Development Policy Review, 2015, 33 (2): 195-219

Would a Commodity-based Trade Approach Improve Market Access for Africa? A Case Study of the Potential of Beef Exports from Communal Areas of Namibia

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Market access for African livestock products has long been stymied by a variety of animal diseases endemic in the region. The concept of commodity-based trade (CBT) has been advanced to make trade dependent on process-related attributes of production that ensure freedom from disease rather than the geographical origin of the animals themselves. This article looks at the potential of CBT in improving market access for beef from communal areas of Namibia, which have historically been excluded from high-value export markets. Model results suggest only modest gains from CBT, given the substantial costs of compliance with SPS and quality standards required for high-value markets. Regional markets may still offer the best option for beef exports from these areas.

Key words: Livestock, market access, SPS, foot-and-mouth disease, system dynamics, Namibia

1 Introduction

While there has been a long history of successful export of non-livestock products from African countries to wealthier countries (particularly vegetables and flowers from East Africa), there are relatively few examples of African countries exporting livestock products to more lucrative developed-country markets (AU-IBAR, 2008; Rich, 2009; Rich and Perry, 2011). Indeed, Namibia and Botswana are the only two that export to international markets, albeit historically in relatively small volumes. An important reason for the poor

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African performance in this respect is the presence of a range of transboundary animal diseases (TADs) that pose risks to animal and human health, making compliance with sanitary and phytosanitary (SPS) standards which regulate trade in agricultural products difficult, if not impossible (AU-IBAR, 2008; Rich, 2009; Scoones et al., 2010). On the other hand, where market access is possible, livestock can act as a potential pathway out of poverty for rural producers and other actors throughout the value chain, as such access increases the potential scope for sales and makes livestock activities more remunerative (Perry et al., 2005; Rich and Perry, 2009).

The concept of commodity-based trade (CBT) has been advocated in many policy circles as a means to enhance market access for African livestock producers (Rich and Perry, 2011). Rather than focusing on the geographic origin of the animal, this regulatory innovation focuses instead both on the process by which meat is produced and the measures taken to ensure freedom from disease, and on specific products (such as de-boned beef) in which the potential for the spread of TADs is minimal to negligible. In doing so, the reasoning goes, CBT could enhance the potential of increased trade volumes in meat from the developing world, including many sub-Saharan African regions whose access to higher-value markets has so far been precluded due to the presence of TADs. This is particularly important in areas where the eradication of foot-and-mouth disease (FMD) is technically or economically not feasible in the foreseeable future, thus relegating farmers in endemic zones (often communal, poorer areas) to informal-market sales (Thomson and Bastos, 2004; Scoones et al., 2010). Acceptance of the CBT approach, by contrast, could open up those markets, expanding regional and high-value trade, and raising incomes in currently disadvantaged areas.

At the same time, very little empirical research has been conducted to understand the economic feasibility of CBT more specifically (AU-IBAR, 2008; Bruckner, 2011). Thomson et al. (2009) speculated that a CBT approach would have broader production, trade, and poverty impacts, but no empirical evidence was presented to support this claim. Most recently, Rich and Perry (2011) looked generally at the structure of global beef production and trade to surmise the potential beneficiaries from the approach. They found that Namibia could be one of the beneficiaries of CBT, given its developed infrastructure for export from FMD-free zones and potential to double its supply base under CBT. However, a formal quantitative modelling exercise was not undertaken. The closest paper in the literature in this area is the analysis carried out by Rich et al. (2009) that assessed the competitiveness of a CBT-type certification programme for beef exports from Ethiopia. This analysis highlighted the high costs of feed rather than SPS compliance costs as an inhibiting factor to trade targeted at markets in the Middle East.

The focus of our analysis is to provide empirical evidence on the potential of the CBT approach, as applied to a case study of expanded beef exports from the Caprivi Strip of Namibia (hereafter Caprivi). The Caprivi, which is administratively divided between the eastern Zambezi Region and the western Kavango East Region, is a predominantly communal and biodiversity-conservation area where FMD is endemic and not eradicable, owing to the presence of large numbers of free-roaming buffalo. Wider acceptance of CBT by trading partners would offer the potential to export de-boned beef from the Caprivi to alternative, high-value markets. At the same time, the actual access to these markets would depend on compliance with the SPS and quality requirements of importing countries. Accordingly, in order to meet these standards, the different stakeholders in the value chain

willing to export to these markets could incur new costs over and beyond those currently experienced.

In summary, CBT can open up new markets where a potential price premium can be fetched. However, these markets often require compliance with stricter SPS and quality standards, and meeting these requirements can be extremely costly. The extent of these costs may outweigh the premium itself, thus making these destination markets less attractive than other, less demanding, importing countries. The present study aims at shedding light on the economic feasibility of accessing important markets that could be opened up by CBT. While the study has focused on the potential of CBT in a specific region of a developing country, we hope that it can contribute to gathering a better understanding of the potential benefits and costs that can be expected from the decision to comply with a different set of standards and norms for accessing different markets. At the same time, the feasibility of CBT is very much case-specific, with some regions potentially more favourable for its adoption than others.

Following Rich et al. (2009), we adopted a systems-dynamics approach to assess the dynamics of increased costs incurred by livestock producers and the abattoir in order to access the new markets. A methodological novelty of this study is linking behavioural decisions at a producer level to market and breed animals with changes associated with CBT under different scenarios, thus explicitly modelling the feedback implicit between production and downstream processing.

The article is structured as follows. The next Section provides an overview of the regulatory context in which beef trade takes place and the challenges faced by developing countries. Section 3 gives some background information about livestock production and trade in Namibia and the Caprivi. Section 4 presents the methodology employed and the model, while Section 5 defines the potential CBT scenarios. Section 6 describes the method of data collection, and Section 7 presents our findings. In the final Section, we draw the main conclusions and make some policy recommendations.

2 Regulations governing international trade in livestock and livestock products

Conventionally, the safe importation of livestock commodities depends upon the absence of TADs, such as FMD, from the country of origin. For four diseases, including FMD, the OIE (World Organization for Animal Health, the relevant international standard-setting body) has developed a formal mechanism for recognising the disease-free status of countries, or zones within countries (Thomson et al., 2009; Bruckner, 2011). However, in many areas eradication of these diseases is impossible, mainly because they are maintained by healthy wildlife populations (for example, the South African Territories (SAT) serotypes of the FMD virus that co-evolved with African buffalo). At the same time, there have been calls among policy-makers in Africa (for example, Ministers of Agriculture of the Common Market for Eastern and Southern Africa – COMESA) to update international livestock standards in a manner that makes them more trade-friendly without increasing the risk of disease spreading (AU-IBAR, 2008). Recently, the OIE has begun to respond positively to this need by recommending options such as trade from ‘compartments’, but questions remain regarding its practical implementation in extensive farming systems.

A further option is CBT. The CBT approach is built on the recognition that different livestock commodities and products present different levels of risk and that many processed products derived from healthy animals pose negligible sanitary risk for importing countries, irrespective of the disease status of the area of production. In fact, processing is often capable of providing decisive risk-reduction by further ensuring that important pathogens are not present in traded products (Thomson et al., 2004; 2009; Scoones et al., 2010). CBT represents a substantial shift in SPS policy for livestock products. The conventional approach based on freedom from disease leaves the responsibility to comply with animal health standards entirely with the public veterinary service and therefore relies on substantial public provision and investments. Conversely, CBT requires greater involvement of the private sector that is expected to cover the majority of the costs associated with both its compliance and certification, in a similar way to what has occurred in the area of food safety since the early 1990s and, more recently, following the emergence and proliferation of private voluntary standards in the food sector.

The concept of CBT is not new, with elements of it progressively applied by the OIE. Several chapters of the OIE's Terrestrial Animal Health Code (TAHC) make provision for the safe trade of animals and commodities, such as hides, skins, and tinned beef from infected countries or zones subject to the application of specific risk-mitigation measures (Rich and Perry, 2009). The CBT concept is particularly relevant to FMD, given that FMD viruses are inactivated in muscle tissues as a result of the pH changes associated with normal beef maturation (Metcalf et al., 1996; Paton et al., 2010). Accordingly, the OIE has developed a standard for the safe import of de-boned beef from an FMD-infected country or zone (Article 8.5.25 of the TAHC 2011). Nevertheless, many importing countries remain concerned about the risks associated with such trade in de-boned beef, and this has limited wider acceptance of CBT. As a matter of fact, geographical freedom from FMD is still a prerequisite for trade in the policies of many importing countries (Bruckner, 2011). This represents an insurmountable barrier to the export of livestock products from most developing countries to higher-value markets, contributing to the marginalisation of African producers as a result of SPS concerns. In addition, given that CBT places increased reliance on private, rather than public, certification, finding an appropriate balance between public and private standards, and the roles of different certifying agencies, will be required as well.

3 Livestock production and trade in Namibia and the Caprivi Strip

In Namibia, the livestock industry is of fundamental economic importance to the country as a whole, contributing about 11% of gross domestic product and 25% of foreign exchange. The livestock sector accounts for 90% of all agricultural production in Namibia and is dominated by cattle production (MCC, 2008). The national cattle herd size is estimated at 2.4 million animals (DVS, 2006). Approximately 60% of households own cattle, including nearly 40% of poor households.

There are two cattle-production systems in Namibia: commercial ('freehold') and communal ('traditional'). The commercial sub-sector, made up of around 4,200 farmers, is well developed, capital-intensive, and export-oriented, and occupies 52% of the grazing land. Some 150,000 households utilise the communal areas with user rights on cropping lands and communal rights to grazing land (Bishi and Kamwi, 2008). Most communal

farmers own the small-framed but well-adapted indigenous Sanga cattle breed. In the low-technology communal sector, livestock play multiple roles in the sustenance of the people through the provision of draught power, manure, milk and meat, as well as a source of cash when in need. In addition, cattle represent an important form of social capital. While the two sub-sectors maintain more or less equal holdings of cattle, commercial producers are the primary suppliers of beef production, providing 75-80% of annual offtake (Cabrera et al., 2008).

Namibia's livestock industry, currently worth N$ 1.6 billion annually (over US$200 million),[1] is dependent on export markets (Strydom, 2011). Namibia typically exports about 80% of its total beef production each year, almost all derived from the internationally recognised FMD-free zone. Current exports of beef are in the order of 22,000 tonnes annually. For historical reasons and trading arrangements under the Southern African Customs Union (SACU), the marketing of Namibian meat is firmly embedded in the market of the Republic of South Africa (RSA) with over half of its exports (Bishi and Kamwi, 2008). European Union members, in particular the United Kingdom, are also major destinations for Namibian beef. Namibia also has access to two lucrative duty-free quotas for exports to Norway (a 2,700-tonne quota shared with Botswana, and access to a shared 500-tonne quota available under a SACU-Norway free trade agreement). EU markets import boneless cuts, with nearly 70% of beef imports consisting of fresh and chilled cuts. The sale of high-value beef cuts to these European markets has so far proved profitable compared with sales to the RSA, but concerns exist about the future capacity of the Namibia beef industry to maintain this market if current preferential access through a provisional Economic Partnership Agreement (EPA) were to be lost. Historically there has been limited value-adding to meat destined for both the RSA and Europe, though branding efforts in both markets have accelerated in recent years.

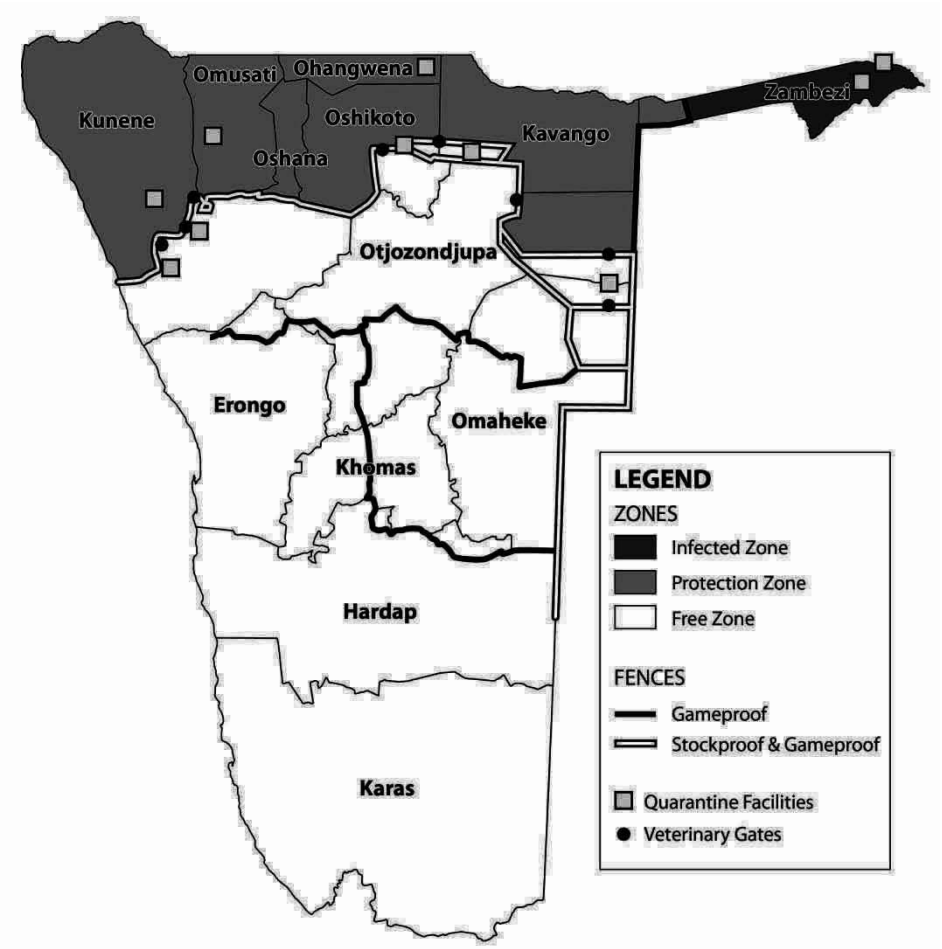
FMD has always been a threat to the Namibian beef export industry. The current FMD control strategy is based on the principles of early detection/early reaction, animal movement control and strategic and mass vaccination in high-risk areas, and, most importantly from this study's perspective, on a zonation system primarily linked to the FMD-free zone recognised by the OIE (Bishi and Kamwi, 2008). Figure 1 illustrates the division of the country into three FMD control zones: an infected zone (Caprivi Strip), a protection zone, and a free zone. The protection zone and the free zone are divided by a Veterinary Cordon Fence (VCF), commonly known as the Red Line. Since 1971, all outbreaks, with the exception of one in adjacent Kavango, have been in the Caprivi Region and have been associated with contact with healthy African buffalo populations resident in the region or with cross-border movement of infected cattle. The zone south of the protection area is recognised by the OIE as free of FMD and, as such, should enjoy unrestricted access to international markets. Nevertheless, European countries apply standards that are stricter than OIE standards and require the deboning of the meat as an additional risk-mitigation measure.

Historically, areas north of the VCF, usually referred to as the Northern Communal Area (NCA), have restricted access for beef to domestic and regional markets only. Furthermore, while de-boned beef originating from south of the Red Line can be exported directly to regional and European markets, livestock north of the VCF must be quarantined

1. The average exchange rate during 2011 was 1US$ = 7.2N$.

for 21 days prior to slaughter, after which the meat has to undergo an additional 21 days quarantine before leaving the abattoir. No offal may be distributed south of the VCF.

Figure 1: FMD zones and fences



Source: Meat Board of Namibia.

While the number of cattle south of the VCF is declining due to technical, environmental and ecological constraints, the cattle population has been growing rapidly in the NCA from about 620,000 in 1990 to 1.03 million in 2005 (DVS, 2006). This dramatic increase in livestock has been attributed to improved institutional service delivery such as veterinary and extension services and the low offtake ascribable to a combination of market constraints, including the transaction costs related to the need to quarantine the animals, and socio-cultural issues surrounding livestock ownership (Ransom, 2011; Ministry of Agriculture, Water and Rural Development, 2004). Even though it is believed that, since 2006, the cattle population in NCA has been increasing at a slower pace, the high livestock

pressure resulting from rising animal stocks has resulted in severe rangeland degradation (MCC, 2008).

Two parastatal entities in Namibia make production and the majority of its exports possible for its cattle and beef industry. These are the Meat Board of Namibia and the Meat Corporation of Namibia (MeatCo). The Meat Board, while government-owned, is privately financed and its primary focus is the maintenance and development of export markets. Meatco is jointly owned by the government and the private sector and is the country's largest meat processor, with four abattoirs (Bowles et al., 2005). Two of these, south of the VCF, are the only abattoirs in the country approved for export to EU countries. The other two, located in the NCA (in Oshakati in the protection zone and Katima Mulilo in the FMD-infected Caprivi, respectively) have historically processed meats for the RSA and other markets (Cabrera et al., 2008).

Cattle owners in the NCA can sell their animals into the informal or indigenous market (with rudimentary slaughtering and marketing facilities) or to MeatCo. Usually, when it comes to marketing cattle, the driving force is the immediate need to generate cash rather than being part of a planned production and marketing cycle (Bruyn et al., 2001). However, over the years the marketing behaviour of farmers in the NCA has clearly demonstrated price responsiveness (Vigne, 2005).

The formal marketing figures in the NCA have remained fairly constant over the last 15 years, with a very low percentage of marketed animals sold to MeatCo's abattoirs. According to Verlinden and Kruger (2007), while around 50% of Namibia's total livestock production originates from the NCA, less than 2% of this is sold into the formal market (compared with 25% in the South), and only 5% of marketed cattle in Namibia are sourced from the NCA (PWC, 2005). Increasing formal offtake in the NCA would generate considerable income for livestock farmers (Cabrera et al., 2008; Strydom, 2011). The NCA offers the greatest potential for intensification and diversification, but in order to achieve agricultural growth, communal farmers need to be integrated into domestic and export markets as a matter of priority (Vigne, 2005).

MeatCo, as the sole institutional buyer of livestock in the region, has experienced a number of viability problems in its NCA operations because of low throughput, poor-quality animals, and a lack of consistency in the supply of slaughter stock at the two abattoirs. The quality of animals is poor because of the advanced age at which animals are marketed, their low nutritional status, and low carcass weights.

Several studies argue that the root cause of the formal marketing problems in the NCA is the Red Line itself and have concluded that the translocation of the VCF to the Angola-Namibia border would bring tangible benefits to the economy in the long run (DVS, 1999; Vigne, 2005). This idea, for the time being at least, has been put aside due to technical and socio-economic considerations. Nevertheless, the overall objective would be the achievement of internationally recognised FMD-freedom. But while the 'National Strategy for the Eradication of Transboundary Animal Diseases' aims at the recognition of disease-free status in the protection zone where no FMD outbreaks have been registered in the last 40 years, such status is not achievable for the Caprivi because of the presence of abundant wildlife. Furthermore, the Caprivi is at the centre of the Kavango-Zambezi Transfrontier Conservation Area (KAZA-TFCA), the largest conservation area in southern Africa; consequently FMD control measures applied elsewhere (for instance, fencing for physical separation of animal populations of different FMD status) are not feasible or economically

justifiable. In fact, these measures would conflict with the development of wildlife-conservation initiatives and hinder the exploitation of their vital environmental and economic benefits.[2] In this context, CBT in the Caprivi may provide a potential solution because in that case access to markets is not dependent upon achieving geographic freedom from FMD.

According to the most recent statistics, the cattle population in the Caprivi is about 156,000 (15% of the NCA population) reared by around 12,000 livestock owners (DVS, 2006). Formal offtakes to the MeatCo abattoir in Katima Mulilo fluctuate between 5% and 7%. In the last few years, around 85% of cattle sold to Meatco were older than 4 years and the average carcass mass was low, around 160 kg (south of the VCF it is 250 kg). Consequently, much of the beef produced is fit for manufacturing purposes only. The abattoir has a slaughtering capacity of 110 cattle a day every other day (i.e., potentially around 14,000 cattle a year). During the 2005–11 period, the annual number of animals slaughtered at the abattoir fluctuated considerably, with a peak of 9,700 in 2006. Insufficient throughput, low carcass weight, restrictions to the marketing of offal outside the region, and lack of access to overseas markets because of disease status have resulted in the abattoir operating at a considerable loss. Meatco suffers operational losses even when capital costs are not taken into account, and these losses are cross-subsidised using income from south of the VCF (PWC, 2005). The situation has been further exacerbated recently by the ban imposed on beef imports from the Caprivi by the RSA, historically the main destination market. In fact, the abattoir was closed between November 2007 and September 2009 following FMD outbreaks in the region that were particularly difficult to eliminate (MeatCo, personal communication). Once these FMD outbreaks were controlled, the abattoir was reopened but, since then, the RSA has continued to ban beef imports from the Caprivi (while still importing from the MeatCo abattoir in Oshakati, in the protection zone).

Currently, the main destination markets are Windhoek (disease-free zone), Oshakati (protection zone), and Angola, representing 65, 17 and 14% of sales value, respectively. Limited amounts are sold to the local market and the Democratic Republic of Congo (DRC). The loss of access to the RSA market represents a serious additional constraint to the development of a profitable and sustainable livestock sector in the region. Wider acceptance of CBT would not only allow the recovery of the main destination market for de-boned beef but also offer the potential to access the high-value EU market. While this looks promising, the economic feasibility of these options deserves a more in-depth analysis.

4 Methodology

We assessed the economic potential of CBT in the Caprivi by developing a system dynamics (SD) model used to conduct a dynamic cost-benefit analysis of interactions taking place in specific nodes of the livestock value chain (production, processing and distribution). A SD model provides a framework for capturing and simulating the complex feedback mechanisms that exist in dynamic systems, such as those present in livestock markets (Sterman, 2000; Rich et al., 2009; 2011). Rich et al. (2011) point out that livestock

2. Recently a consortium of interest groups has produced a film (*Beauty and the Beef*) (www.wcs-ahead.org) that explains how CBT would allow compatibility between wildlife conservation and the livestock sector.

systems are replete with complex herd dynamics and associated delays that influence both the marketing and breeding behaviour of livestock operators in ways that are sometimes not intuitive. SD approaches allow researchers to simulate the behaviour of these livestock systems over time and are conducive to performing *ex-ante* sensitivity and scenario analyses. As noted earlier, Rich et al. (2009) developed a SD model to analyse the dynamic costs and benefits associated with a SPS certification system for beef exports from Ethiopia. Other recent applications of SD models to livestock markets include the one of Rich (2007) that examined the interface between livestock markets and animal disease and Ross and Westgren (2006) that highlighted how different entrepreneurial behaviours influenced profitability and marketing strategies in pig markets.

A methodological novelty is the modelling of two interacting dynamic systems within the value chain – the dynamics of herd behaviour (marketing and breeding) taken at the farm level and the downstream dynamics undertaken by the abattoir. Changes in prices and relative profitability modulate the entire dynamics of the system. For example, we have assessed the economic feasibility of accessing the markets potentially opened up by CBT assuming either the current low-quality or higher-quality beef. In the latter case we assume that the producers would sell younger, heavier animals and would receive higher prices for them. However, producers willing to increase the quality of their animals incur additional costs. The relative profitability of producers will influence their behaviour regarding when to market animals in the short run and how many animals to keep in reserve for breeding. Downstream, higher throughput at the abattoir level will reduce per-kilogram unit costs and improve profitability, which in a CBT world is further enhanced by higher prices to a larger variety of higher-value end markets for beef. However, the ability of processors to obtain more animals for slaughter will depend on decisions made by farmers to sell or breed animals, which depends on the profitability of marketing under the different scenarios and farmer price response to sell or hold animals for breeding. We recognise that other, non-market considerations will influence the marketing of animals in communal areas, but these are not modelled due to a lack of data. Such an exercise would be an interesting area for future research in such types of models.

The model was programmed in iThink (http://www.iseesystems.com). In this system, animals are quarantined and then purchased by the abattoir and moved directly to slaughter, where carcasses are processed and the cuts sold to domestic or export markets. Furthermore, we consider a couple of scenarios in which a subset of animals (young steers) are fattened in a combined feedlot/quarantine facility for a period of four months and then sent to slaughter as above. The quantity of beef sold to different markets depends on the scenario in question (see next Section), though the proportion of the carcass allocated to different cuts is the same across different scenarios and is based on a block test reflecting standard percentages of cuts in the southern African context.

The model also considers the dynamics of herd behaviour for the system. Three states of nature exist at the herd level – young animals (less than one year old), sub-adults (one to two years old), and adults (over two years old). Animals move between states based on probabilities of offtake (sale) and death, with the former further influenced (for sub-adult males and sub-adult and adult females) by sales and breeding elasticities, respectively. Higher prices are expected to increase offtakes of sub-adult males, while the same response would be expected to reduce offtakes of females in order to produce more stock for the future. In order to induce price response in the model, we developed a simple profitability

index (post-CBT returns relative to pre-CBT returns) to capture the net impact of higher prices and costs on farm-level decisions to market or hold for breeding. The herd model is parameterised based on the DynMod herd dynamics model, which is calibrated to highlight herd behaviour in pastoral systems in West Africa (Lesnoff et al., 2007; Lesnoff, 2008). However, parameters related to breeding and offtakes were adjusted downwards in this application to reflect the near-zero growth of cattle herds in Namibia. In addition, because the DynMod does not start at a steady-state and requires some time (about 4-5 years) to reach this, we present our analysis with the model starting in year 5 to ensure such 'noise' is omitted from the scenario analysis. We run the model for a simulation period of 20 years.

5 A description of potential CBT scenarios

Wider acceptance of CBT by trading partners would generate new market opportunities for the export of de-boned beef from the Caprivi to higher-value markets. At the same time, its implementation and, above all, the actual market access to potential new markets would impose new costs on the private sector, over and beyond the ones currently incurred by the different stakeholders in the value chain. Table 1 presents the costs associated with the CBT system for both farmers and producers in the different scenarios. Three sets of additional costs can be considered.

First, CBT will require additional risk-mitigating measures for FMD in the biosecurity system(s). In the case of Namibia, most of these measures are already in place (for example, deboning, deglanding and meat maturation) and only a few additional measures have been taken into consideration (namely, transport by lorry to the quarantine facility in order to reduce the likelihood of livestock-wildlife contact, two FMD vaccinations in the two weeks prior to slaughter, certification of good animal health, and serology tests at the abattoir). These additional measures represent an extra cost. On the other hand, CBT can potentially reduce some costs incurred by the private sector, in particular those related to the quarantine (where no FMD cases have ever been detected). In fact, the OIE standard for the safe import of de-boned beef from an FMD-infected country/zone (Article 8.5.25 of the TAHC 2011) does not require any quarantine. The quarantine process, besides being a net cost for the public sector, significantly increases marketing costs for livestock owners (for example, for transport to the camp, stress-related weight loss and mortality) that constrain formal offtakes. However, the reluctance of many importing countries to accept CBT and the adoption of stricter than OIE standards by some of them (for example, the EU requirement of deboning for imports from southern Africa's FMD-free zones) have suggested a more conservative approach that maintains quarantine in the short to medium term. The most likely scenario (baseline) adopted in this study therefore assumes no change in the requirement for quarantining the animals prior to slaughter. However, because of the significant cost and logistical problems that quarantine generates, its removal has been taken into consideration in our sensitivity analysis.

Second, new destination markets might require compliance with additional food safety-related SPS requirements (for example, the need for an EU-approved export abattoir).

Table 1: Cost parameters associated with different CBT scenarios

Cost Item	Cost	Incurred by	Scenarios applicable
Herd man (1 every 100 heads)	N$ 5.95/month per head	Producer	All
SupaVac vaccine (once a year)	N$ 7.80/year per head	Producer	All
Brucellosis vaccine (life-time immunity)	N$ 195/head	Producer	All
Parasite control	N$ 56/year per head	Producer	All
Transport by lorry to quarantine facility	N$ 34/head	Producer	All
Supplementary feed (winter licks, P12 and salt)	N$ 129/year per head	Producer	2, 3, 5, 6
Two extra FMD vaccinations in quarantine facility	N$ 10 each	Producers in scenarios 1, 2, 4, 5. Feedlot in 3 and 6	All
Steers procurement for feedlot (entry mass 250 kg)	N$ 15/kg live weight	Feedlot	3 and 6
Feed costs for feedlot	Daily grain: 1 kg/day Standing period: 4 months Daily intake: 8.4 kg/day*head Feed cost: N$ 1,800/mo per worker	Feedlot	3 and 6
Labour costs for feedlot	Workers (20)@N$ 1,800/mo per worker Manager (1)@8,000/month	Feedlot	3 and 6
Feedlot infrastructure	Pens: N$ 400,000; Shed (30 days feed): N$ 450,000; Loading ramps: N$ 145,000; Office: N$ 400,000;	Feedlot	3 and 6
Equipment for feedlot	Computer: N$ 6,000; Scale: N$ 30,000; Neck clamps and tools: N$ 30,000	Feedlot	3 and 6
Bleeding and serology test (1:10 animals)	N$200/test	Abattoir	All
Certification of animal good health and compliance with SPS measures	N$ 30/head	Abattoir	All
EU-approved abattoir	N$ 80,000,000	Abattoir	4, 5 and 6
Vacuum packaging for chilled cuts	N$ 2/kg of beef	Abattoir	2, 3, 5, 6
Nature Reserve packaging/branding for chilled cuts	N$ 1.5/kg of beef	Abattoir	2, 3, 5, 6

Note: Scenario numbers refer to those provided in Section 5.

Finally, even if trading partners accept the CBT approach, the marketing of Caprivi beef may be limited by its current low quality. The Farmers Mentorship Programme (FMP), promoted by the Meat Board, already requires compliance with some SPS requirements that

would enhance both the health status of the animals and the beef quality (namely, vaccination against some diseases, but not FMD; parasite control; and need for herding the animals). In this scenario (Quality Option 1), these measures, together with the transport by lorry (rather than trekking), are expected to increase the carcass weight (to an average of around 180 kg) and thus the cut size and quality. However, it is recognised that carcasses and therefore cuts would still be small relative to the requirements of demanding markets, such as the EU, and unlikely to meet their quality requirements. Accordingly, in consultation with several stakeholders in the Namibian beef industry, two additional options have been specifically considered in order to significantly increase the quality and thus allow the export of chilled, rather than frozen, beef cuts from younger animals. First, in Quality Option 2 we have assumed, in addition to compliance with the FMP, the provision of supplementary mineral feed at farm level (from weaning to slaughtering) in order to further enhance beef quality and carcass mass. Second, in Quality Option 3, we foresee the establishment of a combined feedlot/quarantine facility that purchases 18-month-old steers (reared according to the FMP with supplementary mineral feed) and fattens them over a four-month period. This scenario further includes the procurement of older animals as well as conjunction with improvement as envisioned under Quality Option 2. The quality specifications and the additional requirements under the *status quo* and the analysed quality options are presented in Table 2.

As previously mentioned, we have assumed that CBT may open up two new destination markets, namely South Africa and the EU.[3] It is important to bear in mind that, on the one hand, while the Katima Mulilo abattoir is approved for export to South Africa it does not comply with EU hygiene standards. We have thus assumed that a new abattoir would be built if export to the EU is to be considered. On the other hand, both the Namibian Competent Authority and residues control plan are already approved for export to the EU (from south of the VCF). Consequently, no additional public investments are required in order to access the EU other than the construction of lorry-loading ramps in the production areas and some training for the veterinary and abattoir staff in charge of serology tests and the supervision of deboning and deglanding procedures. These relatively minor costs have been ignored.

The analysis takes into account that the destination markets and the quality options would determine different additional benefits and costs accruing from the new market-access opportunities determined by acceptance of the CBT approach (for instance, different cuts of different qualities may be traded to different destination markets in order to fetch the highest price). Consequently, in addition to the *status quo*, a total of six scenarios have been built: (i) Scenario 1: Quality Option 1, new access to the South African market; (ii) Scenario 2: Quality Option 2, new access to the South African market; (iii) Scenario 3: Quality Option 3, new access to the South African market; (iv) Scenario 4: Quality Option 1, new access to the South African and EU markets; (v) Scenario 5: Quality Option 2, new

3. CBT might also facilitate trade with other countries, such as the regional ones and the Middle East. We have chosen to focus on South Africa and EU countries because of the historical relevance of the former and the very attractive price paid by the latter for some quality cuts. Moreover, even though FMD-freedom is not demanded by regional and Middle East countries, these markets are not currently importing from anywhere in Namibia, regardless of the location relative to the VCF (the only exceptions are Angola and DRC that are included in our analysis since they are currently importers from the Caprivi). Other constraints are likely to limit the export to these countries, over and beyond SPS issues.

access to the South African and EU markets; (vi) Scenario 6: Quality Option 3, new access to the South African and EU markets.

Table 2: Scenario options considered and additional requirements

Quality options	Carcass weight (kg)	Slaughter age (years) and carcass grade	Size and type of marketed cuts	Additional requirements [incurred by Producers (P), Abattoir (A), or Feedlots (F)]
Status quo	160	5-7 (C)	Small (frozen)	-
Scenario 1: Quality Option 1 (FMP)	180	5-7 (C)	Small (frozen)	SPS measures 1. Vaccination for other diseases* - (P) 2. Parasite control – (P) 3. Herding men - (P) 4. Transport by lorry – (P) 5. Vaccination for FMD – (P) 6. Certification of good health – (A) 7. Serology test on a sample of animals – (A)
Scenario 2: Quality Option 2 (FMP + supplementary feed)	200	< 3 (B)	Medium (chilled/ frozen)	SPS measures 1. Vaccination for other diseases* - (P) 2. Parasite control – (P) 3. Herding men - (P) 4. Transport by lorry – (P) 5. Vaccination for FMD – (P) 6. Certification of good health – (A) 7. Serology test on a sample of animals (A) Non-SPS measures 1. Supplementary mineral feed for 2 years – (P)
Scenario 3: Quality Option 3 (Feedlots)	202	< 2 (AB) when animals from the feedlot; < 3 (B) when otherwise	Medium (chilled/ frozen)	SPS measures 1. Vaccination for other diseases[a] - (P) 2. Parasite control – (P) 3. Herding men - (P) 4. Transport by lorry – (P) 5. Vaccination for FMD – (F if animals from feedlot; P otherwise) 6. Certification of good health – (A) 7. Serology test on a sample of animals (A) Non-SPS measures 1. Supplementary mineral feed for 1 years – (P) 2. Animals' procurement – (F) 3. Feed for fattening – (F) 4. Feedlot labour – (F) 5. Feedlot infrastructure and equipment – (F)

Table 2 cont.

Quality options	Carcass weight (kg)	Slaughter age (years) and carcass grade	Size and type of marketed cuts	Additional requirements [incurred by Producers (P), Abattoir (A), or Feedlots (F)]
Scenario 4: Quality option 1 + export to EU	180	5-7 (C)	Small (frozen)	As scenario 1 + EU approved abattoir – (A)
Scenario 5: Quality option 2 + export to EU	200	< 3 (B)	Medium (chilled/ frozen)	As scenario 2 + EU approved abattoir – (A)
Scenario 6: Quality option 3 + export to EU	202	< 2 (AB) when animals from the feedlot; < 3 (B) when otherwise	Medium (chilled/ frozen)	As scenario 3 + EU approved abattoir – (A)

Notes: Carcass grades refer to the age of the animal: AB = 18-24 months; B = 24-48 months; C = > 48 months; (a) refers to SupaVac (botulism, black quarter, anthrax) and vaccination for brucellosis.

In our analysis, we have taken into consideration that the Caprivi is an area in which FMD is endemic and that has regularly experienced FMD outbreaks in cattle. Over the last decade, all of southern Africa has witnessed an upsurge in the occurrence of outbreaks that has resulted in questioning the current FMD control strategy (ARC-LNR, 2011). In the Caprivi, four separate cattle outbreaks have occurred in the period 2007–11. When such outbreaks occur, the current FMD control approach in Namibia requires strict movement controls of animals and animal products within and out of the Caprivi, including closure of the MeatCo abattoir until the outbreak is controlled (on average four months). During this period, sales of animals are restricted to the informal market. Since properly de-boned beef derived from healthy animals that have undergone the above-mentioned risk-mitigation measures poses negligible sanitary risk for importing countries, irrespective of the disease status of the production area, the need to close the abattoir in the case of an outbreak under CBT is questionable. Abattoir closure is also not required by the OIE standard: under CBT, an FMD outbreak should not disrupt trade.[4] Accordingly, we have assumed in the *status quo* that a series of FMD outbreaks (ten over the 20-year simulation period) would result in the closure of the abattoir. Conversely, in the CBT scenarios we have assumed that the abattoir would keep operating even during the outbreaks.

4. Unless the outbreak is within a 10-kilometer radius from the production area but, in such a case, the abattoir would procure animals from another area.

6 Data

The present study is based on conservative assumptions regarding the benefits arising from CBT. The focus is exclusively on the direct, first-round benefits arising from new market-access opportunities for primal cuts of de-boned beef (no change of destination is expected for trimmings, bone-in cuts, offal, bones, fat, hides and skins). Indirect benefits such as potential increased value-adding of beef production, and other spill-over effects such as job creation and impact on wildlife conservation and eco-tourism are excluded. We acknowledge these benefits could be sizeable, but their quantification is difficult and outside the remit of this study.

As a starting point, we first carried out an analysis at a disaggregated cut level to determine how trade values could change because of CBT. Disaggregated data on recent sales values, volumes, and prices of beef cuts from the export abattoir in the Caprivi were obtained from MeatCo. Prices for cuts currently exported to South Africa from the other MeatCo abattoir in the NCA (whose quality was assumed to be similar to the one in the Caprivi) were used as a proxy for the prices that can be achieved from the sales of frozen low-quality cuts to the RSA (as for scenarios 1 and 4). Similarly, prices of cuts exported from south of the VCF have been used to proxy the potential selling prices that can be obtained by the export of either low-quality cuts from the Caprivi to the EU or higher-quality cuts (either chilled or frozen) to South Africa, the EU, and the domestic market itself.[5] All prices are ex-factory and have been adjusted based on the appropriate transport costs in order to allow comparison. In our analysis, we assumed that sales are gradually diverted from destination markets paying the lowest prices towards those where the highest prices can be obtained, based on observed cut-level prices from Namibian abattoirs selling to other markets. Since the production in the Caprivi is relatively small, we assumed that destination markets are able to absorb any additional quantity exported by the region.[6] The shares generated from this initial analysis of trade were used as an input to the SD model to compute the additional revenues associated with CBT.

As noted earlier, the provision of higher-quality animals will imply higher costs for farmers in the form of improved farm management. On the other hand, farmers will receive higher prices from the abattoir based on this higher quality. Both these elements have been incorporated in the model. The costs associated with SPS and quality measures (as in Table 1) have been identified in collaboration with the Meat Board, MeatCo, and other key informants in the Namibian beef sector and used to parameterise the additional costs associated with the new market-access opportunities in the SD model. The MeatCo pricing schemes for 2011 were used as a reference for the prices paid to cattle producers. Finally, we have also taken into account the impact of increased throughput on both fixed and variable costs for the abattoir based on disaggregated MeatCo production costs for 2010. For variable costs, we assumed for the sake of simplicity that the abattoir operates under constant returns to scale in the absence of a detailed analysis of its cost structure.

5. A discounting factor of 10% was applied to these prices because buyers might be willing to pay less for beef from an FMD-infected zone.
6. However, we assumed that no new destination market can represent more than 85% of total sales since quality aspects might partially prevent sales to the most lucrative markets.

7 Results

7.1 Trade-diversion scenarios under CBT

Initially, we assessed the potential trade-diversion effects arising from CBT. Table 3 shows the shares of export sales value under different scenarios, based on the assumption that beef sales would divert from low-value destinations to higher-value ones. We find that substantial trade diversion characterises all scenarios, though this occurs to a lesser extent in those scenarios that assume quality increases without EU market access (scenarios 2 and 3). In particular we find that the price paid by the RSA for low-quality beef (for further processing) from scenarios 1 and 4 would be very attractive, with a considerable amount of beef cuts diverted to this market (around 60%), mostly from the Namibian disease-free zone (Windhoek). On the other hand, when exports to the EU are not an option for higher-quality beef (scenarios 2 and 3), the price paid by existing buyers of beef from the Caprivi would remain competitive and the RSA would represent no more than 15-20% of sales. By contrast, in those scenarios where EU market access is allowed (scenarios 5 and 6), we find significant diversion of sales towards the EU market. Under the latter scenarios, sales to Windhoek would be eroded, even though this destination would still represent 40-50% of beef sales from the Caprivi.

Table 3: Share of sales value at the final year of the simulation (%)

	Status quo	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Windhoek	70	20	66	72	20	42	52
Angola	20	15	10	11	17	3	5
Oshakati	6	3	3	3	3	0	1
Katima	2	1	1	1	1	0	0
DRC	2	0	0	0	0	0	0
RSA	0	61	20	13	59	7	10
EU	0	0	0	0	0	46	32
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**

An important consideration concerns the type of meat products to be exported. The production and sale of chilled cuts can be an option to consider only after the quality of the animals has been improved. Should this occur, the most profitable cuts to be sold as chilled would be fillet, ribeye, rump, silverside, striploin, and topside. Interestingly, the main destination markets for these chilled cuts would be Windhoek and the EU. By contrast, the RSA market would be competitive only for frozen lower-value cuts for further processing such as brisket and flank (data not shown).

7.2 Baseline modelling scenarios of CBT feasibility

Results from the simulation of the different scenarios are detailed in Tables 4 and 5.[7] Table 4 provides final-year results associated with the different scenarios (no FMD outbreaks are assumed in the last year of the simulation), while Table 5 compares the discounted additional net benefits generated over the 20-year simulation period. A number of important findings emerge from the simulations.

First, while the revenues of the abattoir considerably increase in all scenarios, the additional costs incurred by the system offset these gains, with abattoir profits lower than the *status quo* in all scenarios. Accordingly, the final year net value-added at a system level (incorporating farmers, processors, and feedlots combined) accruing from the new market-access potential is negative except in scenarios 1 and 5 (Table 4). Through the calculation of discounted net benefits over the course of the simulation (20 years), the potential benefits of CBT as a means of avoiding trade disruption in the case of FMD outbreaks emerge. As a matter of fact, two additional scenarios (2 and 6) become profitable, even though only marginally (Table 5). Aside from the procurement costs for animals (which represent profit for farmers), SPS compliance costs represent by far the major additional cost at a system level (ranging between N$7 and 10 million per year), except in feedlot scenarios where pre- and in-feedlot costs for quality increase are particularly important mainly because of the high cost of feed. Interestingly, most of the additional SPS costs are incurred by cattle producers. The major SPS costs for producers include high labour costs for herding animals and parasite control, as required by the Mentorship Programme (data not shown). The abattoir incurs large SPS costs only in those scenarios requiring the construction of the new EU-approved abattoir (scenarios 4, 5 and 6). In all cases, additional SPS costs strictly linked to FMD risk mitigation combined (namely, transport by lorry, two extra vaccinations for FMD, certification and serology test) do not represent more than 20% of overall SPS costs (data not shown).

Second, the only two scenarios that indicate significant positive benefits from CBT are scenario 1, in which only small improvements are made to animal quality, and where sales are mainly made to the RSA, and scenario 5, in which producers further invest in improving the animal quality by supplying additional mineral feed and where beef can be sold to the EU because of large-scale investments in the construction of an EU-approved abattoir. The additional discounted benefits at a system level from these scenarios are N$17 m. and N$15 m., respectively (Table 5). This represents around a 10% increase in net benefit over a twenty-year period relative to the *status quo*. On the basis of these results, we argue that, at current quality levels, EU market access would make little sense because the large-scale investment required is not justified. Conversely, substantial efforts to improve animal quality are economically justified only if access to the EU market is guaranteed.

7. The graphical representations of the evolution of abattoir profits and marketed animals are not presented but are available upon request.

Table 4: Summary of final-year results from different CBT scenarios

	Status quo	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Marketed animals (animals/year)	9,759	10,037	10,329	10,288	10,037	10,329	10,288
Cattle population (animals)	167,394	174,641	178,641	178,061	174,338	178,641	178,061
Offtake rate (%)	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%
Revenues increase (‘000 N$/year)	–	8,574	10,197	13,762	8,850	16,179	18,402
Cost increase (‘000 N$/year)	–	8,512	12,904	16,231	11,178	15,570	18,898
- Borne by abattoir (‘000 N$/year)	–	1,941	3,477	3,427	4,608	6,144	6,093
- Borne by producers (‘000 N$/year)	–	6,570	9,426	8,742	6,570	9,426	8,742
- Borne by feedlot (‘000 N$/year)	–	0	0	4,062	0	0	4,062
+ for SPS compliance (‘000 N$/year)	–	7,072	7,278	6,919	9,739	9,945	9,585
+ for quality increase (‘000 N$/year)	–	0	2,665	6,030	0	2,665	6,030
+ for higher VC at abattoir (‘000 N$/year)	–	1,439	2,961	2,912	1,439	2,961	2,912
+ for feedlot infrastructure, equip. and lbour (‘000 N$/year)	–	0	0	371	0	0	371
Net CBT benefit (‘000 N$/year)	–	62	(2,707)	(2,470)	(2,598)	609	(496)
- For abattoir (‘000 N$/year) – incl. procurement	–	(2,126)	(10,816)	(8,996)	(4,786)	(7,501)	(7,022)
- For producers (‘000 N$/year) – incl. procurement	–	2,188	8,109	7,301	2,188	8,109	7,301
- For feedlot (‘000 N$/year) -incl. procurement	–	0	0	(774)	0	0	(774)

Notes: Negative values in brackets. Except when indicated, procurement costs are not included in the calculations since they only have a distributional effect along the chain.

Table 5: Discounted additional net benefits of CBT scenarios over a 20-year period

	Status quo	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Abattoir ('000 N$)	–	(15,970)	(65,149)	(57,432)	(36,092)	(50,405)	(50,666)
Farmers ('000 N$)	–	33,174	65,894	62,831	33,174	65,894	62,831
Feedlot ('000 N$)	–	0	0	(8,336)	0	0	(8,336)
Total ('000 N$)	–	17,204	745	(2,937)	(2,918)	15,488	3,829
Indexed net benefits relative to status quo (base = 100)	100	111	100	98	98	110	103

Notes: Procurement costs are included in the calculations. Discount rate: 10%.

Third, we observe that cattle producers benefit in all scenarios, owing to both higher prices for their animals and higher carcass weights, more than enabling them to meet the higher producer costs for SPS compliance and improved quality (Tables 4 and 5). This provides producers with incentives to increase both the herd size and marketed offtake, though the percentage of animals sold does not change (Table 4). Producers gain significantly in scenarios that assume a major quality increase (scenarios 2, 3, 5 and 6), though these benefits are achieved largely at the expense of higher costs incurred by the abattoir and which are mitigated only slightly by higher throughput. Relative to the low-quality scenario 1, scenarios 2 and 3 reveal relatively small gains in revenues for the abattoir compared with the much higher costs associated predominantly with animal procurement. In scenarios 5 and 6, while abattoir revenues are significantly higher owing to export to higher-value markets, the costs associated with the construction of the EU-approved abattoir represent an additional burden. As noted in Table 5, scenarios 1 and 5, and to lesser extent scenarios 2 and 6, provide additional producer benefits that are partially offset by losses at the abattoir level, suggesting that the potential for transfers between producers and abattoirs exists to generate higher returns for the abattoir. However, this interpretation is potentially misleading because of the feedback effects implicit in the model. Lower prices given to producers would change their marketing behaviour, resulting in fewer animals available for sale, and raising unit costs for the abattoir.

Finally, neither of the scenarios including the feedlot generated additional revenues in the simulation analysis. In both scenarios 3 and 6 the feedlot operates at an annual loss, with steer procurement and feed costs representing 65% and 29% of total feedlot costs, respectively (data not shown). This confirms the findings of other studies that question the economic feasibility of feedlots in the NCA (Vigne, 2005).

7.3 Sensitivity analyses

In our baseline scenario we have assumed a total of 10 FMD outbreaks over the 20-year simulation period. Since it is not possible to predict the number of future outbreaks, we tested the hypothesis of a higher (15) and lower (5) number of outbreaks. As expected, as the number of outbreaks rises, so too do the additional net benefits associated with CBT. In particular, 15 outbreaks would make all the scenarios profitable, even though scenarios 1 and 5 would still be the only ones that generate significant benefits to the system (Table 6).

Table 6: Sensitivity analysis of the total additional discounted net benefits relative to status quo (base = 100)

	Status quo	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Baseline (10 FMD outbreaks)	100	111	100	98	98	110	103
15 FMD outbreaks	100	116	105	102	102	115	107
5 FMD outbreaks	100	107	96	94	94	106	98
Higher cut prices (10%)	100	115	105	104	103	116	110
Excluding EU-approved abattoir	100	111	100	98	111	123	116
Removal of quarantine	100	138	127	123	125	137	128

Note: Discount rate: 10%.

In the sensitivity analysis, we have also explored the hypothesis that the higher selling price of beef cuts might increase the profitability of accessing the new markets. Assuming a 10% increase in prices, the net benefit of the system would improve and turn positive for all scenarios. However, again, scenarios 1 and 5 would be the most profitable.

Furthermore, it is possible that the government (or a donor) could incur part or all of the investment in the construction of the EU-approved abattoir. Assuming this cost was not covered by the system under analysis, the profitability of the system in the scenarios allowing access to the EU (scenarios 4, 5, and 6) is significantly higher, in particular for higher-quality beef (scenarios 5 and 6) with an additional net benefit of 23% and 16%, respectively, vis-à-vis the *status quo* (Table 6).

Finally, as mentioned earlier, we have assumed that CBT might remove the requirement for quarantine that is considered to be one of the major bottlenecks to the growth of formal offtake in the NCA. Vigne (2005) carried out a quantitative assessment of the quarantine costs borne by producers. While some costs, such as transaction costs, are difficult to measure, three main categories of marketing costs were quantified: (i) labour and stress-related animal weight loss during the trekking of cattle to the quarantine facility; (ii) herding labour and animal weight loss during the quarantine (no feed other than available grazing is provided); and (iii) motorised transport from the quarantine facility to the abattoir. The first cost is not relevant for the purpose of our analysis because transport

by lorry is required in all CBT scenarios. The cost related to the other two items has been estimated at a current value of N$579 per animal. This would represent a net saving for producers if the quarantine were eliminated. Except in the high-quality scenarios where considerable additional costs are incurred by producers for raising the animal quality, this saving (the measure of which is, however, conservative) would offset almost 90% of all additional costs incurred by producers for SPS and quality measures. Accordingly, this would more noticeably increase the CBT profitability of the system, although the aggregate gains are still rather modest. For instance, in scenarios 1 and 5 the discounted net additional benefit would be 37-38% higher than the *status quo*, which still represents a relatively small real return on investment over the 20-year simulation period. Producers would nonetheless benefit significantly, as in all scenarios their final-year profit would further grow by 20% to 24% in comparison to the baseline, and stimulate producers to sell more animals (300 to 350) to the formal market (data not shown).

8 Discussion and conclusion

Commodity-based trade presents itself as an important regulatory reform to the global trading system in livestock and livestock products. By shifting the emphasis away from eradicating diseases across geographic spaces (countries or zones) to focusing on the product which is to be traded, and ensuring that this product presents no more than an acceptable risk, CBT offers developing countries the potential to increase exports, assuming of course a wider acceptance of the policy as a means to regulate trade in livestock commodities. This may have important implications in terms of national economic growth and poverty reduction. At the same time, the movement towards a process-based standard is not a trivial one. For instance, unlike the conventional approach, it would require the private sector to invest significantly in capacity, infrastructure, and management to ensure the safety of the product for human and animal health.

Much of the earlier literature on CBT has focused either on the technical standards associated with the concept or, more vaguely, on the scope of benefits that exporters, primarily from African countries, would obtain through a CBT approach. However, the potential economic consequences of wider adoption of CBT standards remain to be examined meaningfully. The present study was intended to address that deficiency. Because the potential economic implications are multi-faceted and have an impact on a number of non-livestock sectors concerned with rural development, it is difficult to assess them all in a single study. This article highlighted the likely economic costs and benefits for livestock farmers and the MeatCo local abattoir in the Caprivi of accessing alternative markets, namely, South Africa and the EU, that might be opened up by the adoption of CBT. We have not examined the various ancillary benefits for the livestock sector associated with CBT in detail, in terms of better herd management, quality, employment creation, value adding, and so on in the context of the regional economy. Similarly, implications of CBT for overall management of FMD by the competent authority in the Caprivi and its potential impact on biodiversity conservation in the KAZA TFCA were not addressed during the current exercise and clearly deserve further research.

While there is no doubt that the adoption of CBT would offer the potential to access markets that have been precluded so far, our analysis, in line with the rather limited set of other empirical economic discussions of CBT (Rich, 2009; Rich et al., 2009; Rich and

Perry, 2011), suggests caution. Potential and actual market access are different issues. Indeed, the additional benefits associated with CBT in terms of greater market access are not necessarily significantly higher than the added costs required for compliance with SPS standards (for example, the need for an abattoir meeting the EU's hygiene and safety standards) and quality requirements (for example, larger cut size) in importing countries. Our analysis revealed that these additional market-access costs exceed the costs incurred for FMD risk-mitigation measures required by CBT.

This study has shown that the adoption of CBT principles by South Africa and the EU would induce significant trade diversion from the current pattern of domestic/regional sales. While the additional monetary benefits associated with most scenarios investigated were relatively small in comparison with the *status quo*, a valuable positive impact of the approach was found to be enabling the Caprivi to diversify its sales outside a very limited set of destinations currently targeted. Indeed, scenario 1, which focused on incremental improvements in the quality of animals produced and sales to South Africa, demonstrated both a gain in margins and the potential for increasing trade volumes that could be negotiated bilaterally with other countries in the Southern African Development Community (SADC). While similar benefits arose from a focus on higher-quality products destined for EU markets, such a scenario would be riskier, requiring a substantial investment for the construction of an EU-approved abattoir and a significant amount of time (and cost) in lobbying and negotiating with the EU to foster an acceptance of the CBT standard. Given the small difference between these two scenarios and the uncertainties about the maintenance of current preferential access to the EU market, a focus on regional markets would be the safer option and in line with recommendations made in previous analyses of African beef markets (Rich, 2009; Scoones et al., 2010).

In conclusion, despite the price premium that the EU market would offer for higher-quality cuts, the additional costs that have to be incurred by the private sector for meeting the SPS and quality requirements of this market make this a less attractive option than targeting less demanding regional markets. Furthermore, our study has assumed a continuation of current relative prices in the EU and South African markets. While both markets have prices that are artificially inflated by border measures, these are more likely to be reduced in the RSA where cattle producers are less protected than they are in the EU. A decline in the RSA import tariff affects Namibia in a couple of ways. First, as both Namibia and the RSA are in the SADC, they share a common external tariff, such that a reduction in the external tariff will put cost pressure on Namibian producers to reduce prices. A decline in import prices will increase both local and South African demand for meat and reduce marketable surpluses of beef. On the other hand, higher-price markets such as those in the EU, Norway, or regionally within Africa would be more attractive for Namibian exporters, though some of these markets are limited in size (for example, the Norwegian market, given its duty-free quota). It is also possible that, given protected markets in the EU, the effect of lower Namibian prices would be an increase in quota rents for importers. The dynamics of these marketing changes will thus depend on the nature of demand for different cuts in domestic, regional, and international markets. Besides the EU and the RSA, other regional and Middle East markets, and possibly those in Asia, also offer hope for Namibia, although these would necessitate reducing costs or developing niche products/brands to become competitive with existing suppliers (Brazil, Australia, India).

Our findings confirm that the wider adoption of CBT and the efforts towards the increase in animal quality required to benefit fully from the new market opportunities can have important implications in terms of poverty alleviation. Cattle producers in the region, most of whom are small-scale, would benefit in all scenarios because of both higher prices for the animals and heavier carcasses. These benefits far exceed the higher costs incurred by producers for compliance with SPS and quality standards of the importing countries. However, most of these benefits would come at the expense of the abattoir, due mainly to the much higher costs for animal procurement. Furthermore, the sensitivity analyses have also shown that an increase in the frequency of FMD outbreaks and higher beef prices in the importing countries would considerably enhance the profitability of CBT. This is an issue that should be borne in mind, given the current trends in the region, in terms of occurrence of outbreaks, and globally in terms of higher projected meat prices.

Finally, it is important to address the contextual aspects associated with CBT, particularly in African livestock settings. As noted by Rich (2009) and Rich and Perry (2011), the production of beef in Africa is at present not competitive in a world setting, particularly in comparison with suppliers in South America or South Asia. While a CBT approach may facilitate the potential for more exports from Africa, an equally pressing need is improvements in productivity and infrastructure required to increase the scale of production and lower the costs (including the ones for meeting higher standards). Accordingly, an interesting future analysis would be to examine the impact of CBT in those FMD-affected markets that could be globally competitive in the nearer term (for example, Paraguay in South America and India in South Asia) to gauge the true market-facilitating impacts that CBT could provide.

first submitted September 2012
final revision accepted April 2014

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