-based Trade and Market Access for Developing Country Livestock Products: The Case of Beef Exports from Ethiopia

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Abstract

While Ethiopia is Africa's largest livestock producer, sanitary and phytosanitary (SPS) barriers and animal diseases have traditionally constrained market access. A system dynamics model examined the feasibility of a proposed SPS certification system under a number of scenarios. Model results indicate that the system may not be viable for beef exports to Middle Eastern markets. However, the binding constraint is high domestic input costs rather than the costs of SPS compliance. Sensitivity analyses reveal that while investments in feed efficiency and animal productivity would enhance Ethiopia's export competitiveness, the competitive nature of international beef markets may still prevent market access.

Keywords: SPS, livestock, market access, system dynamics, Ethiopia

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Introduction

Livestock serve a variety of livelihood, risk management, and income-generating functions in the developing world. Where market access is possible, livestock can act as a potential pathway out of poverty for rural producers and other actors throughout the marketing chain, as such access increases the potential scope for sales and makes livestock activities more remunerative (Rich & Perry, 2009). However, market access from Africa has often been stymied by a variety of constraints, including the prevalence of highly contagious transboundary diseases such as foot-and-mouth disease (FMD). These diseases have been mostly eradicated in the developed world, but the fear of their entry from endemic reservoirs in the developing world precludes large-scale livestock product exports into lucrative markets in the European Union, United States, and Japan. Moreover, international trade regulations for meat products require zonal freedom from disease and do not as yet distinguish between products (e.g., bone-in meat vs. deboned meat) in terms of their relative risk of spreading disease. Commodity-based approaches to trade, which instead focus on the process by which products are produced (rather than their regional origin) in assessing their risk of disease, offer the potential for developing countries to export meat products that are lower in risk. Such new standards are being increasingly discussed in international circles (Rich & Perry, 2009; Thomson et al., 2004; Scoones & Wollmer, 2008). However, in order to ensure greater market access, such an approach requires indigenous local systems throughout the supply chain for livestock that demonstrate the risk of disease or pathogen introduction is minimal.

At the same time, the costs of these systems could potentially be high enough to limit the potential for exports. A number of past studies have examined the cost of compliance in developing countries with increased SPS standards in developed ones. Henson, Saqib, and Rajasenan (2004), for example, found that in the case of fish exports from Kerala, the cost of compliance with increased EU standards ranged from 2.5% to 22.5% of turnover, with six of the 14 firms surveyed facing increased costs of 10% or more of turnover. Aloui and Kenny (2004) found that compliance with EUREPGAP standards in Morocco represented 8% of the farm gate cost for efficient farmers and up to double this for an average farmer. Peterson and Orden (2008) estimated compliance costs among Mexican avocado growers exporting to the United States at 15% of the producer price for growers and an additional 5% of the wholesale margin for exporters. In an example among developed world trading partners, Calvin, Krissoff, and Foster (2008) showed that compliance with Japanese phytosanitary protocols raised the costs incurred by U.S. apple growers by 15 cents per pound, or 13.5% of the landed price in Japan. These costs by themselves were enough to make U.S. apples uncompetitive with Japanese ones. While these costs of compliance present non-trivial burdens on producers, the World Bank (2005) argues that they can also represent a means of gaining competitive share in target markets and acting as "a catalyst for progressive change" in terms of modernizing various aspects of agro-food supply chains (xi). Indeed, Jaffee (2003) showed that for green beans from Kenya, while the costs of compliance were about 6 percent of the free on board (FOB) value of exports, the benefits in terms of higher profit margins and export growth have been significant. Moreover, the losses incurred by not complying with standards can be significant – Nin Pratt et al. (2005) found that regional trade bans associated with Rift Valley Fever reduced value-added in the Somali region of Ethiopia by US$132 million, or 42% of the value-added generated in that part of Ethiopia. However, none of these papers couched these issues in the context, costs, competitiveness, and feasibility of specific systems required to facilitate market access for livestock products, particularly in the wake of potential new standards for their access. This remains an important research gap, particularly in assessing the feasibility of commodity-based trade as a global solution for developing world market access.

This paper examines the feasibility of a proposed two-phase SPS certification system designed to enhance beef exports from Ethiopia and which could serve as an indigenous model of a commodity-based approach to trade from the developing world (Thomson et al., 2009). Of particular emphasis is the competitiveness of products derived from such systems vis-à-vis entrenched global exporters of beef. Ethiopia is the largest livestock producer in Africa and one of the largest in the world, maintaining 43.1 million head of cattle, 23.6 million sheep, and 16.4 million goats in 2006. Moreover, Ethiopia's exports of meat (the majority of which were sheep and goat carcasses) have increased rapidly in recent years, with FAO data showing a rise from US$6.3 million in 2003 to nearly US$32 million in 2005. Despite increasing growth in livestock product exports, most exports from this sector remain concentrated in informal sales of live animals, with limited benefits in terms of foreign exchange and value-adding opportunities. In 2004, the Ethiopian Government set a target to increase exports to 30,000 tons of meat by 2008. This target was not met for several reasons. One reason in particular is that the overwhelming majority of this increase will need to be achieved through the export of beef products, since the quantity (and average carcass weight) of sheep and goat meat required to achieve this figure is not feasible in light of domestic supply and demand for such products. At the same time, low productivity, the prevalence of livestock diseases (such as FMD, contagious bovine pleuropneumonia (CBPP), peste des petits ruminants (PPR), and lumpy skin disease (LSD)), low development of market mechanisms, and the high incidence of informal cross border trade, have meant that the contribution of livestock to foreign exchange earnings has traditionally been modest compared to apparent potential.

A methodological novelty of the paper is the use of a dynamic cost-benefit model using system dynamics to assess both the feasibility of meeting SPS standards and to identify constraints to competitive meat exports from Ethiopia. Baseline results reveal that under current conditions for inputs (animals, feed resources, equipment, and capital expenses), the proposed system is not economically feasible for the export of beef products to Middle Eastern markets. However, it is not the marginal costs of SPS certification that inhibits Ethiopian meat exports, but rather the high cost of inputs, especially feed. Indeed, SPS certification costs represent less than 5% of the breakeven value of the final product, whereas the costs of animal feed in the proposed system are between 33%-42%, depending on the type of feeding ration used. Correspondingly, under baseline conditions, the model estimates that the average FOB product weight of beef would be over US$1,000 per ton greater than the average cost, insurance, and freight (CIF) import unit value of Brazilian and Indian meat in markets in the Middle East, such as Bahrain, Qatar and Saudi Arabia.

Improvements in feed use through better rations could lower the cost of the system considerably. Indeed, using best-cost rations, the model computes the FOB product value of improved, SPS-certified beef at US$3,562 per ton. While this is still somewhat more expensive than competitors in the Middle East, sensitivity analysis reveals that lower animal purchase costs or reduced system margins could bring forth noticeable cost savings that would enhance competitiveness.

An important lesson of the paper is that while technical solutions at a local level can be designed to address global market access issues, downstream issues concerning cost, marketing, and product differentiation can transcend technical matters of SPS barriers. In particular, Ethiopia remains in somewhat of a marketing quandary: its products are too costly without certification for low-value, price-sensitive markets in Africa and too costly with certification relative to competitors in the Middle East. Access to the European Union is theoretically possible given preferential, duty-free access to that market, but only if commodity-based approaches are accepted by international standard setting bodies. In the short- to medium-run, Ethiopia will need to focus on other types of marketing approaches to facilitate access to markets in the Middle East, such as product freshness, but the potential size of such markets is unlikely to be large enough to meet government goals for exports.

Overview of the Proposed SPS System

The SPS certification system proposed here is technically feasible, meets international standards, complies with export market requirements, and is designed in line with developing a disease-free compartment within Ethiopia (Zepeda & Salman, 2006; Anon., 2007). The system would first entail the pre-selection of animals in local markets, followed by the initial testing, vaccination, and quarantine of animals over a 21-day period in its first phase (Phase 1). In the second phase (Phase 2), quarantined animals from Phase 1 would then be finished in a feedlot system to bring them up to export weight (400 kg).

Prior to purchase, animals would be visually inspected by trained personnel for physical fitness, body condition, hair coat, alertness, salivation, eye discharge, mouth lesions, lameness, and any other abnormalities. The purchased animals would then be collected and kept for up to three days at temporary collection sites pending transportation to the Phase 1 SPS certification facility. Within 1–3 days, animals would then be transported to the Phase 1 SPS certification facility using specially designed, disinfected, and sealed vehicles. Animals would be loaded, transported, and unloaded humanely. Standard operating procedures (SOPs) for animal handling would be prepared for the certification process, and training and supervision conducted. Animals leaving purchase sites would be accompanied by animal health certificates to be provided by the animal health inspector representing the private sector.

Phase 1 facilities are conceived as small quarantine sites that handle approximately 130 head of cattle every four weeks (three weeks of testing and handling, one week idle for cleaning). They would be owned and run by private entrepreneurs but certification is only made by a "competent authority." Phase 1 operators can charge a fee by either selling animals at a premium or charge a fee to Phase 2 operators for the use of Phase 1 infrastructure. The facilities would be subject to regular inspection and monitoring by the Ministry of Agriculture and Rural Development (MoARD), as well as by representatives of importing countries or companies as required. Upon entry to Phase 1, animals would be ear-tagged, tested for FMD, and vaccinated for FMD, CBPP, and LSD. At day 14, animals would be re-tested for FMD; those that test positive are removed from the facility and sold on domestic markets. If any animals have clinical signs of FMD, the entire batch would be removed.

After 21 days in Phase 1, animals would be certified as "disease-free" and then transported to a Phase 2 feedlot. This facility has a capacity of approximately 5,000 head of cattle and holds animals from other Phase 1 facilities. Animals stay in Phase 2 until they reach 400 kg. This helps to ensure a more consistent supply of animals from pastoral areas and allows for the sourcing of younger bulls. Animals would be vaccinated against FMD and other diseases again should they remain in the facility longer than their duration of immunity from the first vaccination (e.g., six months in the case of FMD). In the event of clinical FMD outbreaks, all affected animals (and those in adjacent pens) would be removed from the facility. The remaining animals would be followed up for 21 days and may also be tested for FMD if necessary. The whole facility would be properly decontaminated. Likewise, proper decontamination and disposal procedures will also be followed in case of outbreaks of other diseases.

The proposed investment will necessitate the expansion of existing slaughter capacity as well as the development of feedlots to both improve off-take levels and improve biosecurity measures. It is expected that feedlots created within the SPS certification framework and the attendant supply chain will sufficiently cater to the capacity requirements of export-oriented abattoirs as well as satisfy demand in the export market for meat products. The benefits of this system are in its ability to ensure to trading partners the ability of Ethiopia to produce higher quality, certified, disease-free meat.

Methodology

The feasibility of the proposed system was evaluated using a dynamic cost-benefit analysis that was undertaken following principles and simulation techniques from the system dynamics literature (Sterman, 2000; McGarvey & Hannon, 2004). System dynamics (SD) models capture the flows and feedbacks inherent in dynamic systems. Because the proposed certification model involves a dynamic process of storing and moving animals, an SD framework presents important advantages in conducting a cost-benefit analysis. First, one can compute the evolution of costs and benefits arising from each step of the process, allowing the practitioner to assess the evolution of profits and costs. This is important since the proposed system will have a number of high, upfront costs and the benefits will not be realized immediately. Second, an SD framework can capture feedbacks between phases and market phenomenon that could impact the system. For instance, a rejection of animals from Phase 1 could have ramifications on the movement (and price) of animals for export in future time periods. Moreover, the proposed system would have important implications on feed demand and tradeoffs between domestic and export meat markets that could be modeled. Increased demand for feed, for example, would raise prices, which will correspondingly impact the profitability of the system. Finally, the use of an SD framework allows the user to visually identify and analyze potential bottlenecks and conduct sensitivity and scenario analysis of key parameters to assess the optimal mix of interventions necessary to improve the system.

The model is programmed in STELLA 9.0.2 (http://www.iseesystems.com), which denotes these dynamic relationships graphically. Figure 1 illustrates the mechanics of the two-phase system process in STELLA. Each box in the figure represents the stock of animals at each point in time (one week). The wide arrows between stocks represent the flows of animals between one state to another, while the circles are parameters associated with disease incidence and other market relationships. The thin arrows that link parameters, flows, and stocks denote relationships between them. For example, the flow "Movement to Holding" is a function of the stock "Phase 1 pretesting" and the parameter "Probability of disease on arrival". In STELLA, the actual nature of the functional relationship is written as an equation that can be accessed by double-clicking on the graphical map of the model.

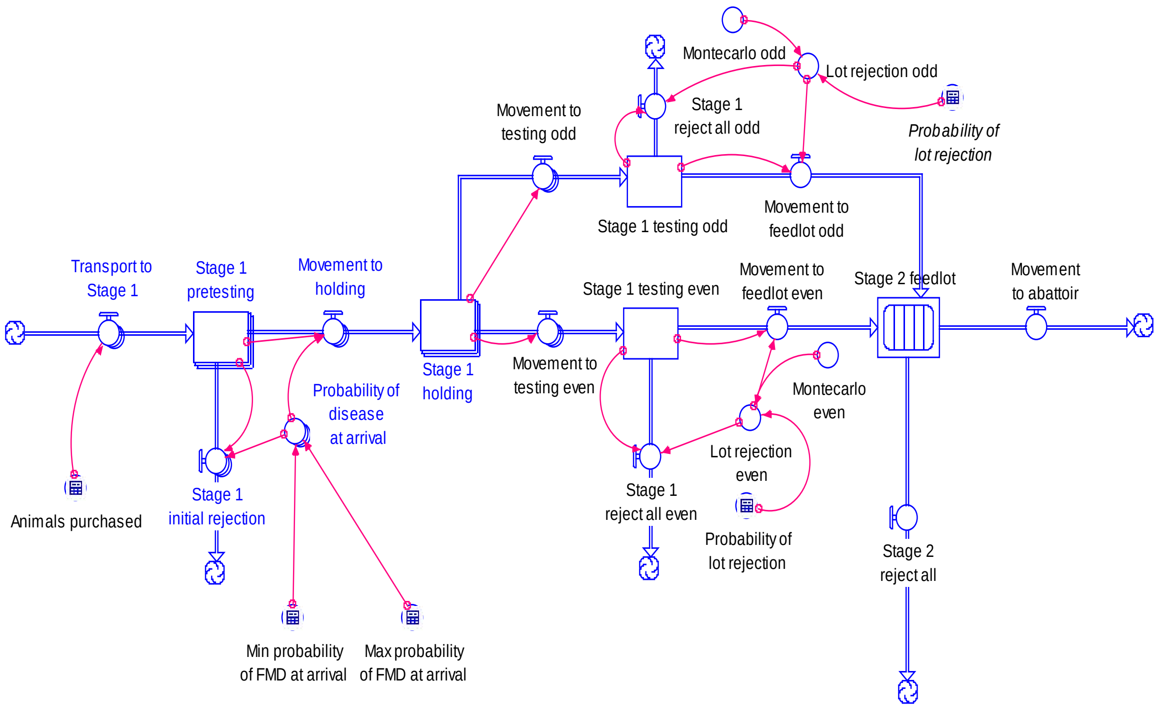

Figure 1: STELLA diagram of the two-phase SPS certification process.

The starting point of the model is a representative network of Phase 1 and Phase 2 facilities. Eight Phase 1 facilities are required, given that each Phase 1 facility supplies the Phase 2 facility once every four weeks. In Phase 1, purchased animals are transported, tested, and inspected during the first week ("Phase 1 pretesting"). The baseline assumes that animals enter the system at 250 kg. After the first week, a portion of animals are rejected and sold on the domestic market ("Phase 1 initial rejection"), with the remainder moved to holding. Note that in both the Phase 1 and Phase 2 models, there are parameters related to disease incidence that determine the probability of animals being rejected from the system. Animals are held for a week ("Phase 1 holding") and then re-tested during the third week ("Movement to testing"). A cohort of animals moves to the Phase 2 facility[1] if all animals test negative for disease; otherwise, the entire cohort is rejected. The odd and even distinction in the model is a modeling technique to preserve identification of the individual cohort that is being re-tested prior to movement to the Phase 2 facility. Beginning with the fifth week of the model, two cohorts of animals move into Phase 2 every week. Given an assumed baseline daily rate of weight gain of 1 kg/day, this implies that animals stay in Phase 2 for a period of 22 weeks (150 days divided by 7, rounded up to the next

[1] More specifically, each stock and flow in Phase 1 is denoted as an array so that each cohort can be identified. However, because Phase 2 does not preserve cohorts and because flows to sub-models without arrays must also be array-free, each pair of Phase 1 facilities is separated into even and odd components to maintain consistency with the rest of the Phase 1 part of the model.

integer week), after which they are moved to the abattoir for slaughter[2]. The "Phase 2 feedlot" stock in the model is actually a sub-model that represents the week-by-week movement of animals during each week they remain in the Phase 2 facility. In the case of clinical FMD outbreaks in particular pen(s), all animals in the pen(s) and probably in adjacent pen(s) will be removed from the facility. The animals in other pens will be followed up for 21 days and if required, these animals may also be tested for FMD. If there is clinical FMD in all of the pens of Phase 2, the entire feedlot is rejected, with animals diverted into the domestic market at a loss. Animals sold in the local market are valued at the per-kilogram price times their weight at exit. In the model, the salvage value distinguishes between each cohort that is rejected from the system and thus the system keeps track of the implicit value of all system animals.

Upon reaching 400 kg and assuming that the feedlot has not been rejected, two cohorts of animals move to slaughter per week (recall that two cohorts enter every period, with the model preserving a first-in, first-out system). Animals are converted to meat equivalent based on a conversion rate of 30.25% (based on expert consultation with the Texas AgriLife Research team) and moved to storage (one week) after which the meat is either exported or sold domestically. The model assumes that high-value cuts are sold overseas, with offal and trimmings (5% of the live weight) kept in the domestic market. The amount of beef generated by a representative network in the SD model in a given year is approximately 1,300 tons of boneless beef equivalent. It is envisaged that 10,000 tons of the government's goal of 30,000 tons of overall meat exports will be comprised of high-value beef exports from this system. This would suggest that 8 feedlot networks (with each network containing one Phase 2 feedlot and eight Phase 1 facilities) are required to meet the government's volume goals for beef exports.

Data

The economic feasibility of the system was assessed using primary and secondary data. An initial rapid assessment of the feedlots and abattoirs located in Awassa, Melge Wondo, in and around Adama, Debre Zeit/Bushoftu, Addis Ababa and Sebeta, and site interviews with Shallo Quarantine Station, the National Veterinary Institute (NVI), and the National Animal Health Diagnostic and Investigation Centre (NAHDIC) provided a basic picture of the present marketing system. From this rapid assessment, initial surveys of feedlots and abattoirs were developed and carried out by the Texas AgriLife Research team from December 2006 to January 2007, with follow-up visits occurring from February to April 2007. These data were used to construct enterprise budgets to reveal the nature and profitability of the current system, the flows of animals for export, specific costs of production, and gross margins.

As the proposed system entails additional costs related to certification that are currently not incurred by the industry, additional data were collected from a series of expert informant interviews of veterinary officials, engineers, government officials and estimates from existing feedlots and abattoirs. These data included:

[2] Because movement between states is on a weekly basis, it is necessarily the case that animals exiting the system may be slightly over 400 kg. For example, in the baseline, an animal at exit will be 404 kg based on an entry weight of 250 kg + 154 kg gained in the feedlot at 1 kg/day (note that an animal stays in the feedlot for the full week in which it reaches 400 kg).

1. Initial and recurrent costs of training staff in "good manufacturing" practices to comply with SPS measures;
2. Capital investments on fences, land, paddocks, boreholes, and trucks devoted to the maintenance and viability of the certification system itself;
3. Laboratory, diagnostic, and vaccine costs, some of which may be incurred by the public sector;
4. The costs incurred of rejecting animals out of the export system and into the domestic market;
5. Additional costs related to certification, including tagging, marking, and other types of traceability measures;
6. Relative profitability in foreign markets as a result of this system, based on a comparison of Ethiopian meat to competitors.

Results

In this section, we examine the economic feasibility of the proposed SPS system using the dynamic cost-benefit model described earlier. We first examine the feasibility of the system based on the data parameters provided in the last section and identify potential bottlenecks to its profitability. We also distinguish between costs related to SPS compliance and those inherent in improving quality. We then conduct a series of sensitivity analyses on various cost and disease incidence parameters to identify those parameters that might significantly impact competitiveness in export markets. The implications of the model and possible modalities required to promote cost savings will be discussed in later sections.

Baseline Results

The baseline scenario involved running the model with the parameters presented above over a 260-week (five-year) period to capture the range of costs and benefits associated with the system from each cohort produced. For the first 25 weeks of the model (3 weeks in Phase 1 and 22 weeks in Phase 2 in the baseline), the only revenues that are generated are derived from the salvage value of animals rejected due to disease in Phase 1. From the 26th week onwards (once animals reach 400 kg or more), two cohorts of fattened animals exit the system en route to slaughter. At this point, revenues are generated at Phase 2 from sales to the abattoir, assuming that the facility meets its costs plus a 10% margin. Likewise, once animals are slaughtered and sold for export, we assume that the abattoir receives a 10% margin on top of the value of costs incurred. While this ensures profitability in the system, these profits occur with a delay, as model results show that non-recurrent investments are paid for only after year five.

Table 1 summarizes the breakeven costs of the two-phase system given prevailing feed rations used at present by two sample feedlots, one with high feeding costs and the other with lower feeding costs. The breakeven computations include the margins paid between Phase 2 and the slaughterhouse and the slaughterhouse and export. The FOB breakeven price ex-slaughterhouse from the system is ETB (Ethiopian Birr) 4,721/animal for animals from the low-cost feedlot and

Table 1. Breakeven price computation of two-phase system in the baseline

Cost component	Value (ETB/animal)	
	Lower- cost feedlot	Higher-cost feedlot
Entry cost of purchased animals into Phase 1	2,250	2,250
Added costs from Phase 1	526	526
Revenues from Phase 1 (rejected animals)	275	276
Total costs of animal after exit from Phase 1	2,501	2,500
Entry cost of animals into Phase 2	2,501	2,500
Added costs from Phase 2	1,620	2,452
Total costs of animal after exit from Phase 2	4,121	4,952
Phase 2 margin (10%)	412	495
Entry cost of animals to slaughterhouse (Phase 2 cost + Phase 2 margin)	4,533	5,447
Added costs from processing	525	525
Revenues from hides and skins	163	163
Revenues from domestic sales (offal and trimmings)	603	606
Net total costs of animals from slaughterhouse	4,291	5,203
Slaughterhouse margin (10%)	429	520
FOB breakeven costs of certified animal (slaughterhouse costs + margin), ex-slaughterhouse (ETB/animal)	4,721	5,723
Final weight (kg)	402	404
FOB breakeven costs of certified meat @ product weight (30.25% conversion rate), ex-slaughterhouse (US$/ton)	4,310	5,203

Source: Model simulations. Note that totals may not exactly sum due to rounding.

ETB 5,723/animal for animals from the high-cost feedlot (the model assumes an exchange rate of US$1=ETB 9 that prevailed in late 2007/early 2008). The large difference in the two feedlots can be attributed to the much higher cost feed ration used by the high-cost feedlot that adds nearly 800 ETB per animal to the costs incurred in Phase 2 (Table 1). Converting these prices to US$/ton and boneless meat equivalent yields an FOB product value of improved, SPS certified beef of US$4,310/ton (low-cost feedlot) and US$5,203/ton (high-cost feedlot).

How do these costs compare with prices prevailing in target markets in the Middle East? In Table 2, we compiled average import unit values (CIF) for the most recent year available (2006 for Qatar and Saudi Arabia; 2007 for Bahrain) for fresh boneless beef in selected markets in the Middle East where data were available. These figures are a weighted average of different cuts and qualities imported into each market and do not provide specific information on particular

Table 2. Average import unit values for fresh boneless beef to selected Middle Eastern markets by selected sources, most recent year

Market	All sources	Brazil	India	Pakistan
Bahrain (2007)	5,254	3,203	2,223	4,417
Qatar (2006)	5,084	2,796	2,301	NA
Saudi Arabia (2006)	3,151	3,009	3,061	NA

Source: UN COMTRADE. Note that 2006 figures for Bahrain are US$5,116 (all sources), US$3,526 (Brazil), US$1,407 (India) and US$3,491 (Pakistan)
Values in US$/ton. NA: not applicable

cuts (and whether such cuts are high- or low-value) that a particular supplier sells in a given market. Nonetheless, they serve as a proxy to compare the competitiveness of fresh boneless beef based on our conversion rate (30.25%). We further distinguish between the values from all sources, Brazil, India, and Pakistan – markets that Ethiopian meat would compete with in the short- and medium-term. Based on these figures, we note that the average FOB price engendered by the Ethiopian SPS system is much higher than the average CIF prices in the Middle East for

Table 3. Differentiation of SPS costs of compliance in two-phase system

Cost component	Value (ETB/animal)	
	Lower-cost feedlot	Higher-cost feedlot
Added costs from Phase 1	526	526
SPS costs of compliance	170	170
Other costs (feed, transport, handling etc.)	356	356
Percentage of SPS costs in added Phase 1 costs	32.2	32.2
Added costs from Phase 2	1,620	2,452
SPS costs of compliance	33	32
Feed costs	1,547	2,379
Other costs	42	42
Percentage of SPS cost in added Phase 2 costs	1.9	1.2
Added costs from processing	525	525
SPS costs of compliance	4	4
Processing costs	520	520
Percentage of SPS cost in processing costs	0.80	0.80
Total costs of SPS compliance (all phases)	204	204
FOB breakeven price ex-slaughterhouse	4,721	5,723
Percentage SPS costs of compliance as a share of breakeven value ex-slaughterhouse	4.3	3.6

Source: Model simulations. Note that totals may not exactly sum due to rounding.

meat from Brazil, India, and Pakistan (for the high-cost feedlot). In the case of the lower-cost feedlot, adjusting the FOB price for transportation costs utilizing improved road-sea links analyzed in earlier Texas AgriLife Research studies (US$370/ton) lands Ethiopian meat at a value lower than the average import unit value in Bahrain and Qatar, but still at a premium over Brazilian and Indian meat. While one could argue that the quality of the product produced in the certified system is superior to products from India and Pakistan, and possibly on par with that from Brazil, the ability of Ethiopia to obtain higher prices would rely on its ability to market and differentiate its product accordingly, which will add further costs that are not computed here. Indeed, it is likely that Ethiopian beef would need to be sold at a discount (relative to the quality of the meat) to gain market share in initial attempts at market penetration.

Despite the higher costs of Ethiopian meat in these Middle Eastern markets, we demonstrate in Table 3 that these costs are generally not attributable to the SPS system itself. Indeed, we find that the total costs to comply with higher SPS standards are only 4.3% (for the lower-cost feedlot) and 3.6% (for the high-cost feedlot) of the final, FOB breakeven price. We find that the vast majority of SPS costs of compliance occur in Phase 1 and represent about 32% of the total added costs in Phase 1. Nonetheless, the main input responsible for higher costs in the two-phase system is the cost of feed: ETB 1,547/animal (lower-cost feedlot) and ETB 2,379/animal (higher-cost feedlot). These costs strongly suggest modalities to lower feed costs as a way to improve competitiveness in foreign markets.

SPS System Competitiveness Using Best-cost Rations

In order to explore the feasibility of the two-phase SPS system under different feeding regimes, we applied two different types of best-cost rations derived by the Texas AgriLife Research team. One of these is predominately a maize-wheat middlings mix, while the other is mainly wheat middlings; each also contains smaller amounts of molasses and oilseed cakes. The breakeven analysis based on these rations and different entry weights is summarized in Table 4 and contrasts markedly with baseline results reported in Table 1.

In all cases, the wheat middlings ration (the identified ‘best-cost’ ration) yields markedly lower-cost animals (and meat) relative to the baseline. For the wheat middlings ration, the FOB breakeven cost per animal ranges from ETB 3,927/animal based on a 200 kg entry weight to ETB 4,244/animal for a 300 kg entry weight (Table 4). Comparing like entry weights with the baseline (250 kg) reveals a difference of ETB 635/animal between the best-cost ration and the baseline lower-cost feedlot ration. Converting to boneless meat equivalent and US$/ton yields an FOB export value of improved, SPS certified Ethiopian meat that ranges from US$3,562 to 3,818 per ton (Table 4). The maize-wheat middlings ration adds about ETB 200 to 400 more per animal (depending on entry weight) relative to the predominantly wheat middlings ration, but is still less costly than the lower-cost feedlot ration (cf. Table 1).

Table 5 reveals the breakdown of SPS costs of compliance under the use of best-cost rations. The percentage of SPS costs as a share of the breakeven value is slightly larger in this case because the breakeven value is lower than in the baseline. Nonetheless, these costs only represent 4.6–5.2%

Table 4. Breakeven price computation of two-phase system using best-cost rations

Cost component	Value (ETB/animal)					
	Maize-wheat middlings ration			Wheat middlings ration		
	200 kg entry	250 kg entry	300 kg entry	200 kg entry	250 kg entry	300 kg entry
Entry cost of purchased animals into Phase 1	1,800	2,250	2,700	1,800	2,250	2,700
Added costs from Phase 1	526	526	526	526	526	526
Revenues from Phase 1 (rejected animals)	221	274	331	223	276	335
Total costs of animal after exit from Phase 1	2,105	2,501	2,895	2,103	2,500	2,891
Entry cost of animals into Phase 2	2,105	2,501	2,895	2,103	2,500	2,891
Added costs from Phase 2	1,700	1,342	997	1,366	1,097	844
Total costs of animal after exit from Phase 2	3,805	3,843	3,892	3,469	3,597	3,735
Phase 2 margin (10%)	380	384	389	347	360	374
Entry cost of animals to slaughterhouse (Phase 2 cost + Phase 2 margin)	4,185	4,227	4,281	3,816	3,956	4,109
Added costs from processing	525	525	525	525	525	525
Revenues from hides and skins	163	163	163	163	163	163
Revenues from domestic sales (offal, trimmings)	609	602	609	607	604	612
Net total costs of animals from slaughterhouse	3,938	3,988	4,034	3,570	3,714	3,858
Slaughterhouse margin (10%)	394	399	403	357	371	386
FOB breakeven costs of certified animal (slaughterhouse costs + margin), ex-slaughterhouse (ETB/animal)	4,332	4,386	4,437	3,927	4,086	4,244
Final weight (kg)	406	401	406	405	402	408
FOB breakeven costs of certified meat @ product weight (30.25% conversion rate), ex-slaughterhouse (US$/ton)	3,918	4,016	4,016	3,562	3,729	3,818

Source: Model simulations. Note that totals may not exactly sum due to rounding.

Table 5. Differentiation of SPS costs of compliance in two-phase system

Cost component	Value (ETB/animal)					
	Maize-wheat middlings ration			Wheat middlings ration		
	200 kg entry	250 kg entry	300 kg entry	200 kg entry	250 kg entry	300 kg entry
Added costs from Phase 1	526	526	526	526	526	526
SPS costs of compliance	170	170	170	170	170	170
Other costs (feed, transport, handling etc.)	356	356	356	357	356	357
Percentage of SPS costs in added Phase 1 costs	32.2	32.2	32.2	32.2	32.2	32.2
Added costs from Phase 2	1,700	1,342	997	1,366	1,097	844
SPS costs of compliance	31	32	31	32	32	31
Feed costs	1,627	1,269	924	1,293	1,024	771
Other costs	42	42	42	42	42	42
Percentage of SPS cost in added Phase 2 costs	1.8	2.3	3.1	2.2	2.8	3.6
Added costs from processing	525	525	525	525	525	525
SPS costs of compliance	4	4	4	4	4	4
Processing costs	521	521	520	520	520	520
Percentage of SPS cost in processing costs	0.80	0.80	0.80	0.80	0.80	0.80
Total costs of SPS compliance (all phases)	204	204	204	204	204	204
FOB breakeven price ex-slaughterhouse	4,332	4,386	4,437	3,927	4,086	4,244
Percentage SPS costs of compliance as a share of breakeven value ex-slaughterhouse	4.7	4.7	4.6	5.2	5.0	4.8

Source: Model simulations. Note that totals may not exactly sum due to rounding.

of the breakeven price, depending on the ration and entry weight. Table 5 further highlights the marked difference in feed costs attributable to the best-cost ration relative to the baseline.

Even with the noticeable reduction in breakeven costs from the use of best-cost rations, in the best-case scenario (200 kg entry weight with the predominantly wheat-middlings ration), the FOB price of SPS certified Ethiopian meat remains somewhat above that of Brazilian and Indian meat in target Middle Eastern markets. This suggests that an examination of other parameters is required to assess where further scope for cost-savings could be realized. We address these issues in the sensitivity analysis.

Sensitivity Analysis

The sensitivity analyses highlighted changes in a variety of parameters using the best-cost rations analyzed in the previous section. We focused on the following set of alternative simulations:

- A reduction in feed prices (by 10% and 20%) to simulate an easing of feed prices relative to current levels.
- A widening of the range of animal rejections in Phase 1 to simulate sub-optimal purchasing and inspection practices for purchased animals, in terms of detecting diseased animals prior to entry into Phase 1.
- The introduction of government subsidies for SPS-related costs. The baseline assumes that all SPS costs are incurred by the private sector – this simulation considers 50:50 cost sharing by the government and private sector.
- Reduction in the margin between Phase 2 and the slaughterhouse and slaughterhouse to export from 10% to 5% and 0%. The latter case could represent a fully integrated system owned by one firm, for instance, or the subsidization of certain costs.
- Alternate purchase prices for live animals, including simulating lower purchase prices (ETB 5.75/kg and ETB 7.5/kg) and higher prices (ETB 10/kg). Lower purchase prices could be interpreted as reducing the transactions costs at purchase between producer and buyer or improved productivity, for example.
- Alternative conversion rates for boneless meat to simulate lower and higher processing efficiency, respectively.
- Reduced transportation costs between different phases (50% lower costs).
- Reduced wage labor costs in each phase (50% lower costs).

Table 6 summarizes the results of this battery of sensitivity analyses, focusing on the FOB breakeven price in meat equivalent and US$ per ton. A reduction in feed costs results in some cost savings, particularly when feed prices fall by 20%. Under the wheat middlings ration, a 20% fall in feed prices reduces the breakeven FOB price by over US$250 per ton for animals entering at 200 kg (Table 6). This highlights the critical importance of feed in the feasibility of the system and finding ways to improve feed availability and productivity. The change in the probability of rejection range had no noticeable impact on the breakeven price, while subsidizing SPS costs saves approximately US$100–125 per ton. On the other hand, reducing margins has a marked impact on the system's viability, with zero margins resulting in a best-case breakeven FOB value of US$2,924 per ton. Of course, the realism of this simulation would necessitate other ways that returns on investments could be realized. For example, one interpretation might be that it reflects government underpinning some of these costs through subsidies.

Lower purchase prices for live animals (from better productivity or supply chain efficiency) also have an important impact on the viability of the system. If we assume the purchase price of ETB

Table 6. Results of alternative scenarios based on sensitivity analysis of selected parameters

Scenario	FOB breakeven costs of certified meat @ product weight (30.25% conversion rate), ex-slaughterhouse (US$/ton)		
	200 kg entry	250 kg entry	300 kg entry
Maize-Wheat Middlings BCR (from Table 4)	3,918	4,016	4,016
Wheat Middlings only BCR (from Table 4)	3,562	3,729	3,818
Maize-Wheat Middlings BCR, 10% lower feed prices	3,741	3,881	3,924
Wheat Middlings only BCR, 10% lower feed prices	3,431	3,621	3,753
Maize-Wheat Middlings BCR, 20% lower feed prices	3,572	3,746	3,823
Wheat Middlings only BCR, 20% lower feed prices	3,289	3,512	3,657
Wheat Middlings only BCR, probability rejection range 5-20%	3,555	3,706	3,822
Wheat Middlings only BCR, 50% subsidy on SPS costs	3,453	3,615	3,714
Wheat Middlings only BCR, 5% margin Phase 2-slaughterhouse, slaughterhouse-export	3,237	3,387	3,469
Wheat Middlings only BCR, 0% margin Phase 2-slaughterhouse, slaughterhouse-export	2,924	3,060	3,142
Wheat Middlings only BCR, purchase price ETB 5.75/kg	2,936	2,945	2,894
Wheat Middlings only BCR, purchase price ETB 7.5/kg	3,274	3,365	3,389
Wheat Middlings only BCR, purchase price ETB 10.0/kg	3,754	3,973	4,110
Wheat Middlings only BCR, boneless conversion rate 25.3%, domestic trimmings 10%	3,534	3,721	3,841
Wheat Middlings only BCR, boneless conversion rate 34%, domestic trimmings 0%	3,706	3,859	3,942
Wheat Middlings only BCR, 50% lower transport costs	3,416	3,588	3,682
Wheat Middlings only BCR, 50% lower labor costs	3,407	3,573	3,670

BCR: best-cost ration.
Source: Model simulations.

5.75/kg that prevailed in late 2006, we also obtain breakeven FOB meat values that are less than US$3,000/ton (Table 6). Interestingly, we also see under this scenario that the returns to heavier animals are higher than those when purchase prices are higher. This is because under lower purchase prices for live animals, the cost of feed outweighs the effect of the purchase price for the animal, making it more cost-effective to use heavier animals. This suggests that the price per kilogram of entry animals needs to be considered as a critical decision-making component by producers in understanding when it is profitable to engage in exporting beef. The impact of alternative conversion rates in processing, lower transport costs, and lower labor costs is relatively small (Table 6).

Finally, as a thought exercise, we computed the price per ton of meat produced by only Phase 1 of the system (i.e. without the feedlot). The idea here was to examine the breakeven costs of only engaging in the simple quarantine and inspection activities of Phase 1 (i.e., without the feedlot), based on the entry of a 300-kg animal. The results in Table 7 are striking and reveal that a partial SPS system would be less competitive. In particular, because animals are not improved as far as weight gain, the Phase 1 system alone adds costs without adding quality. Rather, it may well make more sense to combine SPS certification with meat quality improvements (as envisioned by the proposed system) and charge a higher price rather than sell lower-quality, but SPS certified meat at above-market prices.

Table 7. Feasibility of system assuming only Phase 1 and wheat middlings best-cost ration

Cost element	ETB per animal
Exit costs from Phase 1 at 300 kg (see Table 4)	2,891
Margin for certification system (10%)	289
Entry cost at slaughterhouse	3,180
Processing costs of abattoir (includes transport to port)	525
Revenues from hides and skins	163
Revenues from trimmings and offal (5% of live weight or 15 kg @ ETB 30/kg)	450
Exit costs from slaughterhouse	3,092
Margin for slaughterhouse (10%)	309
FOB breakeven costs of certified animal (slaughterhouse costs + margin), ex-slaughterhouse (ETB/animal)	3,401
FOB breakeven costs of certified meat @ product weight (30.25% conversion rate), ex-slaughterhouse (US$/ton)	4,164

Source: Model simulations

Discussion

Based on the baseline results, the proposed model suggests that the binding constraint to the feasibility of the proposed SPS certification system is feed ingredient prices. In particular, the rapid price inflation over 2007 in Ethiopia resulted in a near-doubling of feed prices that puts the prices of Ethiopian beef above those of competitors in targeted Middle Eastern markets. With improved, best-cost feed rations, Ethiopian beef would cost around US$3,600–3,800 per ton

FOB Ethiopia, higher than the prices of meat from Brazil, India, or Pakistan in Middle Eastern markets, though still much lower than the average price from all sources.

Given the pessimism of the baseline results in target markets and in the absence of technical interventions to improve this system, we consider first if there are alternatives to the SPS system, in terms of finding other markets that might have lower SPS standards than those in the Persian Gulf. Scoones and Wollmer (2008), for example, highlight the potential of regional markets within Africa. To do this, we assessed a number of markets in Africa and the Middle East on a variety of dimensions, including per capita consumption of beef products, beef consumption growth, dependency on imported beef, market size, GDP per capita and GDP growth, to determine which markets might be poised for entry by Ethiopian products. For those high-potential markets (based on an index of these factors), we collected import unit value data as available. We then compared those import prices (see table 8) to 2005–06 Ethiopian export prices (US$2,244/ton FOB for half-carcasses or quarters) based on Ethiopian company-level sales to Africa (proxied by sales to Congo-Brazzaville). This comparison highlights that Ethiopia is potentially competitive in beef markets with lower standards, including Algeria, Cote d'Ivoire, Gabon, and Lebanon. Ethiopia has exported to markets such as Egypt recently; in 2005–06, it exported over 934 tons of beef at an average FOB export price of US$1,724/ton, somewhat above the average CIF price for fresh boneless beef in Table 8.

Table 8. Assessment of import prices in key identified markets for Ethiopian beef

Market (date of reporting)	Fresh carcasses	Fresh bone-in beef	Fresh boneless meat	Frozen carcasses	Frozen bone-in beef	Frozen boneless meat
Algeria (2006)	3,670	4,220	4,247	1,982*	1,955*	2,398
Cote d'Ivoire (2006)	14,713	16,574	15,453	1,538	2,296	1,406
Egypt (2006)	NA	NA	1,356	2,167	1,797	1,847
Gabon (2006)	8,358	7,135	6,165	3,141	1,143	1,377
Jordan (2006)	1,551	3,091	2,328	NA	1,763	1,552
Lebanon (2004)	1,999	2,860	2,598	NA	2,967	1,904

*Prices for 2005. Prices in US$ per ton
NA: not applicable
Source: UN COMTRADE.

However, while the prices revealed in Table 8 are encouraging for non-certified Ethiopian beef in certain African markets, two complications make such a scenario unlikely. First, if one looks at the lucrative markets for beef (i.e. fresh beef) in markets such as Algeria, Cote d'Ivoire, and Gabon where prices are high, the actual volumes traded are tiny: less than 1% of total imported volumes as shown in Figure 2. The overwhelming volume of imports are in frozen beef, where prices are not only lower, but are dominated by Brazil and India, exporters with standards equal to or exceeding those of Ethiopia and whose landed prices are even lower than Ethiopia's (Figure

3). If one considers Angola and the Democratic Republic of Congo, lower-value markets that have seen combined imports of beef rise from 42,000 tons in 2004 to over 69,000 tons in 2006, one sees a similar pattern of overwhelmingly high (over 99%) imports of frozen beef from low-value competitors, particularly India. Indeed, these low prices from Brazil and India serve as a

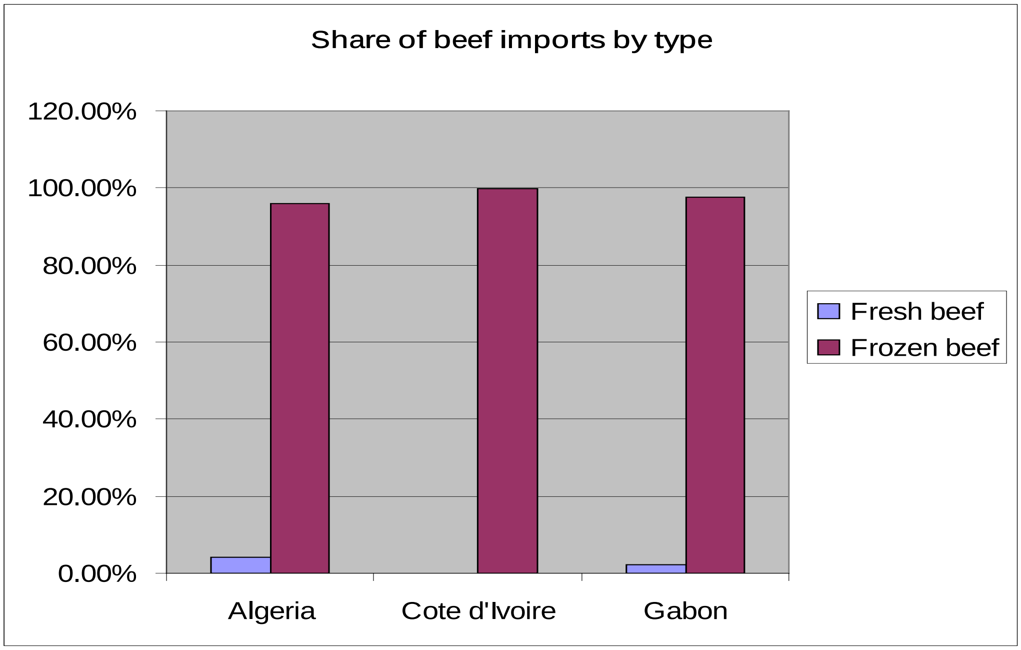

Figure 2: Proportion of imported beef by type in Algeria, Cote d'Ivoire, and Gabon.
Source: UN Comtrade

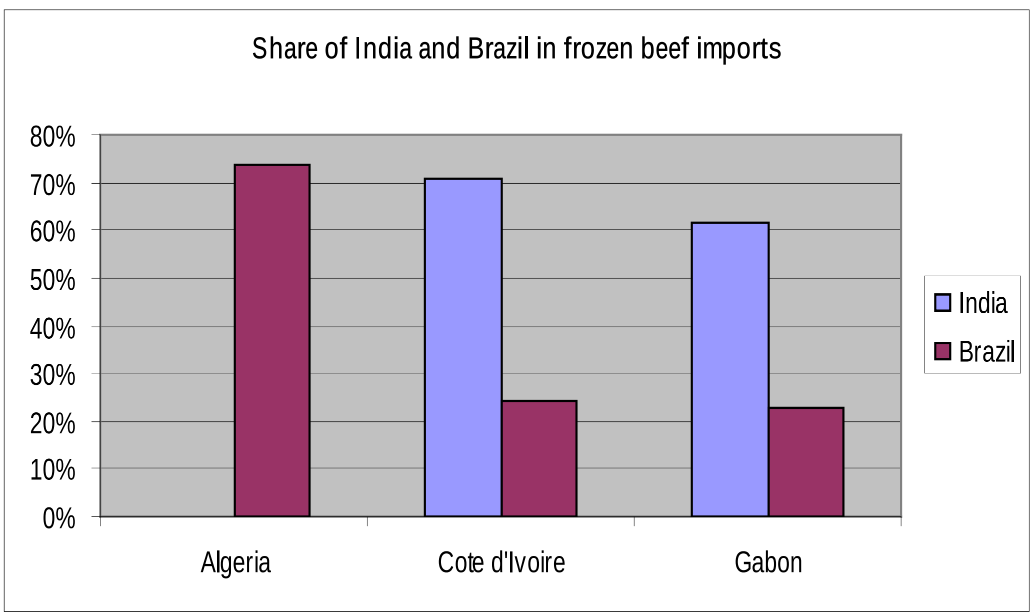

Figure 3: Share of beef imported by Algeria, Cote d'Ivoire, and Gabon from Brazil and India.
Source: UN Comtrade

precautionary tale for those advocating commodity-based trade as a panacea for future African meat exports, as African suppliers may not appreciably benefit (cf. Scoones & Wolmer, 2008). In price-sensitive regional markets in Africa, it is unlikely that consumer willingness to pay for higher-quality products will be sizable in either the short- to medium-term.

The case of Algeria shows an additional area in which Ethiopia is further disadvantaged. Algeria receives a large proportion of imported beef from the European Union, which is traditionally a high-cost producer. However, because the highly protected European market allows for high prices to prevail in domestic markets, European meat producers are able to sell high-value cuts domestically and effectively dump lower value cuts to third markets, including Algeria. By contrast, Ethiopia does not have such flexibility as it must export high-value cuts to remain profitable. This highlights the need for Ethiopia to raise standards in such a way that allows it to market different cuts based on their demand and economic profitability in different markets and further suggests the need to develop certification programs that facilitate this process.

We also considered whether Ethiopia could potentially compete in even higher-value product lines with the SPS system, where various non-price attributes will take greater precedence. On the one hand, one area in which Ethiopia has a marked advantage over Brazil is in its geographical proximity to the Middle East. Consequently, Ethiopia would conceivably have the ability to supply fresh beef instead of frozen beef (as is the case from Brazil) and supply growing markets for foodservice, restaurants, supermarkets, and hotels in the region (USMEF, 2008). Two issues govern the feasibility of such a prospect. First, it is not clear whether consumers of frozen Brazilian beef would pay higher premiums for fresh Ethiopian-sourced beef, particularly since most beef in the Middle East is labeled by country-of-origin and consumer perceptions of such products are unknown. Second, if we look at the current market for fresh, boneless beef itself in the Middle East, UN Comtrade data reveal that the overall import market for such products is relatively small in the region (18,205 tons); by comparison, frozen beef imports are about 80% of total beef imports in Saudi Arabia. Moreover, the high-value grain-fed market (meat originating from Australia and USA) is only about 11% of this total (just over 2,000 tons). While Ethiopia could potentially compete on price under the SPS system with Australia and USA in certain market channels (assuming its product is of similar quality), the size of the market for such a product falls well short of the government's 30,000 ton target.

A final potential avenue for Ethiopian beef exports could be high-value markets such as the European Union that are increasingly deficit in high-quality beef (Agritrade, 2008). Indeed, one significant advantage held by Ethiopia is that it maintains duty-free, quota-free access to the European Union by virtue of the Everything but Arms (EBA) initiative that allows such market access to least-developed countries. By contrast, countries such as Brazil do not have similar preferential access and are forced to pay high (50-100%) over-quota duties on beef exports (Rich & Perry, 2009). This could provide Ethiopia with a significant cost advantage relative to Latin American competitors. On the other hand, this would necessitate a wider acceptance of aforementioned commodity-based approaches in international standard setting bodies such as the OIE. While such initiatives are under discussion, there has not been as yet any clear consensus on what constitutes a commodity-based approach, though the aforementioned system in Ethiopia has been cited as one potential model (Thomson et al., 2009).

Conclusions

The simulation and sensitivity analyses highlighted the importance of lower feeding costs (or lower animal costs) in improving the competitiveness of the proposed two-phase SPS system. Whether Ethiopian beef could compete on price or quality against existing competitors is an open question and one that will likely necessitate significant investments and efforts in marketing and product differentiation. Sullivan (2007) highlights the potential of retail and food service providers (particularly hotels and restaurants) in Middle Eastern markets. The latter is a strategy that Namibia has followed in the European Union and avoids many of the hurdles in the retail sector of developing a brand reputation based on one's country of origin. The rise of organized retail in the Middle East will further provide opportunities for meat products, including those from Ethiopia, but will require cultivating access to these supply chains on the basis of providing consistent volumes and quality. Given the nature of competition in international beef markets, Ethiopia will likely be forced to compete on quality, exporting a diversity of cuts on the basis of demand and competitiveness in different regions, and in differentiating its product relative to competitors over and beyond higher disease-free and food safety standards. Consequently, programs like the proposed two-phase system will be required in order to meet those demands and will be essential in the highest-value markets (e.g., European Union).

While the study mainly focused on the economic feasibility of the proposed SPS system, an important consideration is determining the beneficiaries from such a program, particularly smallholder farmers. The sensitivity analysis highlighted a few potential entry points for smallholders. First, the development of a more integrated supply chain for livestock and meat products would have strong pro-poor benefits in terms of reducing intermediaries and raising farm-gate prices for producers, potentially providing greater incentives for disease control efforts at the farm level. Second, the model strongly highlighted the need for better integration between feed markets and livestock markets. A crucial success factor for the viability of the SPS system is improved feed through animal nutrition and enhanced feed resources. While better rations are an important component of improved livestock products, the long-term sustainability of such a system will be the development of a market-oriented feed sector, which will depend on integrating smallholder producers with markets and disseminating improved technologies to enhance productivity. A significant expansion of the feed industry could thus open up important income-generating opportunities for smallholders in the feed supply chain. A final poverty impact of this system includes the various downstream beneficiaries from the expansion of livestock exports, in terms of employment opportunities in certification facilities, feedlots, abattoirs, and other supply chain support functions. Indeed, achieving the government's aim of 30,000 tons of meat exports would imply a considerable expansion of livestock supply chain activities that could have quite strong pro-poor impacts.

Acknowledgements

The authors acknowledge and appreciate helpful input and comments from the Ethiopia-based Texas AgriLife Research team, notably Dr. Hank Fitzhugh, Ato Belachew Hurissa, Dr. Wondwosen Asfaw, Dr. Nega Tewolde, and Ato Mitiku Gobana. Dr. Alex Winter-Nelson provided additional useful comments. Partial funding for this project was provided by USAID under the SPS-LMM project managed by Texas AgriLife Research. The views expressed in this paper are those of the authors and do not reflect those of USAID or the U.S. Government.

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