Benefits and costs of compliance of sanitary regulations in livestock markets: The case of Rift Valley fever in the Somali Region of Ethiopia

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Preface

Conventional wisdom indicates that the increasingly stricter Sanitary and Phyto-sanitary Standards (SPS) are a barrier to trade, often used to protect domestic production, and, most importantly, discriminating poor countries, and within those countries poor producers and processors. However, little quantitative information is available to support those perceptions. The World Bank, in collaboration with a large number of partners, has therefore launched a study on the cost of compliance with SPS regulations and their distributional effects in developing countries. The study covers case studies on the cost to comply with food safety and agricultural health of perishable foods, such as fish products, fruits and vegetables, nuts and spices and meat in ten low and middle-income countries. The costs to comply with animal health standards and their distributional effects are the subject of this case study in Ethiopia.

The picture, which emerges from the overall study, is of a wide range of impacts, with rather modest costs (in particular the recurrent costs) and quite varied distributional impacts. SPS standards are often not the only barriers to trade, more generally quality and supply problems are more important. However, SPS regulations can act as a catalyst for improvement in the entire chain. As also shown in this study, countries manage SPS often in a reactive 'fire-fighting' mode. More pro-active, preventive policies, as assessed also in this study are, therefore, recommended.

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Abstract

A recent outbreak of Rift Valley fever in East Africa has led to an export ban by Saudi Arabia and other Gulf countries on livestock products from Ethiopia. An evaluation of the costs of the ban on Ethiopia's main exporting region (Somali) and their distribution among different types of households, producers and traders is conducted using a standard Computable General Equilibrium (CGE) model. Investment strategies to regain access to the Gulf market and reduce the probability of future bans are also evaluated. Results show that Somali Region's GDP is reduced by 25% as a consequence of the ban. In addition, poor and better off producers experience total losses in value added of around 50% of their respective levels in a normal year. The evaluation of an animal health programme in the Somali Region to minimise the impact of future bans shows that its implementation is feasible and justifies further analysis focusing in the main factors driving the results. However, results of the analysis of different alternatives to charge producers for the equivalent amount of the cost of the programme show that distortions introduced by taxes and increased transaction costs affect the viability of the programme. Among these alternatives, increasing taxes on livestock sales offers the best prospect as the way to implement the health certification plan in the Somali Region given that it has pro-poor redistribution effects.

Executive summary

The ban on livestock exports from the Horn of Africa has had a major impact on the livestock dependent economy of Somali Region in Ethiopia. However, no attempt was made to quantify the actual cost of the ban to the region. To analyse the economy-wide effects of the ban, a Social Accounting Matrix (SAM) of the Somali Region economy was built. SAM is a comprehensive data framework representing the economy, where different economic agents, institutions (households, producers, government etc.), and flows of commodities and money between these agents are represented in the format of a square matrix. This SAM, representing the economy in a normal year (with livestock exports to the Middle East) is used to calibrate a CGE model to simulate the impact of the ban. The model is run reducing livestock exports to analyse how original economic relationships represented in the SAM change with the ban.

Results of the simulation show that the ban has a devastating effect on Somali Region's economy. GDP is reduced by US$ 91 million in nominal terms, which represents a 25% reduction compared to a normal year. Evaluating the effects of the ban at the micro-economic level, we find that in the short-run, the ban sharply reduced livestock prices directly affecting the activities most dependent on livestock sales, and deteriorating pastoralist's input/output price ratio. The total loss in value added generated in the region is US$ 132 million or almost 42% of total value added produced in a normal year by pastoralists and agro-pastoralists in the region.

Analysis of the impacts of the ban on the Somali Region using a CGE analysis was complemented by an analysis of the links between agents in the livestock production–marketing chain and the distribution of costs of the ban among these agents based on case studies. These agents were interviewed during a survey conducted in the northern part of Somali Region between June and July 2003. Results of the survey show that livelihoods of pastoralists have been severely affected by the ban, deteriorating their income, changing the composition and reducing the number of animals in the herd, changing consumption patterns and decreasing purchases of food and grain. Marketing agents like traders, brokers, transporters and retailers also experienced negative effects in income and in the volume of business.

Having evaluated the extent of the negative impact of the ban on exports on Somali Region's economy, certifying exported live animals from a Rift Valley fever (RVF) non-free zone, as is the case of Ethiopia is evaluated as one possibility to handle the problem and matching international and Office Internationale des Épizooties (OIE) sanitary regulations. Costs and benefit measures are provided and an evaluation of the proposed programme of live animal certification using benefit–cost analysis is conducted. The approach chosen here is quite restrictive given that the analysis focuses exclusively on RVF, not considering other List A diseases present in Ethiopia that could also affect trade of livestock products and animals in the future. For policy recommendations, a more comprehensive analysis including other alternatives such as the establishment of disease-free zones, which is the

current Ethiopian strategy, would have been desirable. However, expanding the analysis and data collection to include the impact of other diseases and other alternatives to comply with them was beyond the scope of this study.

The benefit–cost analysis shows that implementing an animal health programme in the Somali Region is feasible and justifies further analysis focusing in the main factors driving the results. Different alternatives (export tax, sales tax and increased transaction costs) to charge producers for the equivalent amount of the cost of the programme are analysed. Results show that distortions introduced by taxes and increased transaction costs (not normally considered in the benefit/cost analysis) affect the viability of the programme. Increasing taxes on livestock sales offers the best prospect as the way to implement the health certification plan in the Somali Region. This option has the higher benefit for the poor given that it implies a transfer from middle and better-off producers to poor producers while the total amount of the losses experienced by better-off and middle producers is small.

By showing the consequences for a poor economy and for poor producers of losing access to markets, this study illustrates how agricultural producers in poor countries benefit from markets, increasing their income, gaining access to cash and consumption goods and increasing their assets by keeping larger number of animals in their herds. The case of the Somali Region of Ethiopia is a clear example of the cost that poor countries pay for lack of investment in animal health programmes. Results of this study also show that there are options to explore that could be adapted to the resources and possibilities of poor countries, allowing increased and more stable trade flows and contributing to a much needed diversification of exports.

1 Introduction

Until 1998, several million sheep and goats were exported every year to Saudi Arabia from ports in Somalia, during a four-month period correlating with the Haj activities in Mecca. Pastoral populations in Ethiopia's south-eastern lowlands depend heavily on livestock exports to Somalia for their livelihoods, most of which are re-exported to Saudi Arabia and other Gulf states. The trade has proceeded for many years, until an outbreak of Rift Valley fever (RVF) in the region of the Horn of Africa (Sudan, Kenya, Somalia, Eritrea, Ethiopia and Djibouti) prompted two consecutive bans by Saudi Arabian authorities in 1998 and 2000 (Ahrens 1998; Aklilu 2002, 42) with dramatic consequences on the economies of the region.

RVF is an infection that causes abortions and mortality in sheep, goats, cattle and camels; fever and acute infection in humans in whom a lower incidence of more serious symptoms occur including blindness and haemorrhaging. As a List A[1] disease among the OIE classification of contagious diseases that bring threats to international economy, RVF has a major stake for the establishment of non-tariff barriers. The ban on livestock imports from the Horn of Africa was apparently imposed for public health reasons because of concerns that slaughtering RVF-virus infected livestock could result in disease transmission to people attending the Haj. Exports resumed after 16 months of imposing the ban. Two years later, in September 2000, a new ban on imports of livestock from the Horn of Africa was imposed by Saudi Arabia, Yemen and the UAE following an unprecedented outbreak of RVF in Saudi Arabia and Yemen that killed over 100 people. Although some of the importers in the Arabian Peninsula partially lifted the ban in 2001, the ban was still in place in 2003.

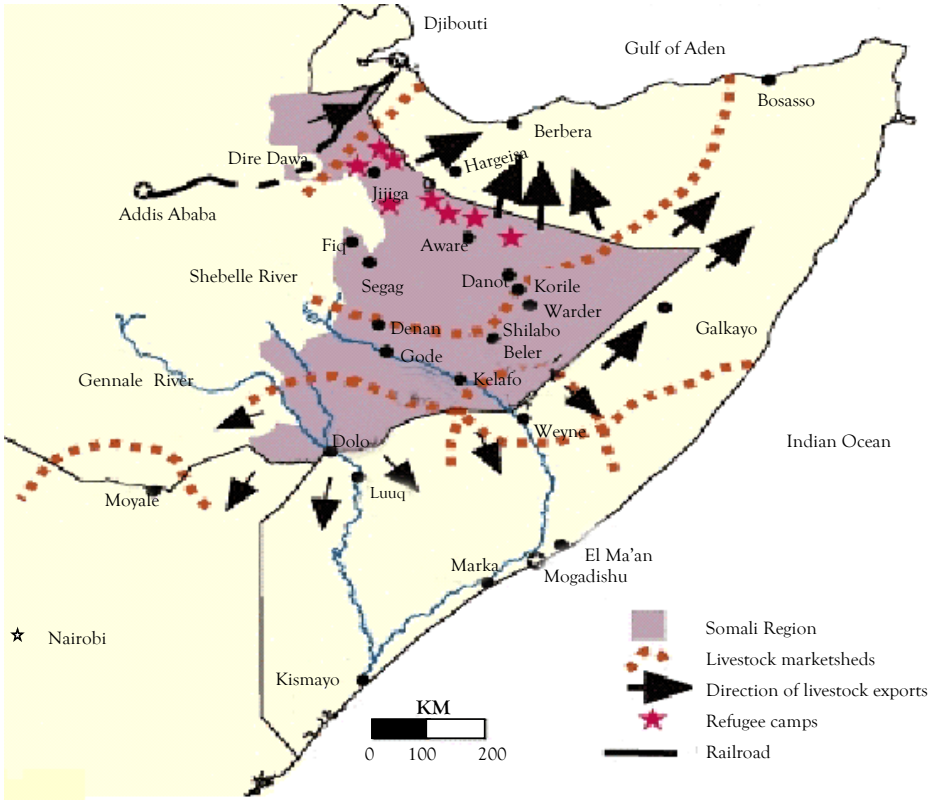
What are the implications of the ban for the Ethiopian economy? Looking at the official trade statistics, the magnitude of trade in livestock products is surprisingly low given the importance of the livestock sector in the economy. Exports of live animals are also insignificant in total value: sheep exports in the peak year of 1997 before the ban amounted to a total of US$ 1.6 million. This suggests that efforts invested in solving this problem would not be justified.

However, the official statistics on livestock trade are misleading. The bulk of livestock exports from Ethiopia occur as informal trade and come from the eastern and south-eastern lowlands, mainly from the Somali Region, a vast and underdeveloped region with ethnic and economic links with neighbouring Somalia. With a predominantly nomadic population of nearly 3.5 million, only 15% of the population lives in so called urban centres and an estimated 90% derive their livelihood from pastoralism and animal related activities (Ahrens 1998). The region has the largest stock of sheep and goats in Ethiopia.

Most livestock exports from the Somali Region pass through ports in Somaliland and Somalia. FEWS (1998) report divides the Somali Region into a set of livestock market sheds,

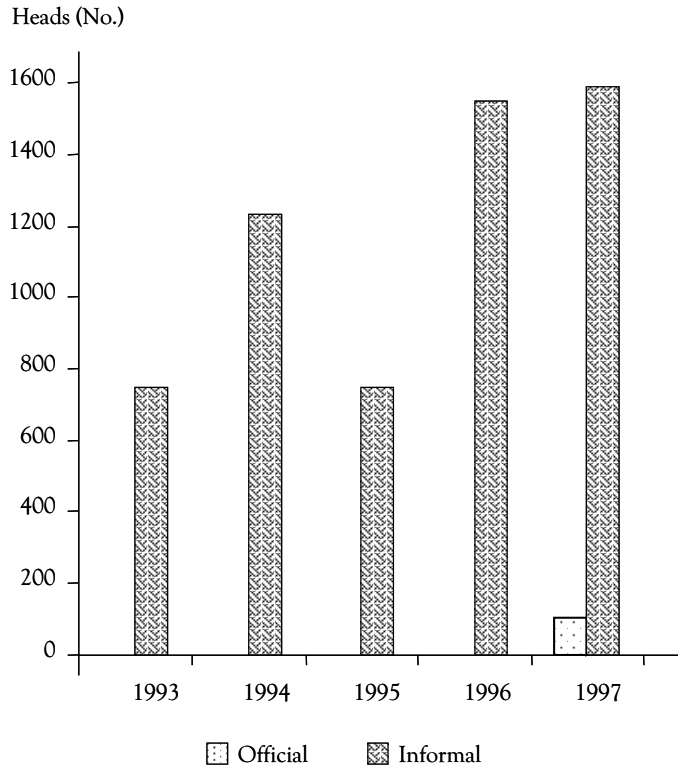
1. World Organization for Animal Health (OIE) classification of diseases, List A: Transmissible diseases that have the potential for very serious and rapid spread, irrespective of national borders, that are of serious socio-economic or public health consequence and that are of major importance in the international trade of animals and animal products.

defined in terms of the destination markets through which exports occur (Figure 1). Berbera is Somali Region's main outlet for livestock exports, which is one day's sail closer to Saudi Arabia than the alternative port, Bosasso. Prices paid for animals in the latter port are also lower than in Berbera due to the greater distance from importing markets. Livestock from southern Somali Region headed historically to Mogadishu but during the civil war they were diverted to Bosasso. Livestock from Moyale are mainly delivered to slaughterhouses in Nairobi (FEWS 1998). The majority of animals sold for export, mainly to Saudi Arabia, are males of the Somali blackhead or fat-tailed sheep, followed by male goats, male cattle and young male camels, which are used mainly for meat (Ahrens 1998).



Source: FEWS (1998).
Figure 1. *Livestock market sheds in the Horn of Africa.*

Figure 2 compares official data on formal and informal exports of live animals from the Somaliland ports of Berbera and Bosasso between 1993 and 1997. However, estimates of the number of animals exported vary considerably from about 1.3 million to 3 million (Ahrens 1998). According to Ahrens (1998), of the livestock exported annually through Berbera port, between 60% (according to Somaliland sources) and 80% (Ethiopian sources) are of Ethiopian origin.



Note: Informal exports from Somaliland ports of Berbera and Bosasso.
Figure 2. *Official and informal exports of live sheep and goats from Ethiopia.*

Some of the impacts of the ban reported from the field help to understand the importance of the livestock export activity for the Somali Region. Ahrens (1998) reported that imposing the ban made prices shrink to levels between 55 (sheep) and 65 (cattle) percent of prices in a normal year, while in the short-run, traders and retailers obtained negative returns to capital and labour and in the medium-run the loss in value added represented 35% of its level in the base scenario. Ahrens (1998) reported that ending livestock exports has had a serious impact on the economy of the Somali Region: 'cash income from livestock exports, on which prior to the ban the large majority of the population depended, has stopped. No more goods are coming across the border. Goods available in local shops represent old stocks, and by the time of the mission's visit, had started to become more expensive. Terms of trade are deteriorating with animal prices going down and grain prices increasing. Due to the people's significantly reduced purchasing power, the general trade business in the towns visited has already suffered drastic cuts. According to local informants, in Harshin about 25% of the shops are closed, in Camoboker about 30% and in Rabasso and Daror up to 50%'. Finally, the household food economy analysis conducted by Save the Children Fund (SCF-UK 1998) reported that middle and better-off households are generally more affected because they rely more heavily on livestock sales in a normal year. According to SCF-UK (1998) to counter the initial deficit in the current year, households will employ a variety of strategies, the first of which

will be to reduce spending on non-essentials in order to increase food purchases from available income. The better off the household, the greater the capacity it has to switch expenditure.

Measuring the cost of the ban on livestock exports from this region is the first step to verify the negative impacts reported from the field by several missions as presented above. This analysis would also help to find if there is justification to comply with the costs of developing an animal health programme that would allow a regular export flow between the Somali Region and the Gulf countries. If this is the case, there could be opportunities to 'formalise' this informal economy, contributing to its integration with the rest of the country. It could also give an opportunity to the Government of Ethiopia to play a central part in developing and stabilising an insecure region while sharing the benefits of growing exports of live animals and livestock products.

The study was originally organised in three modules and the results are presented in sections 2 to 5. Module 1 analysed the costs of the ban for the Somali Region economy as a whole and for producers, consumers and government using quantitative analysis such as Social Accounting Matrix and CGE model. Information used to build a Social Accounting Matrix that determines the main economic relationships within the region is presented in section 2. Structure of the CGE model used and results from simulations are presented in section 3.

Module 2 focused on the analysis of the links between agents in the livestock production–marketing chain and the distribution of costs of the ban among agents based on case studies of selected producers, processors, exporters, transporters, households and the government using information of a survey conducted in the region as part of the study. Results of case study surveys are summarised in section 4.

Finally, Module 3 used a benefit–cost analysis to compare the incremental costs and benefits associated with a move from the present situation to different scenarios implying different government actions to reduce the damage of future bans. Based on the estimated costs of the ban using the CGE simulation, incremental costs and benefits associated with a proposed health programme to reduce the damage of future bans are analysed and different alternatives for its implementation are evaluated in section 5. For policy recommendations, a more comprehensive analysis including other alternatives such as the establishment of disease-free zones, which is the current Ethiopian strategy, would have been desirable. However, expanding the analysis and data collection to include the impact of other diseases and other alternatives to comply with them was beyond the scope of this study.

2 Data for a Social Accounting Matrix for the Somali Region of Ethiopia

2.1 An economic model

Measuring the impact of the ban on imports from Ethiopian Somali Region is a difficult task given the informal nature of the region's economy and the absence of official records. On the other hand, the fact that the Somali Region is a very simple agricultural economy allows modelling its core structure and approximate estimates of the cost of the ban on exports. This is done by using information from reports and studies conducted in the region mainly by Save the Children Fund (SCF-UK)[2] and UN missions, information from the Regional Office of Population of the Somali National Regional State (SNRS), the Central Statistical Authority of Ethiopia (CSA) and data from a survey conducted in Somali Region by this study. Figure 3 presents a simplified diagram of the economic model developed in this study, highlighting the main agents and economic flows in the model.

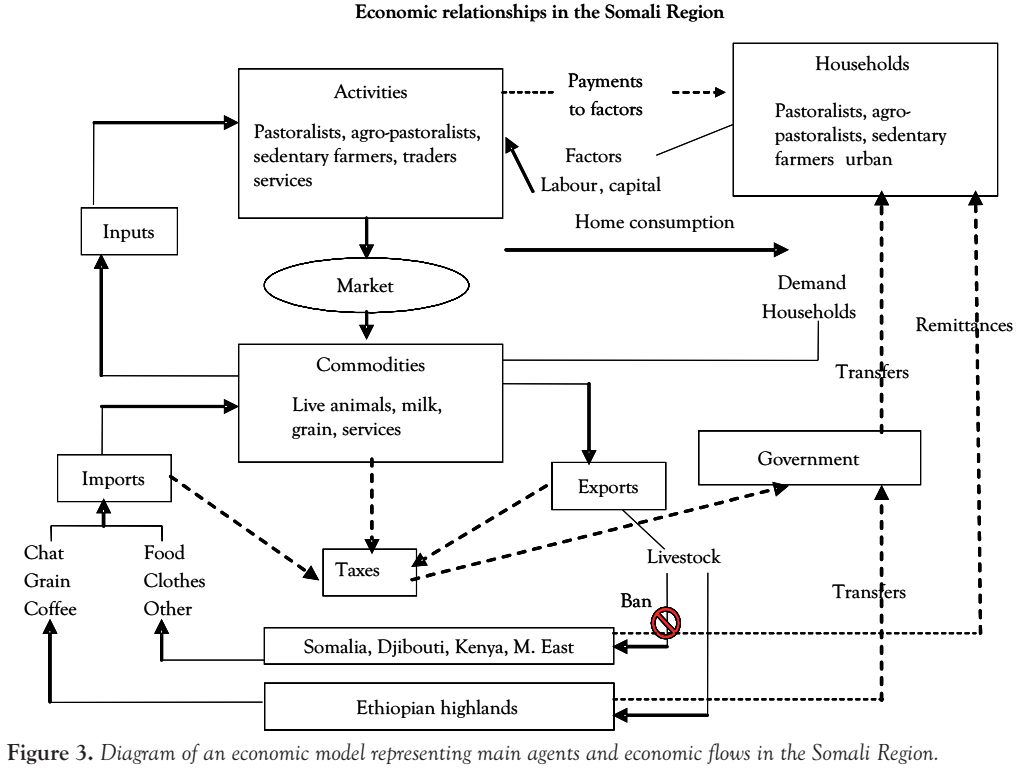


Figure 3. *Diagram of an economic model representing main agents and economic flows in the Somali Region.*

2. We refer to SCF-UK to refer to several reports undertaken by Save the Children Fund (UK) as part of a household food economy analysis in the Somali region. See reference section for more details.

Agricultural activities defined in the model are: pastoralists, agro-pastoralists and sedentary farmers, each of these divided into poor, middle and better-off, making a total of nine agricultural activities (for more details on the key characteristics of these different wealth classes see section 2.2 and Appendix B). Trade and services are non-agricultural activities. Households are the consumption units in this economy. They are the owners of capital and labour and they earn factor incomes from the activities. They also receive transfers from Government and remittances from the rest of the world and use this income to purchase commodities, make transfers to other households or to the rest of the world or to save (not represented in the diagram). The model includes a total of 12 households: pastoralists, agro-pastoralists, sedentary farmers and urban households each divided in three wealth categories.

Livestock, livestock products (milk), grain and services (trade and others) are commodities produced by the activities. The destination of these commodities is final consumption by households, intermediate use by activities as inputs, or the rest of the world (ROW) as exports. ROW in our analysis includes the Ethiopian highlands, Somalia, Djibouti, Kenya and the Arab countries. Grain, other food and non-food commodities are main imports while live animals are the main exported commodities by the Somali Region. A total of 223 thousand tonnes of imported grain are needed to complement the 386 thousand tonnes produced in the region in order to satisfy domestic demand. Other food and non-food goods are not produced in the region so total demand for these goods is satisfied with imports from neighbouring countries and the highlands. Total value of imports is US$ 67 and 127 million in the case of other food and non-food products respectively. Central government transfers to pay for local government deficits balance the difference between total imports and total exports that resulted in an inflow of money from outside the region.

Domestic transaction costs represent the costs of moving the commodity from the border to the domestic markets in the region in the case of imports; while for exports it is the cost of moving the commodity from the producer to the border (not represented in the diagram). For livestock exports, transaction costs include costs of trekking, feed and water, and vaccination and trucking in the case of animals going to Arab countries. A trade commodity is defined with total value equal to the sum of all transaction costs. Thus, the sum of transaction costs equals total output of the trade and transport sector.

The government pays transfers to households, collect taxes and purchase goods. Purchases of services by the government are defined to balance the service sector, which together with the trade sector is the main source of income for the urban households. There is no official information available on tax collection in Somali Region. According to Ahrens (1998), the regional government collects taxes on livestock sales in local municipal markets. There is an export tax collected only by Somaliland. According to information gathered from the Ethiopian Somali livestock traders and brokers, export fees in Berbera are US$ 3.50, 18 and 35 per head of sheep and goat, cattle and camel respectively (Ahrens 1998).

Economic relationships in the Somali Region as presented in Figure 3 are modelled in a Social Accounting Matrix. A SAM is a comprehensive economy-wide data framework representing the economy (Reinert and Roland-Holst 1997; Robinson et al. 1998; Lögfren et al. 2001). Technically, a SAM is a square matrix in which each account is represented by a

row and a column. Incomes of an account appear along its row, its expenditures along its column. Each cell shows the payment from the account of its column to the account of its row. The underlying principle of double-entry accounting requires that, for each account in the SAM, total revenue equals total expenditure (row total equals column total). Information collected from different sources does not comply with the SAM requirement of balanced rows and columns. We balanced the SAM using non-linear programming developed by Zenios et al. (1986).

The main characteristics of the Somali Region economy are summarised in a macro-economic SAM (Table 1). This macro SAM has nine accounting categories: activities, commodities, transaction costs, taxes, factors, households, government, rest of the world and savings–investment.[3] Total value of output produced in the Somali Region is US$ 478 million of which US$ 345 million is transacted in the market as commodities, while output that worth US$ 103 million is directly consumed at home. Total commodity value adds to US$ 634 million. This should be equal to the column total which includes the value of commodities produced by activities (at producer price), plus transaction costs of selling those commodities, plus sales and export taxes (US$ 8 million), plus the value of imported commodities (US$ 236 million). The rows for sales and export taxes capture tax payments for commodity sales and the tax columns pay the total amount of taxes collected by the government. Activities pay to the factor's account for the use of capital and labour (value added, US$ 366 million) and factors transferred this amount to households. Government receives payments from the tax account and transfers from ROW, and purchases commodities and pays transfers to households. ROW sells commodities to Somali Region (imports), purchases commodities from Somali Region (exports) and pays transfers to households and government. Finally, the savings–investment account receives payments from households (savings) and pays to commodities (investments).

2.2 Data and sources of information

The nature and characteristics of some of the information used to estimate the key components of the SAM are highlighted in this section. Using information of total animal stock from SNRS (2003) and information from SCF-UK on average stock composition, annual sales of different species and quality of different animals sold by each household type in the region helped to allocate animal stock between households. SCF-UK reports allowed determining animal sales by species and consumption of animal products by different households.

3. The macro-economic SAM summarises the micro-economic SAM developed for this study (Appendix A). The complete SAM has 40 accounts: 11 activities, 7 commodities, 3 transaction costs accounts, 2 factor accounts (labour and capital), 12 households, 2 tax accounts, government, ROW and savings-investments accounts. This SAM provides the database for the empirical implementation of a general equilibrium model to analyse the impact of the ban on exports from the Somali region of Ethiopia. The procedure for constructing SAM and background information from various sources that needed to be reconciled are detailed in Appendix B.

Table 1. *Macro-economic SAM for Somali Region (US$ × 10^3).*

	Activities	Commodities	Sales tax	Export tax	Factors	Households	Government	Rest of the world	Savings–investment	Total
Activities		344,850				102,887				447,737
Commodities	81,856	45,339				286,864	111,909	97,419	11,005	634,392
Sales tax		349								349
Export tax		7435								7435
Factors	365,881									365,881
Households					365,881	798	16,297	18,578		401,554
Government			349	7435				120,422		128,206
Rest of the world		236,419								236,419
Savings–investment						11,005				11,005
Total	447,737	634,392	349	7435	365,881	401,554	128,206	236,419	11,005	

Source: Elaborated by authors.

According to SNRS (2003) the total livestock population in the region is 8.467 million livestock units (LU)[4], which include 3.746 million cattle, 9.053 million sheep, 8.547 million goats, 2.032 million camels and 213 thousand donkeys. Cattle and camel are mainly kept to provide milk for family consumption while small ruminants are mainly kept as a source of cash and capital deposit. A poor pastoralist owns 42 sheep and goats (shoats), 5 cattle and 3 camels, and sells 6 shoats and eventually one cattle every two years and one camel every 10 years. A rich pastoralist, on the other hand, owns on average 168 shoats, 29 cattle and 28 camels and sells more than 20 shoats and 0.8 camels per year, but would also sell one head of cattle every two years. Better-off pastoralists sell a greater proportion of quality animals than poor pastoralists. These are estimated average numbers for Somali Region, with the composition of species varying between zones depending on agro-ecological conditions.

According to this study, approximately 2.4 million shoats, 0.17 million cattle and 0.04 million camels are sold each year by local producers in Somali Region. This represents 14% of total stock of shoats, and 4 and 2% of cattle and camel inventory respectively. The total number of export quality shoats estimated in this way is below 1.5 million. Total exports to Arab countries resulting from our estimates account for 1.3 million shoats, 37 thousand cattle and 12 thousand camels, which represent 46% of total animal sales in value terms. The value of total animal sales amounts to US$ 92 million in a normal year. Of this total amount, US$ 22 million are sold domestically and US$ 70 million are exported to other regions and countries. The total value of exports to Arab countries is US$ 42 million, 46% of total value of animal sales or 60% of total value of exports, with exports including sales to Ethiopian highlands. It also represents 10% of total household income in the region.

Livestock sales are the most important income source for all wealth rural groups. Sales of livestock products also appear as important sources of income for the 'poor' and 'middle' pastoralists and also for agro-pastoralists and sedentary farmers. In general, the poorer groups need to diversify their sources of income so they engage in more income-generating activities than the 'middle' and 'better-off' groups, such as petty trade (sales of bush products like firewood and charcoal), and labour exchange like assisting caravans transporting contraband goods, leading pack camels to neighbouring countries, self-employment like renting an own pack camel to transfer goods etc. Remittances are also received from relatives working outside the region (SCF-UK). In some areas, better-off households take children from poor households to do herding and other types of work. Gifts in kind from better-off households are another source of income for poor households in the region. Better-off households can obtain rents from property in towns. Finally, households receive transfer from the government and transfers and gifts from other households.

Wealth categories among pastoralists are determined by livestock ownership. The main determinants of wealth for sedentary farmers are oxen, labour and area of land cultivated. Information to classify urban households in wealth categories is obtained from the report on the household, income, consumption and expenditure survey of the Central Statistical Authority of Ethiopia, which contains information on expenditure and income sources by expenditure group (CSA 1999).

4. Transforms the number of all livestock species so that the total number of animals can be expressed as the number of bovine equivalents.

Average income per capita varies for different households from less than US$ 60 per year for the poor rural households to US$ 160 in the case of better-off pastoralists. Urban incomes are higher on average than rural incomes in all categories. Rural households consume their own production: mainly milk and ghee in the case of pastoralists; milk, ghee and grain in the case of agro-pastoralists and sedentary farmers. Milk is the main produced and consumed item by pastoralists while meat consumption usually takes place on special occasions and holidays. All wealth groups purchase food to make up the majority of their food needs but purchase requirements tend to decrease as wealth increases, with the 'better-off' relying the least on the market for food (SCF-UK 2001). All pastoralists and poor agro-pastoralists and sedentary farmers purchase grain as staple food. This is complemented by purchases of other food, mainly sugar, oil and tea. Purchases of grain and sugar take more than 50% of total purchases by poor pastoralists, while better-off households spend from one-quarter to one-third of their income on these staple goods. Non-food items normally include clothes and other essential goods for the family. Urban household's staple food is grain and livestock products as is the case for rural households. The middle and better-off urban households have access to more diversified food and non-food items.

3 Model structure and results

3.1 Model structure

Trade implications of a ban on exports including the implications for different types of producers and households and the wider macro-economic effects suggest the use of a general equilibrium approach (Hertel 1990; McDonald and Roberts 1998; Hubbard and Philippidis 2001; Perry et al. 2003, Chapter 5).

Lack of data also makes a CGE approach convenient. Social accounting matrices used by CGE models for their empirical structure can be used as the guideline to organise this information in a way compatible with the basic accounting identities of the economy. The need for all households to be in their budget; the fact that all firms exhaust their revenues on factor payments, taxes and transfers to households and that markets are in equilibrium provide a powerful check on the consistency of the data collected.

SAM presented in the previous section is linked to the CGE model developed by Lögfren et al. (2001). The model follows the neoclassical-structuralist modelling tradition (Dervis et al. 1982) and includes household consumption of non-marketed commodities, transaction costs for commodities that enter the market, and separation between producing activities and commodities that permit any activity to produce multiple commodities and any commodity to be produced by multiple activities. The model is fully developed and explained by Lögfren et al. (2001). Some of the features of the model that are relevant to the analysis are described below.

In its mathematical form, the model is a system of simultaneous, non-linear equations, with the number of equations equal to the number of variables. Endogenous variables are most prices with the exception of export and import prices, quantities of commodities demanded and supplied including exported and imported commodities. Parameters of the model are defined using information from the specific SAM and are used to benchmark the model to this original information.

CGE model assumes that each producer (activity) maximises profits subject to a production function that uses a Leontief function to determine the combination of inputs and value added. The latter is itself a CES function of primary factors whereas the aggregate intermediate inputs are assumed to have a Leontief relationship. The user can choose between alternative mechanisms for equilibrating supplies and demands in factor markets. The default closure assumes fixed factors, but factors can move between activities. Economy-wide factor prices are free to vary to equilibrate factors demand and supply. Alternatively, it is possible to assume fixed factor prices and factor unemployment. With fixed factor prices, factor supply is endogenous and activities are free to hire any desired quantity. A third closure simulates segmented factor markets where factors are assumed to be activity-specific. With this closure, each activity is forced to hire the observed base-year factor quantity.

For a marketed output, the first stage in the model is to generate a domestic aggregate output from the output of different activities, assuming that commodities produced by different activities are imperfect substitutes. At the next stage, aggregated domestic output is allocated between exports and domestic sales assuming imperfect transformability between these two categories. In the international markets, export demands are infinitely elastic at given world prices. If the commodity is not exported, total output is passed to the domestic market.

Domestic demand is made up of the sum of demands for household consumption, government consumption, investment, intermediate inputs and transaction inputs. When a commodity is imported and produced domestically (grain in our data), all domestic market demands are for a composite commodity made of imports and domestic output (Armington structure). Household consumption of both market and home commodities is allocated across different commodities according to Linear Expenditure System (LES) demand functions.

The model allows several rules for clearing the macro-economic balances or how equilibrium is achieved in the balances for the government, the rest of the world and the savings investment account. In this analysis, a closure that combines fixed foreign savings, fixed real investment and fixed real government consumption are used. This closure avoids misleading welfare results that occur in a single-period-model when increases in foreign savings, decreases in investment and changes in government consumption could increase welfare, not capturing welfare losses in later periods (Lögfren et al. 2001). The model determines relative prices and the numeral used is an aggregated consumer price.

3.2 Simulations and results

Two scenarios are developed to capture different types of adjustment to the export ban. The first scenario is a short-run scenario where it is assumed that capital and labour are not mobile between activities, so the quantity of factors employed by each activity is fixed. The second scenario represents the medium-run where labour and capital are mobile but total supply of each factor is fixed. These different scenarios are determined by defining the closure that equilibrates factor markets, as explained in the previous section. In both scenarios, livestock export prices are shocked to cause exports of live animals to fall to the desired level.

To define the level of export reduction we refer to Table 2 where livestock sales are allocated between different destinations. The share of animal exports to Arab countries in total exports is 60%, and so, a shock reducing exports of live animals by 60% would be required. However, there is evidence that during the ban, animal exports from Somali Region are not necessarily down to zero. The ban could be partially lifted or lifted by some countries and not others. Sources in the region mention that even during the ban, 30% of the number of animals exported in a normal year was still exported from Somali Region to Arab countries. Applied to animal exports in Table 2 this implies a 42% reduction on total animal exports from Somali Region as a consequence of the ban.

Table 2. *Exports from Somali Region by destination in normal and ban year and percentage of exports reduction (US$ × 10^3).*

		Ban year			
Destinations	Normal year	Medium-run	Change (%)	Short-run	Change (%)
Arab countries	43,733	13,120	–70	33,529	–23
Kenya	9517	9517	0	9517	0
Highlands	19,068	19,068	0	19,068	0
Total	72,317	41,704	–42	62,113	–14

To measure the total cost of the ban we assume duration of the ban of 16 months, which is within the range of duration of bans in the past. The shock on exports occurs in two stages. In the first stage total exports of live animals are reduced by 15% (first 4 months of the ban) and producers cannot reallocate factors of production between activities. In the second stage (medium-run), total livestock exports are reduced by 42% (last 12 months of the ban) but at this point producers react to the changes allocating resources according to the new situation. The experiments are conducted independently, so possible interactions between both scenarios are neglected. The total impact of a 16-month ban results from adding up the effects of these two scenarios.

3.2.1 Macro-economic impacts

Table 3 shows the impact of the ban on different macro-economic variables. As expected, the ban has a devastating effect on Somali Region's economy. GDP is reduced by US$ 22 and US$ 70 million in nominal terms in the short- and medium-run, respectively, representing a reduction of 25% of GDP compared to the value in a normal year. Absorption is also significantly affected, reducing its value by a total of approximately US$ 70 million during the 16-month period, while private consumption falls by almost US$ 40 million. Comparing nominal and real values for the different variables, we verify the extent to which the ban affects prices in the region. Real GDP, or equivalently the difference in total real absorption between the base and the ban cases falls by US$ 0.5 million in the short-run and losses increase to US$ 10.1 million in the medium-run.

The importance of the nominal effect is the consequence of a relative price shift, resulting in a significant reduction of livestock prices, which are discussed below in more detail. Given the importance of livestock in this economy, this relative price shift is reflected in the region's GDP as shown by the changes in GDP's nominal values. On the other hand, the real effects are very small in the short-run as a result of the closure used (no factor mobility). In the medium-run, factor mobility is allowed and an adjustment in production occurs with reduction of livestock production, which cannot be too large given the specialisation in livestock production of this economy and the constraints to move to production of other commodities (e.g. lack of water).

The use of macro indicators to measure the economic impact of the ban is useful as a general indication of the aggregate effects in the economy of the region, but at the same time, it does not allow to capture the differential effects of the ban on producers and

households, a key aspect when defining policies to tackle the problem. We now proceed to analyse the impact of the ban at the micro-economic level, focusing on producers and households in the Somali Region.

Table 3. *Impact of the ban on livestock exports: Changes in macro-economic variables (US$ × 10^3).*

Variables	Short-run			Medium-run		
	Base	Ban	Difference	Base	Ban	Difference
Nominal						
Private consumption	129,917	119,927	–9990	389,752	360,559	–29,193
Absorption	170,888	155,409	–15,479	512,665	457,907	–54,759
GDP	124,555	102,882	–21,673	373,665	303,560	–70,106
Exports	32,473	31,216.67	–1256	97,419	77,741	–19,678
Real						
Private consumption		129,414	–503	389,752	379,678	–10,074
Absorption	170,888	170,385	–503	512,665	502,592	–10,074
GDP	124,555	124,052	–503	373,665	363,591	–10,074
Exports	32,473	28,775	–3698	97,419	70,011	–27,408

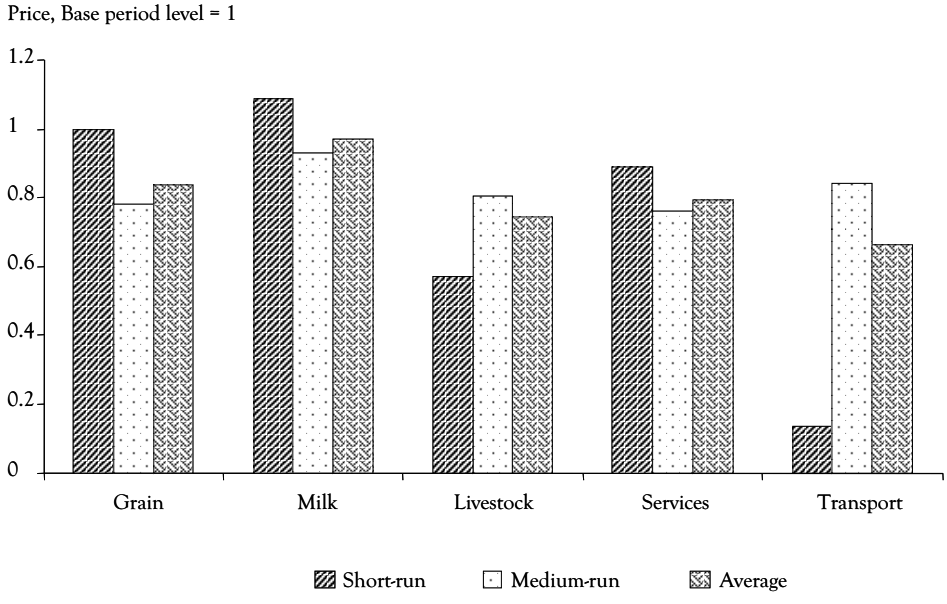
Source: Authors from model simulation.

3.2.2 Micro-economic impacts

Figure 4 shows that livestock producer prices plunge to 57% of their level in a normal year in the short-run while production falls by less than 10% as a consequence of the ban (Figure 5). To cope with a shrinking income, households substitute away non-basic imported goods, now more expensive as a result of the deteriorating terms of trade of the region with the rest of the world and increase their demand for staple food (grain and milk) (Figure 6). Poor producers reduce consumption of non-essentials between 8 and 13% in most cases. Consumption of grain reduced by 1% on average in the short-run but stays stable in the medium-run, while milk purchases increase. As a consequence, milk and grain prices increase significantly relative to livestock prices in the short-run.

In the medium-run, producers react reallocating resources between activities, reducing supply of livestock and transport services and further increasing supply of milk and grain (Figure 5). This results in partial recovery of livestock and transport prices compared to the effect of the initial shock and pushes grain and milk prices down (Figure 4), negatively impacting sedentary farmers and agro-pastoralists that were less affected by the ban in the short-run.

A summary of the impacts of a 16-month ban on exports from the Somali Region producers is presented in Table 4. Pastoralists and traders are as expected, the most affected by the ban. Losses in the short-run amount to 77, 58 and 50% of value added in a normal year for better-off, middle and poor pastoralists respectively. In the medium-run, losses are reduced compared to the short-run as pastoralists reallocate their resources responding to changes in relative prices.



Note: Prices in the base period = 1.

Figure 4. *Commodity prices in the short- and medium-run as a result of the ban on livestock exports.*

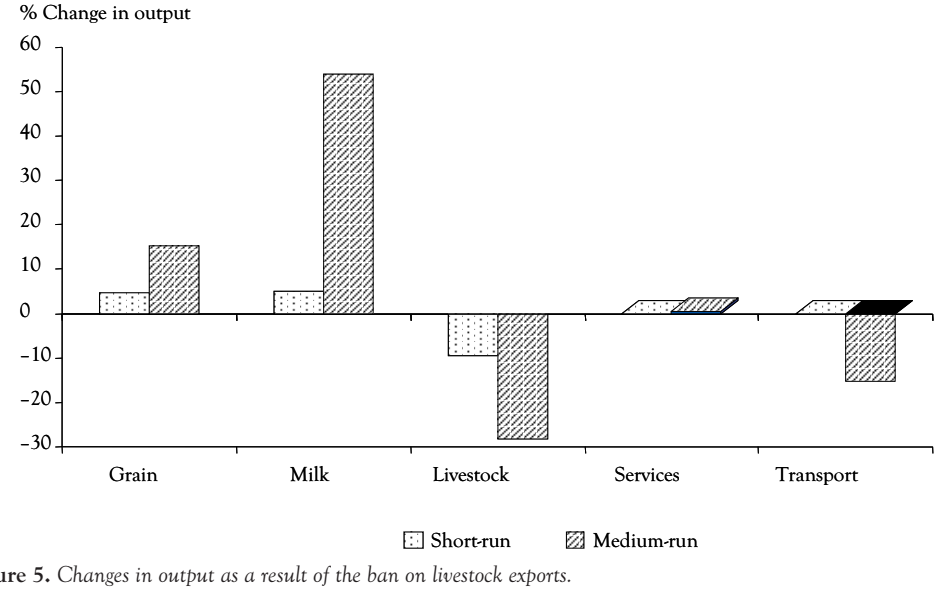


Figure 5. *Changes in output as a result of the ban on livestock exports.*

The impact of the ban on household income is presented in Table 5. All households are affected by the ban, experiencing a substantial reduction in their income. In the short-run this reduction is in all cases close to 30% of the level of income in a normal year. In the medium-run households are able to reduce their losses but the ban implies a significant reduction of income of more than 20% in most cases, even after households adjust to the shock.

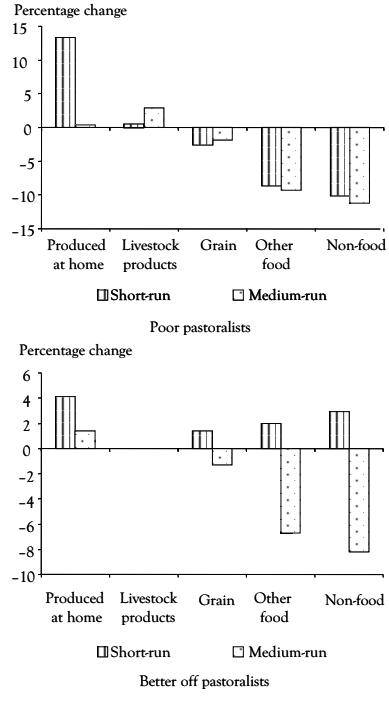


Figure 6. *Changes in household consumption patterns in the short- and medium-run as a consequence of the ban on exports.*

Table 4. *Impact of the ban on exports on producers measured in terms of value added (US$ × 10^3).*

	Short-run				Medium-run			
	Base value added	Ban value added	Difference ban–base	Change value added (%)	Base value added	Ban value added	Difference ban–base	Change value added (%)
Pastoralist								
Poor	8220	4096	–4124	–50	24,661	15042	–9619	–39
Middle	12,072	5071	–7001	–58	36,217	17981	–18236	–50
Better-off	5152	1208	–3944	–77	15,457	6948	–8509	–55
Agro-pastoralist								
Poor	3105	2580	–525	–17	9316	13,004	3688	40
Middle	7744	6703	–1041	–13	23,232	23,614	382	2
Better-off	4779	4394	–385	–8	14,336	11,922	–2414	–17
Sedentary								
Poor	2325	2315	–10	0	6976	6947	–29	0
Middle	10,980	11,144	164	1	32,939	29,167	–3772	–11
Better-off	12,061	11,111	–950	–8	36,182	28,023	–8159	–23
Other activities								
Services	48,280	38,895	–9385	–19	144,839	110,213	–34,626	–24
Traders	7242	–1604	–8846	–122	21,726	7115	–14611	–67

Source: Authors from model simulation.

Table 5. *Impact of the ban on livestock exports on household's income (US$ × 10^3).*

	Base value added	Ban value added	Difference ban–base	Change value added (%)	Base value added	Ban value added	Difference ban–base	Change value added (%)
Pastoralists								
Poor	13,587	9867	−3720	−27.4	40,760	31,503	−9257	−22.7
Middle	25,177	18,111	−7067	−28.1	75,532	58,110	−17,422	−23.1
Better-off	14,171	10,502	−3669	−25.9	42,512	33,470	−9042	−21.3
Agro-pastoralists								
Poor	3104	2329	−775	−25.0	9312	7402	−1910	−20.5
Middle	8882	6481	−2400	−27.0	26,645	20,738	−5907	−22.2
Better-off	4653	3338	−1315	−28.3	13,958	10,725	−3233	−23.2
Sedentary farmers								
Poor	2720	1976	−744	−27.4	8160	6303	−1857	−22.8
Middle	11,521	8280	−3241	−28.1	34,563	26,590	−7973	−23.1
Better-off	9408	6964	−2445	−26.0	28,225	22,223	−6002	−21.3
Urban								
Poor	1645	1256	−389	−23.7	4935	3962	−973	−19.7
Middle	16,669	12,501	−4168	−25.0	50,007	39,795	−10,212	−20.4
Better-off	22,637	17,310	−5327	−23.5	67,911	54,708	−13,203	−19.4

4 Case study of the impacts of the ban on producers and market agents

A survey was conducted in the region as part of this study to directly capture some of the impacts of the ban as seen by relevant actors of the livestock marketing chain in the region. A case study approach was taken rather than conducting a probabilistic sample survey. Agents in the livestock production–marketing chain (pastoralists and agro-pastoralists, exporters, transporters, retailers and households) were interviewed during June and July 2003 in the northern part of Somali Region, from where the largest number of Ethiopian animals is exported to the Middle East. The regions and markets covered by the survey are shown in Table 6.

Table 6. *Livestock markets covered in the survey.*

Survey centre	Region/Administrative Zone	Livestock markets covered in the survey
Dire Dawa	Somali/Shinile	Bike, Adigalla and Aysha
Dire Dawa	Dire Dawa	Dire Dawa
Harar	Oromiya/Eastern Hararghe	Werer, Alamaya, Dawa, Babile, Gursum
Jijiga	Somali/Jijiga	Jijiga, Chinhakson, Teferiber and Hartishek

Results of the survey show that livelihoods of pastoralists have been severely affected by the ban, deteriorating their terms of trade and forcing them to sell livestock for very low prices and in larger numbers. To compensate for the income losses, pastoralists develop different strategies, like taking the animals to better grazing areas and highlands to gain more weight, and travelling to different local markets in their zone as well as across the regional border in search of alternative prices. Grain and cash crop cultivation is also one of the strategies pastoralists used to cope with stress created by the ban and the drought. The situation also forced them to look for alternative incomes, like sending some of their children to be herdsmen for the rich or working in acacia tree bush clearing for charcoal making and wood sale.

Significant changes occurred in livestock herd composition. Mostly goats and camel species increased while cattle and sheep population decreased, although this cannot be fully attributed to the ban given that change in herd structure could also relate to drought. Majority of the pastoralists were obliged to keep fewer animals in their herds in the last three years and they also agreed on the fact that the age groups of the animals they rear has changed, with an increase in the share of young and female stock.

Consumption patterns were also affected. The drought problem and strict contraband control, coupled with the RVF ban effects, have forced pastoralists to spend less on food (sugar, oil and salt) and non-food items. Most pastoralists still purchase grains, but it is not adequate to sustain all the household members. Milk consumption also decreased since

they use it as an alternative to generate income. They have also decreased meat consumption, partly because they produce grains and partly because they have access to contraband pasta and rice and food aid.

With respect to traders, the survey shows that almost all traders suffered and endured the effects of the ban, which resulted in decline in their income due to fewer transactions of animals because of drought and the ban. About 75% of the traders feel they changed the nature of their trade by relying more on local livestock trade, shifting to other non-livestock goods (contraband and chat sale), or still trading livestock but diversifying to more species of animals.

Other agents were also affected by the ban. Most brokers experienced reduced livestock market operation and two-thirds of them reported a decline in their income by about 80%, while one-third said there was no change in income due to diversification of business. Almost all transporters were transporting less than half the number of livestock now compared to three years ago. Market administrators report that the ban has decreased government's revenue from tax collection. Butchers in part benefited from the ban because of the low price of livestock, increasing their purchasing power although they report that their income has decreased by 15–60% in the past three years due to lower volume of business. Results for grain retailers were mixed and clothes retailers reported that they experienced a decline in their income due to a 57–95% decline in the quantities of goods exchanged because of the weakening of the purchasing power of their various customers.

5 Export certification scheme to comply with OIE regulations

5.1 Elements of the proposed scheme

Certifying exported live animals from a RVF non-free zone, as is the case of the Somali Region in Ethiopia, is evaluated as one possible option to handle the problem by matching international and OIE sanitary regulations. OIE admits two status with regards to RVF for animals exported from non-free countries: vaccinated or non-vaccinated. Given that costs and procedures are similar and assuming that the benefits of both treatments are the same, we focus on evaluating the non-vaccinated animal's treatment.

The treatment implies keeping the animals to be exported in collection ground for 30 days. During this period, animals need to be fed and watered in collection ground and a first sampling and testing of 1 to 5% of animals is conducted. After this period, the animals enter quarantine for 30 days, where feeding and watering are also required and a second sampling and testing of animals to be exported is conducted.

Costs and investments required to implement the health certification programme for non-vaccinated animals during a 20-year period are presented in Table 7. More detailed cost estimations and assumptions are described in Appendix C. Investments are low compared to the operation costs of the project. The most important cost component of the treatment proposed is the feed cost with a share of 85% of total annual operating costs. Information on feeding costs is from Shank (1997) who estimates the cost of feeding animals at the port of Berbera by trucking maize and sorghum fodder. The estimated cost of water is from SCF-UK, who provides information of better-off pastoralists owning water reservoirs and selling water as part of their income.

Table 7. *Present value of investments and costs of a 20-year certification scheme.*

Investments	
Animal facilities	250
Clinics	413
Vehicles and others	257
Total investment	920
Costs	
Feed	50,639
Tests	621
Salaries	826
Other	2052
Total costs	54,138

Source: Elaborated by the authors from several sources (Appendices B and C).

The expected benefits of the treatments proposed during the 20-year projected period are the avoided costs of future bans imposed on Somali Region exports because of disease outbreaks. We take 16 months as ban duration without treatments. If treatment is applied and there is an outbreak of the disease, the effect of the certification system will be to reduce the ban to the duration of a RVF outbreak event, which we assume to be six months. The incremental benefit resulting from the treatment is to avoid 10 months costs of possible future bans on exports each time that an outbreak of the disease occurs in the next 20 years.

To define the probability of different number of outbreaks of the disease in 20 years, it is assumed that the expected occurrence of RVF in one particular year is 1/20, once every 20 years (Davies and Nunn 1998; EMPRES/FAO 1998; Tibbo 2001). Having defined this probability, a Poisson distribution to model the occurrence of outbreaks of the disease, and a Monte Carlo approach to simulate the occurrence of outbreaks over 20 years repeating the simulation 5000 times was used. Each of these 5000 simulations obtained is one possible event in terms of number of RFV outbreaks in the next 20 years. The avoided costs of the ban together with the distribution of outbreaks in the Monte Carlo simulation are used to obtain a distribution of future income resulting from our treatment.

5.2 The benefit–cost indicator

The benefit–cost ratio is a discounted measure of project worth calculated by dividing the present value of the benefit stream by the present value of the cost stream. When analysing the convenience of investing in a certain project, the selection criterion is to accept projects with a benefit–cost ratio of 1 or greater when discounted at a suitable discount rate (Gittinger 1982). The mathematical statement of the benefit–cost ratio is given below.

(1)
$$B/C = \frac{\sum_{t=0}^{n} (B_t / (1+i)^t)}{\sum_{t=0}^{n} (C_t / (1+i)^t)}$$

The benefit–cost ratio approach has been extensively applied to disease control analysis (for a review of previous studies see Perry et al. 2003). According to Perry et al. (2003) there is a wide variability in how this analysis is conducted particularly with respect to predicting the interaction between control efforts and disease outbreaks over time and the degree to which indirect impacts of the disease are effectively incorporated into the analysis. In this study, the ratio is applied to measure the costs and benefits that producers in Somali Region would face if an animal health programme, as the one proposed in the previous section, were implemented. The benefit–cost ratio in this particular case is an indicator of the benefits that producers in Somali Region could expect from implementing the plan.

Alternatively, we also consider the net present value (NPV) as a measure of the results producers would obtain from applying the certification programme to complement the information given by the benefit–cost ratio. This measure can be interpreted as the present

value of the income stream generated by the investment and it can be computed by finding the difference between the present value of the benefit stream less the present value of the cost stream.

The absolute value of the benefit–cost ratio (and the NPV) will vary with the discount rate *i* chosen. For financial analysis, the discount or cut-off rate is usually the rate at which the enterprise is able to borrow money. It is not possible to determine this rate for producers in the Somali Region with the available information. We assume a discount rate of 10% presuming a higher interest rate than the official real interest rate in Ethiopia for the past 10 years, which varied around 8% according to information from the World Bank, but we were not able to determine the actual cost of money in the Somali Region.

As the benefit–cost ratio is applied to distributing incomes and costs generated using the Poisson distribution and the Monte Carlo procedure as discussed above, a distribution of benefit–cost ratios were obtained with probabilities for different values of the ratio. Results of the benefit–cost analysis are presented in Figure 7. The probability of having a benefit–cost ratio greater than 1 is 0.5 and the overall expected value of the benefit–cost ratio is 1.5. The expected NPV for a 20-year period is US$ 14 million resulting from adding expected gains and losses weighted by their respective probabilities.

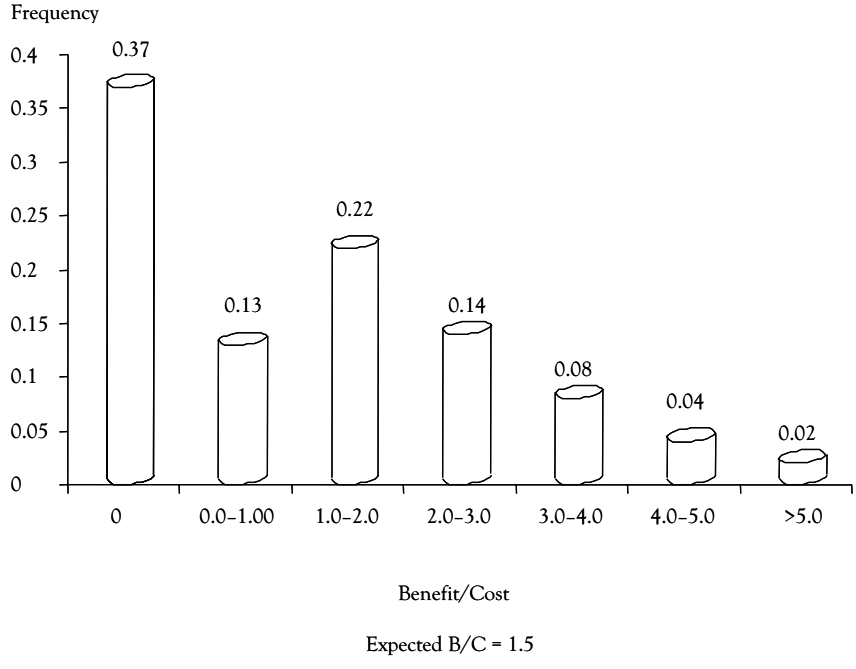


Figure 7. *Distribution of the benefit/cost ratio for the animal health certification programme.*

Some considerations about these results must be made. First, the overall expected benefit–cost ratio is greater than 1, but not high and the probability of it being less than 1 is substantial (0.5%), which generates doubts about the usefulness of this investment. Two main factors are driving these results. The first of these factors is the probability of an outbreak of the disease extracted from the literature and assumed to be 1/20. A more

detailed technical analysis to determine this probability could be needed to verify our results and the benefits of the investment. The second of these factors is the cost of feeding animals during quarantine and testing. This is an OIE requirement difficult to implement in the Somali Region, given its resources and production system. The possibility of implementing a programme like the one proposed here would depend on the development of an efficient system of producing and delivering fodder to collection grounds.

On the other hand, the fact that only static economic gains are considered, assuming that income losses avoided are those of the base year, must be emphasised. By doing so we are underestimating the gains from the programme given that we should expect dynamic benefits coming from increased economic growth in a more stable region, with increased exports and investments (e.g. slaughterhouses).

Another factor normally affecting results of the benefit–cost analysis is the value of the discount rate. Given the structure of the stream of benefits and costs in our analysis (low investments relative to high operating costs), the results are not sensitive to changes in the discount rate. Finally, the results above do not bring into consideration the way the programme is implemented and how the costs of the programme are charged to producers. Introducing taxes or increased transaction costs to pay for the programme would create distortions and potentially increase the costs of the proposed investment.

Taking these elements into consideration, and given the expected results of the benefit–cost ratio and the NPV, we conclude that the resulting costs and the risks of the programme are manageable and within the range of expected income. The possibility of implementing an animal health programme in the Somali Region is feasible and justifies further analysis focusing in the main factors driving the results as discussed above.

In the next section one of the factors affecting these results, i.e. how different policy options to implement the plan and recover its costs could affect the region and the different producers and households is discussed.

5.3 Implementing the programme and policy implications

Simulation using benefit–cost analysis, as presented above, simply assumes that investments and costs of the certification programme do not result in distortions to the economy, not affecting competitiveness, not making other considerations about how this plan is going to be implemented and how producers will pay for the service. In this section we discuss some simple policy alternatives to implement the health certification scheme proposed, evaluating the implications that these different options have for producers and consumers in terms of income and welfare.

The present value of all costs and investments needed to comply with OIE's standards as a RVF non-free country (US$ 55 million in 20 years) is converted to an annual constant payment using financial equivalences resulting in an annual cost of US$ 6.5 million. Assuming that producers can pay this annual cost as shown by the benefit–cost analysis in

the previous section, different alternatives are discussed to make these payments using instruments already in place in the region:

- Scenario 1. The government implements the animal health plan and puts in place an export tax to collect an amount equal to the cost of the plan.
- Scenario 2. The government implements the animal health plan and puts in place a tax on livestock sales to collect an amount equal to the cost of the plan.
- Scenario 3. There is no government intervention and no tax increase. The plan is implemented by the private sector charging a fee to the user of the service. The costs to move animals from the market to the port (border) are increased by the amount of the cost of the plan.

The impact of these different alternatives on the welfare of producers and consumer's is analysed using the SAM of the Somali Region developed for this study linked to the CGE model developed by Lögfren et al. (2001). In each scenario, different instruments are shocked (export taxes, sales taxes or transaction costs) to charge producers for the total cost of the plan. The impact of these shocks on value added and welfare is measured to determine the final cost of the plan, including costs of distortions resulting from increased taxes or costs.

Results from the simulations show that the annual cost of the programme of US$ 6.5 million is increased to US$ 8, 11 and 22 million if this amount is collected increasing sales taxes, transaction costs or export taxes, respectively. With expected annual gains from the programme of approximately US$ 7.6 million, the results of the benefit/cost analysis appear to be sensitive to the particular implementation of the certification scheme. Distortions introduced by taxes and increased transaction costs used to fund the programme (not normally considered in the benefit/cost analysis) affect its viability.

Table 8 presents the impact of the three policies on value added by production specialisation and wealth category. Pastoralists and non-agricultural activities would be the most affected by an export tax, losing 12 and 6% of value added respectively. In general, pastoralists would pay for the policies targeting exports while implementing a tax on livestock sales results in lower costs for the economy and evenly shared by all groups. The better-off and middle producers are in general more affected than poor producers by the three policy scenarios. Better-off producers would loose 7% of value added if an export tax is imposed, while poor producers will loose 3%. The sales tax scenario results in gains (4% of value added) for poor producers and lower losses for other activities if compared with the scenarios targeting exports.

In sum, poor producers are expected to gain with the certification scheme if a sales tax is implemented, while middle and better-off producers might lose in any scenario. However, the expected losses for middle and better-off producers are low. The worse possible case for better-off producers is a 4% decrease in value added in scenario 1.

We conclude that increasing taxes on livestock sales offers the best prospect as the way to implement the health certification plan in the Somali Region. This option has lesser negative impact on exports, and welfare; it also has the higher benefit for the poor given that it implies a transfer from middle and better-off producers to poor producers. The sales tax policy would benefit pastoralists and traders and will affect sedentary farmers and agro-pastoralists negatively although the total amount of the losses expected is small.

Table 8. *Changes in value added as a result of different policies to cover the costs of the animal health certification programme by wealth category and production specialisation.*

	Wealth category			Production specialisation		
	Poor	Middle	Better-off	Pastoralists	Sedentary and agro-pastoralists	Non-agriculture
Value added (US$ × 10^3)						
Base	40,953	92,388	65,975	76,336	122,981	166,565
Export tax	39,388	86,893	61,351	67,327	120,305	156,168
Sales tax	42,586	89,246	62,722	74,732	119,822	163,305
Transaction cost	39,856	88,363	62,732	70,743	119,822	163,409
Percentage change						
Export tax	–3.8	–5.9	–7.0	–11.8	–2.2	–6.2
Sales tax	4	–3.4	–4.9	–2.1	–2.6	–2.0
Transaction cost	–2.7	–4.4	–4.9	–7.3	–2.3	–1.9

Summary and conclusion

The ban on livestock exports from the Horn of Africa has had a major impact on the livestock dependent economy of Somali Region in Ethiopia; however, no attempt was made to quantify the actual cost of the ban to the region. To analyse the economy-wide effects of the ban, a social accounting matrix of the Somali Region economy is built and used SAM to simulate the impact of the ban using a CGE model.

Results of the simulation show that the ban has a devastating effect on Somali Region's economy. GDP is reduced by US$ 91 million in nominal terms, which represents a 25% reduction compared to a normal year. Evaluating the effects of the ban at the micro-economic level, we find that in the short-run, the ban causes a sharp reduction of livestock prices directly affecting the activities most dependent on livestock sales, and deteriorating pastoralist's input/output price ratio. Total loss in value added generated in the region is US$ 132 million or almost 42% of total value added produced in a normal year by pastoralists and agro-pastoralists in the region.

Analysis of the impacts of the ban on the Somali Region using a CGE analysis was complemented by analysis of the links between agents in the livestock production–marketing chain and the distribution of costs of the ban among these agents based on case studies. These agents were interviewed during a survey conducted in the northern part of Somali Region between June and July 2003. Results of the survey show that livelihoods of pastoralists have been severely affected by the ban, deteriorating their income, changing the composition and reducing the number of animals in the herd, changing consumption patterns, and decreasing purchases of food and grain. Marketing agents like traders, brokers, transporters and retailers also experienced negative effects in income and in the volume of business.

Having evaluated the extent of the negative impact of the ban on exports on Somali Region's economy, certifying exported live animals from a RVF non-free zone, as is the case of Ethiopia is evaluated as one possibility to handle the problem and matching international and OIE sanitary regulations. Costs and benefit measurements are provided and an evaluation of the proposed programme of live animal certification using benefit–cost analysis is conducted.

The benefit–cost analysis shows that implementing an animal health programme in the Somali Region is feasible and justifies further analysis focusing in the main factors driving the results. Different alternatives (export tax, sales tax and increased transaction costs) to charge producers for the equivalent amount of the cost of the programme are analysed. Results show that distortions introduced by taxes and increased transaction costs (not normally considered in the benefit/cost analysis) affect the viability of the programme.

Increasing taxes on livestock sales offers the best prospect as the way to implement the health certification plan in the Somali Region. This option has the higher benefit for the poor given that it implies a transfer from middle and better-off producers to poor producers while the total amount of the losses experienced by better-off and middle producers is small.

By showing the consequences for a poor economy of losing access to markets, this study illustrates how agricultural producers in poor countries benefit from markets, increasing their income, gaining access to cash and consumption goods and increasing their assets by keeping larger number of animals in their herds. The case of the Somali Region of Ethiopia is a clear example of the cost that poor countries pay for lack of investment in animal health programmes. The results of this study also show that there are options to explore that could be adapted to the resources and possibilities of poor countries, allowing increased and more stable trade flows and contributing to a much needed diversification of exports.

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Appendix A. SAM for Somali Region, Ethiopia

SAM for Somali Region (Region 5, Ethiopia) in US$ × 10^3, 1997.

		Activities										
		1	2	3	4	5	6	7	8	9	10	11
1	Pastoralist–poor											
2	Pastoralist–middle											
3	Pastoralist–better-off											
4	Agro-pastoralist–poor											
5	Agro-pastoralist–middle											
6	Agro-pastoralist–better-off											
7	Sedentary–poor											
8	Sedentary–middle											
9	Sedentary–better-off											
10	Trader											
11	Services											
12	Livestock		3926	2455		3577	4502		4684	4813		
13	Milk											
14	Grain				17	257	359	230	1105	1291	551	
15	Other food											
16	Non-food	3436	11,796	11,792	0	4	8	0	3	7	5566	4388
17	Transport										8800	1429
18	Services										644	1952
19	Transaction costs–Export											
20	Transaction costs–Import											
21	Transaction costs–Domestic											

SAM for Somali Region (Region 5, Ethiopia) in US$ × 10^3, 1997.

		Activities										
		1	2	3	4	5	6	7	8	9	10	11
22	Labour	18,696	19,295	8047	4765	12474	7733	5310	16,339	16,920	11,216	100,366
23	Capital	5965	16922	7410	4551	10758	6603	1666	16,600	19,262	10,510	44,474
24	Households pastoralist—poor											
25	Households pastoralist—middle											
26	Households pastoralist—better-off											
27	Households agro-pastoralist—poor											
28	Households agro-pastoralist—middle											
29	Households agro-pastoralist—better-off											
30	Households sedentary—poor											
31	Households sedentary—middle											
32	Households sedentary—better-off											
33	Households urban—poor											
34	Households urban—middle											
35	Households urban—better-off											
36	Sales tax											
37	Export tax											
38	Government											
39	ROW											36
40	Savings–investment											
	Total	28,097	51,939	29,704	9333	27,070	19,205	7206	38,732	42,292	41,550	152,608

SAM for Somali Region (Region 5, Ethiopia) in US$ × 10^3, 1997 (continued).

		Commodities									
		12	13	14	15	16	17	18	19	20	21
1	Pastoralist—poor	22,817									
2	Pastoralist—middle	34,075									
3	Pastoralist—better-off	17,610									
4	Agro-pastoralist—poor	2596	2528								
5	Agro-pastoralist—middle	7834	6849	1111							
6	Agro-pastoralist—better-off	4651	4087	1057							
7	Sedentary—poor		408	2382							
8	Sedentary—middle	2507	4347	13,406							
9	Sedentary—better-off	6513	684	15,232							
10	Trader						41,550				
11	Services						16,342	136,266			
12	Livestock										
13	Milk										
14	Grain										
15	Other food										
16	Non-food										
17	Transport								9002	25,080	11,257
18	Services										
19	Transaction costs—Export	9002									
20	Transaction costs—Import			4138	6544	14,399					
21	Transaction costs—Domestic	6214	1730	3313							
22	Labour										
23	Capital										
24	Households pastoralist—poor										

SAM for Somali Region (Region 5, Ethiopia) in US$ × 10^3, 1997 (continued).

		Commodities									
		12	13	14	15	16	17	18	19	20	21
25	Households pastoralist—middle										
26	Households pastoralist—better-off										
27	Households agro-pastoralist—poor										
28	Households agro-pastoralist—middle										
29	Households agro-pastoralist—better-off										
30	Households sedentary—poor										
31	Households sedentary—middle										
32	Households sedentary—better-off										
33	Households urban—poor										
34	Households urban—middle										
35	Households urban—better-off										
36	Sales tax	349									
37	Export tax	7435									
38	Government										
39	ROW			42,431	67,150	126,837					
40	Savings-investment										
	Total	121,603	20,632	83,069	73,694	141,236	57,893	136,266	9002	25,080	11,257

SAM for Somali Region (Region 5, Ethiopia) in US$ × 10^3, 1997 (continued).

		Factors	
		22	23
1	Pastoralist–poor		
2	Pastoralist–middle		
3	Pastoralist–better-off		
4	Agro-pastoralist–poor		
5	Agro-pastoralist–middle		
6	Agro-pastoralist–better-off		
7	Sedentary–poor		
8	Sedentary–middle		
9	Sedentary–better-off		
10	Trader		
11	Services		
12	Livestock		
13	Milk		
14	Grain		
15	Other food		
16	Non-food		
17	Transport		
18	Services		
19	Transaction costs–Export		
20	Transaction costs–Import		
21	Transaction costs–Domestic		
22	Labour		
23	Capital		
24	Households pastoralist–poor	28,124	10,188
25	Households pastoralist–middle	43,247	29,382
26	Households pastoralist–better-off	22,869	15,846
27	Households agro-pastoralist–poor	4672	3464
28	Households agro-pastoralist–middle	14,136	10,808
29	Households agro-pastoralist–better-off	7435	6024
30	Households sedentary–poor	5941	1745
31	Households sedentary–middle	18,651	14,584
32	Households sedentary–better-off	13,550	12,148
33	Households urban–poor	2910	1069
34	Households urban–middle	20,803	21,755
35	Households urban–better-off	38,821	17,708
36	Sales tax		
37	Export tax		
38	Government		

SAM for Somali Region (Region 5, Ethiopia) in US$ × 10^3, 1997 (continued).

		Factors	
		22	23
39	ROW		
40	Savings–investment		
	Total	221,160	144,721

SAM for Somali Region (Region 5, Ethiopia) in US$ × 10^3, 1997 (continued).

		Households											
		24	25	26	27	28	29	30	31	32	33	34	35
1	Pastoralist–poor	5280											
2	Pastoralist–middle		17,864										
3	Pastoralist–better-off			12,094									
4	Agro-pastoralist–poor				4209								
5	Agro-pastoralist–middle					11,276							
6	Agro-pastoralist–better-off						9411						
7	Sedentary–poor							4416					
8	Sedentary–middle								18,473				
9	Sedentary–better-off									19,863			
10	Trader												
11	Services												
12	Livestock												
13	Milk	1267			184						175	2841	4686
14	Grain	18,731	19,126	6860	2472	4745	467	1302	3830	1062	787	10,589	9287
15	Other food	6454	12,415	6386	879	3398	1552	447	2516	1750	2568	18,153	17,175
16	Non-food	6914	17,195	10,013	1309	5712	1845	1246	6888	3379	1291	15,647	29,234
17	Transport										19	310	1079
18	Services	2114	5631	4001	259	850	242	748	2141	1335	95	1422	3839
19	Transaction costs–Export												
20	Transaction costs–Import												
21	Transaction costs–Domestic												
22	Labour												
23	Capital												
24	Households pastoralist–poor			964									

SAM for Somali Region (Region 5, Ethiopia) in US$ × 10^3, 1997 (continued).

		Households											
		24	25	26	27	28	29	30	31	32	33	34	35
25	Households pastoralist—middle												
26	Households pastoralist— better -off												
27	Households agro-pastoralist—poor						252						
28	Households agro-pastoralist—middle												
29	Households agro-pastoralist—better-off												
30	Households sedentary—poor									178			
31	Households sedentary—middle												
32	Households sedentary—better-off												
33	Households urban—poor												367
34	Households urban—middle												
35	Households urban—better-off												
36	Sales tax												
37	Export tax												
38	Government												
39	ROW												
40	Savings—Investment		3301	2194		664	189		715	656		1043	2244
	Total	40,760	75,532	42,512	9312	26,645	13,958	8160	34,563	28,225	4935	50,007	67,911

SAM for Somali Region (Region 5, Ethiopia) in US$ × 10^3, 1997 (continued).

		Other institutions					
		36	37	38	39	40	Total
1	Pastoralist—poor						28,097
2	Pastoralist—middle						51,939
3	Pastoralist—better-off						29,704
4	Agro-pastoralist—poor						9333
5	Agro-pastoralist—middle						27,070
6	Agro-pastoralist—better- off						19,205
7	Sedentary—poor						7206
8	Sedentary—middle						38,732
9	Sedentary—better-off						42,292
10	Trader						41,550
11	Services						52,608
12	Livestock				85,940	7442	121,603
13	Milk				11,479		20,632
14	Grain						83,069
15	Other food						73,694
16	Non-food					3563	141,236
17	Transport			916			57,893
18	Services			110,993			136,266
19	Transaction costs—Export						9002
20	Transaction costs— Import						25,080
21	Transaction costs— Domestic						11,257
22	Labour						221,160
23	Capital						144,721
24	Households pastoralist— poor			434	1049		40,760
25	Households pastoralist— middle			826	2078		75,532
26	Households pastoralist— better-off			464	3332		42,512
27	Households agro- pastoralist—poor			99	825		9312
28	Households agro- pastoralist— middle			288	1412		26,645
29	Households agro- pastoralist—better-off			151	348		13,958
30	Households sedentary— poor			87	210		8160
31	Households sedentary— middle			375	953		34,563
32	Households sedentary— better-off			305	2222		28,225

SAM for Somali Region (Region 5, Ethiopia) in US$ × 10^3, 1997 (continued).

		Other institutions					
		36	37	38	39	40	Total
33	Households urban—poor			480	109		4935
34	Households urban—middle			6229	1219		50,007
35	Households urban— better-off			6560	4822		67,911
36	Sales tax						349
37	Export tax						7435
38	Government	349	7435		120,422		128,206
39	ROW						236,419
40	Savings–investment						11,005
	Total	349	7435	128,206	236,419	11,005	

Appendix B. Constructing a SAM of the Somali Region of Ethiopia

General characterisation of the region

The Somali National Regional State is a large geographical area in the eastern and south-eastern part of Ethiopia bound by Kenya in the south, Djibouti and the Ethiopia Afar Region in the north, Somalia Republic in the east and south-east and Oromiya Region in the West (Figure B.1). The Somali Region falls into the arid and semi-arid agro-ecological climatic zone. Its altitude ranges from 500–1600 metres above sea level. The temperature ranges from 20–45^{o}C and the average annual rainfall is 300–500 mm. Somali Region consists of nine administrative zones. According to the 1997 census, the population of the region was 3,839,860 of which 86% live in rural areas (CSA 1999). The majority of the rural population of the region is pastoralist and livestock is the main source of livelihood. Crop production is also practised in the region with important potential zones being Gode, Jijiga, Liben and Afder. Agricultural land includes irrigable land along the banks of large rivers. The region has poorly developed socio-economic services and infrastructures.

Population household expenditure and wealth categories

According to the census of the 1997, Somali Region has a total urban population of 492,710 and a total of 2,947,350 people residing in the rural areas (CSA 1999). This region is among the areas of the country with lower population density. With land area of 281,900 km^2, the region has a population density of 12 persons/km^2. Table B.1 presents data on population distributed by zone. As of 1997 Somali Region has 6% of Ethiopia's population and this population is unevenly distributed in the various zones with Jijiga accounting for 23% followed by Liben (14%), Afder and Shinile zones (10%).

Information from the 1997 census, the demographic and socio-economic profile from the Regional Office of Population of the Somali Regional State, the report on the 1999/2000 household, income, consumption and expenditure survey of the Central Statistical Authority of Ethiopia and the household food economy analysis baseline report undertaken by Save the Children Fund (UK) are being used to classify households in the region (Table B.2). Wealth classification of households is discussed below. Rural population was divided by occupation (SNRS 2003). Urban households whose main occupation is pastoralism are included as pastoralists in the rural population. This explains the difference in urban and rural population between Tables B.1 and B.2. According to our classification, 43% of the population are engaged in pastoralism, 15% combines herding with crop production (agro-pastoralists), 24% are sedentary farmers and the rest are urban population engaged in retail, trade and service activities.

We divided the rural households (pastoralists, agro-pastoralists and sedentary farmers) in three wealth categories using information from SCF-UK (Table B.3). In its analysis of the food economy in the region, SCF-UK determines wealth categories among pastoralists by livestock ownership. In the case of agro-pastoralists, wealth is determined mainly by

livestock holdings, as livestock is still the main source of income and, households with the higher number of livestock, especially cattle, have the potential to cultivate more land. Finally, SCF-UK identifies the main determinants of wealth for sedentary farmers as oxen, labour and area of land cultivated. Information to classify urban households in wealth categories is obtained from the report on the 1999/2000 household, income, consumption and expenditure survey of the Central Statistical Authority of Ethiopia, which contains information on expenditure and income sources by expenditure group (CSA 2001).

Table B.4 shows the disposition of income and the structure of expenditure of the different households defined. Average income per capita varies for different households from US$ 40 per year for the poor sedentary households to US$ 160 in the case of better-off pastoralists. Urban incomes are higher on average than rural incomes in all categories. Rural households consume their own production, mainly milk and ghee in the case of pastoralists; milk, ghee and grain in the case of agro-pastoralists and sedentary farmers. The importance of own livestock products (milk, ghee and meat) as a source of food increases with wealth. Milk is the main produced and consumed item by pastoralists while meat consumption usually takes place on special occasions and holidays. All wealth groups purchase food to make up the majority of their food needs but purchase requirements tend to decrease as wealth increases, with the better-off relying least on the market for food (SCF-UK 2001). All pastoralists and poor agro-pastoralists and sedentary farmers purchase grain as staple food. This is complemented by purchases of other food, mainly sugar, oil and tea. According to SCF-UK (2001), sugar appears to be as much a staple food as grain in the Jijiga zone. Consumption increases with wealth, with very poor households consuming about 250 g/day and the better-off consuming over a kg/day. Combined with tea, it is seen as an essential part of the diet by all groups. Rice, pasta and vegetable oil are rarely purchased, even by the better-off. Purchases of grain and sugar take more than 50% of total purchases by poor pastoralists, while better-off households spend from one-quarter to a third of their income on these staple goods. Non-food items normally include clothes and other essential goods for the family. Urban households staple food are grain and livestock products as is the case for rural households. The middle and the better-off urban households have access to more diversified food and non-food items.

Sources of income

Table B.5 presents the main sources of income for households. Most of the income in all cases comes from own agricultural enterprise in the case of rural households. Income from own enterprise and wages and salaries for urban households are not disaggregated and shown as total income from both sources. Sales originated in the family business for rural households are presented in Table B.6. Livestock sales are the most important income source for all wealth rural groups. Sales of livestock products also appear as important sources of income for the poor and middle pastoralists and also for agro-pastoralists and sedentary farmers.

In general, the poorer groups need to diversify their sources of income so they engage in more income-generating activities than the middle and better-off groups. In addition to

sales of livestock and livestock products, poor households have other income sources such as petty trade (sales of bush products like firewood and charcoal), and labour exchange like assisting caravans transporting contraband goods, leading pack camels to neighbouring countries, self employment like renting an own pack camel to transfer goods etc. Remittances are also received from relatives working outside the region (SCF-UK). In some regions, better-off households take children from poor households to do herding and other types of work. These children are fed and clothed by the better-off household, which usually also makes a payment (in cash or in kind) to the poor households for the work. Each poor household typically has one child living with a better-off household. Children or other members of poor households can also go to towns for employment (SCF-UK). Gifts in kind from better-off households are another source of income for poor households in the region. Better-off households can obtain rents from property in towns. Finally, households receive transfer from the Government and transfers and gifts from other households.

Livestock holdings and animal sales

To determine production and sales in agricultural activities two sources of information were used. Total animal stock is obtained from SNRS (2003). Using information from SCF-UK allowed allocating animal stock between households. The same SCF-UK reports allowed determining animal sales by species and consumption of animal products, by different households. Total animal stock by species and region is presented in Table B.7. As indicated by SNRS (2003) there is no reliable information or data about the number of livestock in the Somali Region. The figure used by SNRS is based on estimate made by various sources. According to SNRS (2003) the total population of livestock in the region is 8.467 million LU, which includes 3.746 million cattle, 9.053 million sheep, 8.547 million goats, 2.032 million camels and 213 thousand donkeys. Cattle and camel are mainly kept to provide milk for family consumption while small ruminants are mainly kept as a source of cash and capital deposit.

To estimate animal holdings per type of activity we use information from SCF-UK on average stock composition, annual sales of different species and quality of different animals sold by each household type. We combine this information with the number of households of each type to allocate total animal stock from Table B.7 and animal sales to each type of household. We then value this sales using producer prices for the different animal categories and check, together with other sources of income, total income of the different households. The results show that total income obtained using sales/inventory coefficients from SCF-UK was too high for many of the household types when compared to estimated expenditure, savings and transfers of each household as showed in Table B.4. In other words, the resulting income was higher than the sum of expenditure, transfers and savings for each household. To correct for this problem we adjusted total livestock sales down so that income for each household would equal expenditure plus savings and transfers. This resulted in reducing the number of animals sold per head of animal and per household compared to the figures in SCF-UK. Animal stock composition and proportion of quality animals sold is the same as in SCF-UK. Tables B.8 and B.9 show our final estimates of

animal holdings and sales for each household type. Table B.8 shows that a poor pastoralist owns 42 shoats, 5 cattle and 3 camels. A rich pastoralist, on the other hand, owns on average 168 shoats, 29 cattle and 28 camels. These are estimated average numbers for Somali Region, with the composition of species varying between zones depending on agro-ecological conditions. Table B.8 also shows number of animals sold per year and the quality of those animals. A poor pastoralist sells 6 shoats and eventually 1 cattle every 2 years and 1 camel every 10 years. A better-off pastoralist sells more than 20 shoats and 0.8 camels per year, but would also sell 1 head of cattle every 2 years. Better-off pastoralists sell a greater proportion of quality animals than poor pastoralists. Using the information in Table B.8 and the information on animal stock for the Somali Region we determine the aggregate animal inventory and animal sales by type of household and value of animal sales (Table B.9). According to our estimates, approximately 2.4 million shoats, 0.17 million cattle and 0.04 million camels are sold each year by local producers in Somali Region. This numbers represent 14% of total stock of shoats, and 4 and 2% of cattle and camel inventory respectively. The total number of export quality shoats estimated in this way is below 1.5 million. Estimates by SCF-UK are much higher with off-take rates for sheep of around 20%. The use of these numbers would imply a much higher animal supply, with more domestic sales and exports, which is not supported by the available data on animal demand.

The next step is to determine the final destination of total animals sold between domestic sales, the Ethiopian highlands, Djibouti, Somalia and exports to the Arab countries and Kenya. The number of animals sold domestically within the Somali Region should equal demand, basically, animals bought by producers and animals sold to butchers and retailers for final consumption. We assume that the remaining animals are exported to neighbouring countries, the Ethiopian highlands or the Arab countries via Somalia. Given the market sheds defined in FEWS (1998) we assume that export quality animals in Liben zone are exported to Kenya. The remaining group of animals should be allocated between exports to the highlands and exports to the Arab countries. To do this, we assume that the remaining export quality animals are the ones being exported to Arab countries and the low quality animals are sold to the highlands and other destinations like Djibouti or Somalia. Table B.10 shows the final destination of livestock sales. Total exports to Arab countries resulting from our allocation account for 1.3 million shoats, 37 thousand cattle and 12 thousand camels, which represent 46% of total animal sales value. Kenya is the final destination for 145 thousand shoats and 28 thousand cattle or 10% of animal sales value. The rest are sold in similar proportions domestically in the Somali Region and to the highlands and other destinations. The value of total animal sales amounts to US$ 92 million in a normal year. Of this total amount, US$ 22 million are sold domestically and US$ 70 million are exported to other regions and countries. The total value of exports to Arab countries is US$ 42 million, 46% of total value of animal sales or 60% of total value of exports, with exports including sales to Ethiopian highlands. It also represents 10% of total household income in the region.

Milk production, consumption and sales

Milk production and sales are derived from SCF-UK reports, which present information for agro-pastoralists and also milk sales for sedentary farmers (Table B.11). As indicated by SCF-UK, while milk sales are uncommon among pastoralists, sales of ghee are common for poor and middle households, but not in very large quantities. Given the relative small importance of sales of milk and ghee compared with livestock sales, we assume that pastoralists do not sell milk, although they consume their own milk production.

Crop production, consumption and sales

Most of the land in the region (75% of total area) is woodland and grazing land. Only 1.5% of the land is used in crop production and the remaining 24% is unproductive land. Of the total area under crops, 94% is under grain production. The yield reported for the years 1997 and 1998 on average is 1188 kg/ha (Table B.12). Information from SFC-UK reports yields lower than the figure reported by SNRS. Table B.13 presents information extracted from SFC-UK on area under cereals, yields, consumption, and sales for agro-pastoral and sedentary farmers in the region. Table B.14 aggregates information per household from SFC-UK to a regional level multiplying household data by the number of households in each category and presents total value of grain production and sales. Total area under crops in the Somali Region estimated in this way amounts to a total of 463 thousand hectares, which is very close to the SNRS number of 450 thousand hectares, so we use the SFC-UK data and coefficients to estimate production and sales of grain.

Costs of production

Cost structure of the different rural activities defined for the Somali Region includes livestock inputs, seeds, and animals purchased as replacement and payments to factor of production (Table B.15). All producers spend in livestock inputs including salt, drugs and water. Seed use was determined in Table B.13 when crop production data were presented. The number of animals bought by producers is very small in a normal year. As poor producers cannot afford buying animals we assume that purchases are made by middle and better-off producers occasionally to replace stock, or as investment. Sedentary farmers sell oxen (5–6 years old) each year and with cash income gained purchase a smaller ox (3–4 years old) at a lower price (SCF-UK). Payments to labour were made proportional to the total population in each activity/household and payments to capital were adjusted as a residual. Cost structure of trade and service activities was taken from the cost structure of the same activities in a SAM of Mozambique (Arndt et al. 1998).

Imports

Having defined the structure of expenditure and consumption and the production activities and commodities produced, we define imports to Somali Region as the difference between demand and supply of the different commodities. A total of 223 thousand tonnes of imported grain are needed to complement the 386 thousand tonnes produced in the region to satisfy domestic demand. Other food and non-food goods are not produced in the region so total demand for these goods is satisfied with imports from neighbouring countries and the highlands of Ethiopia. Total value of imports is US$ 67 and US$ 127 million in the case of other food and non-food products respectively. The difference is balanced by central government transfers, paying for local government deficits and resulting in an inflow of money from outside the region.

Government

The government in our model pays transfers to households, collect taxes and purchase goods. Purchases of services by the government are defined to balance the service sector, which together with the trade sector is the main source of income for the urban households.

There is no official information available on tax collection in Somali Region. We consider two different types of taxes. According to Ahrens (1998), local municipal markets collect fees on every animal brought for sale. At Jijiga livestock market, for example, the fees are Birr 1 per shoat, Birr 2.50 per cattle and Birr 5 per camel. Reportedly, none of these municipality revenues are shared with the regional fiscal system and no national export taxation system is in place. These values are used in this study to determine sales taxes on animals sold domestically but assuming that only part of the animals sold are taxed. The most important tax to consider is an export tax collected only by Somaliland. According to information gathered by Ahrens (1998) from Ethiopian-Somali livestock traders and brokers, export fees in Berbera are US$ 3.50, 18 and 35, per head of shoats, cattle and camel, respectively. This export tax is assumed to be collected by the Regional Somali government to capture the effect of the tax on exports. It is also assumed that the central government covers the local government deficits by transfers from outside the region.

Trade and transaction costs

Trade flows are related with trade and transportation costs (transaction costs). Domestic transaction costs represent the costs of moving the commodity from the producer to the domestic market. For imports it represents the cost of moving the commodity from the border to the domestic market, while for exports, it is the cost of moving the commodity from the producer to the border. In the case of livestock exports transaction costs include costs of trekking, feed and water, and vaccination and trucking in the case of animals going to Arab countries. Domestic movement of animals is estimated to include only trekking and lower costs of feed and water assuming movements over shorter distances (Table B.16). Commodities other than livestock are charged with a marketing margin calculated as

proportion of the total value of the commodity traded. A trade commodity is defined in our model with total value equal to the sum of all transaction costs. Thus, the sum of transaction costs equals total output of the trade and transport sector.

Source: UNDP–EUE (1996).
All borders are unofficial and approximate.
Figure B.1. *Administrative regions and zones of Ethiopia.*

Table B.1. *Distribution of population by zones, urban and rural, Somali Region, 1997.*

Zones	Total	Urban	Rural	Population density
Shinile	355,626	53,374	302,252	10
Jijiga	806,576	155,891	650,685	41
Fiq	231,306	22,607	208,699	12
Degehabure	332,115	57,866	274,249	9
Warder	321,289	24,681	296,608	6
Korahe	240,212	37,226	202,986	9
Gode	324,570	70,499	254,071	11
Afder	355,640	25,747	329,893	6
Liben	472,527	44,819	427,708	14
Somali Region	3,439,860	492,710	2,947,150	12

Source: Regional Office of Population of the Somali National Regional State (SNRS).

Table B.2. *Population and number of households by occupation and wealth type.*

	Population (No.)	%	Households (No.)	%
Pastoralists	1,497,200	44	185,435	37
Poor	624,778	18	90,142	18
Middle	610,009	18	72,053	14
Better-off	262,413	8	23,240	5
Agro-pastoalists	532,725	15	89,562	18
Poor	159,817	5	26,869	5
Middle	266,362	8	44,781	9
Better-off	106,545	3	17,912	4
Sedentary farmers	821,719	24	133,214	26
Poor	205,430	6	29,603	6
Middle	410,860	12	69,074	14
Better-off	205,430	6	34,537	7
Urban	588,216	17	95,701	19
Poor	63,730	2	10,369	2
Middle	349,839	10	56,918	11
Better-off	174,647	5	28,415	6
Total	3,439,860	100	503,912	100

Source: Regional Office of Population of the Somali National Regional State (SNRS) and Save the Children (UK).

Table B.3. *Wealth categories among households based on livestock ownership and land use.*

	Cultivated land (ha)	Shoats (No.)	Cattle (No.)	Camels (No.)	Oxen (No.)	Donkeys (No.)
Pastoralists						
Poor		20–35	2–3	0–1		
Middle		70	10	15		
Better-off		120	15	40		
Agro-pastoralists						
Poor	0.4	4–10	2–5	1		
Middle	1.0	10–20	5–10	2–5		
Better-off	1.5	20–30	8–15	5–10		
Sedentary farmers						
Poor	1.5	2–3	2.0		0	1
Middle	2.3	5–10	4–6		1	1
Better-off	5.0	10–15	8–10	1	2	1

Source: Save the Children (UK).

Table B.4. *Disposition of income by household type in percentage of total income.*

	Pastoralist			Agro-pastoralist			Sedentary			Urban		
	Poor	Middle	Better-off	Poor	Middle	Better-off	Poor	Middle	Better-off	Poor	Middle	Better-off
Consumption of own production	13.0	23.7	28.4	45.2	42.3	67.4	54.1	53.4	70.4	0.0	0.0	0.0
Milk, ghee, meat	3.1	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	3.5	5.7	6.9
Grain	46.0	25.3	16.1	26.5	17.8	3.3	16.0	11.1	3.8	15.9	21.2	13.7
Other food	15.8	16.4	15.0	9.4	12.8	11.1	5.5	7.3	6.2	52.0	36.3	25.3
Non-food	17.0	22.8	23.6	14.1	21.4	13.2	15.3	19.9	12.0	26.2	31.3	43.0
Transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.6	1.6
Services	5.2	7.5	9.4	2.8	3.2	1.7	9.2	6.2	4.7	1.9	2.8	5.7
Transfers	0.0	0.0	2.3	0.0	0.0	1.8	0.0	0.0	0.6	0.0	0.0	0.5
Savings	0.0	4.4	5.2	0.0	2.5	1.4	0.0	2.1	2.3	0.0	2.1	3.3
Total (US$ × 10^3)*	40,760	75,532	42,512	9312	26,645	13,958	8160	34,563	28,225	4935	50,007	67,911
Income/capita	65	124	162	58	100	131	40	84	137	77	143	389
Income/household	452	1048	1829	347	595	779	276	500	817	476	879	2390

* Values are in 1997.

Source: Authors based on Save the Children (UK) and Central Statistical Authority of Ethiopia (CSA).

Table B.5. *Sources of income for households by household type in percentage of total income.*

	Pastoralist			Agro-pastoralist			Sedentary			Urban		
Income sources	Poor	Middle	Better-off	Poor	Middle	Better-off	Poor	Middle	Better-off	Poor	Middle	Better-off
Agricultural enterprise	50.1	83.1	77.5	44.7	68.2	84.1	68.6	91.4	91.0	0.0	0.0	0.0
Non-agricultural enterprise	11.5	12.2	13.3	0.0	17.3	12.3	0.0	0.0	0.0	80.6	85.1	83.2
Wages and salaries	9.7	0.0	0.0	8.1	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0
Petty trade and recollection	22.7	0.9	0.3	34.5	8.1	0.0	16.5	4.7	0.0	0.0	0.0	0.0
Household transfers	2.4	0.0	0.0	2.7	0.0	0.0	2.2	0.0	0.0	7.4	0.0	0.0
Government transfers	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	9.7	12.5	9.7
Remittance	2.6	2.8	7.8	8.9	5.3	2.5	2.6	2.8	7.9	2.2	2.4	7.1
Total (US$ × 10^3)	40,760	75,532	42,512	9312	26,645	13,958	8160	34,563	28,225	4935	50,007	67,911

Source: Authors based on Save the Children (UK) and Central Statistical Authority of Ethiopia (CSA).

Table B.6. *Sales composition in home family business.*

	Pastoralist			Agro-pastoralist			Sedentary		
	Poor	Middle	Better-off	Poor	Middle	Better-off	Poor	Middle	Better-off
Livestock	79.5	72.8	69.7	54.5	56.7	57.3	0.0	8.6	34
Milk	20.5	27.2	30.3	45.5	40.3	39.0	66.7	54.3	20
Cereals	0.0	0.0	0.0	0.0	3.0	3.7	33.3	37.1	46
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100

Source: Authors using information from Save the Children (UK).

Table B.7. *Total animal stock by species and zones (× 10^3 heads).*

	Cattle	Sheep	Goats	Donkeys	Camels
Shinile	228	913	776	46	72
Jijiga	439	1316	548	42	29
Fiq	252	560	672	18	74
Degehabur	287	538	574	11	57
Warder	274	1372	1960	5	480
Korahe	168	1150	719	6	275
Gode	402	1004	636	8	14
Afder	985	1231	788	14	77
Liben	711	969	1874	63	954
Total	3746	9053	8547	213	2032

Source: Regional Office of Population of the Somali National Regional State (SNRS).

Table B.8. *Animal holdings and sales by household type (number of heads).*

	Pastoralists			Agro-pastoralists			Sedentary farmers		
	Poor	Middle	Better-off	Poor	Middle	Better-off	Poor	Middle	Better-off
Animal holdings									
Shoats	42.0	93.0	168.0	9.0	20.0	34.0	3.0	11.0	18.0
Cattle	5.0	20.0	29.0	3.0	7.0	10.0	1.0	4.0	9.0
Camels	3.0	14.0	28.0	0.0	1.0	3.0	0.0	0.0	0.0
Sales									
Shoats	5.5	12.1	20.8	1.6	3.8	6.3	0.0	1.6	3.3
Cattle	0.5	0.8	0.6	0.0	0.4	0.6	0.0	0.0	0.5
Camels	0.1	0.4	0.8	0.0	0.0	0.0	0.0	0.0	0.0
Quality of animals sold									
Shoats low quality	1.8	4.8	8.2	0.6	1.5	2.5	0.0	0.6	1.3
Shoats export quality	3.7	7.3	12.6	1.0	2.3	3.8	0.0	1.0	2.0
Cattle low quality	0.4	0.6	0.4	0.0	0.0	0.4	0.0	0.0	0.0
Cattle export quality	0.1	0.2	0.2	0.0	0.4	0.2	0.0	0.0	0.5
Camel low quality	0.1	0.4	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Camel export quality	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0

Source: Regional Office of Population of the Somali National Regional State (SNRS) and Save the Children (UK).

Table B.9. *Animal holdings and sales by household type (× 10^3 heads).*

	Pastoralists			Agro-pastoralists			Sedentary farmers			
	Poor	Middle	Better-off	Poor	Middle	Better-off	Poor	Middle	Better-off	Total
Animal holdings										
Shoats	3775	6709	3911	255	909	606	80	748	608	17,600
Cattle	474	1431	671	69	305	183	25	294	294	3746
Camels	258	979	655	11	56	59	0	0	14	2032
Sales										
Shoats	492	871	484	44	169	113		113	113	2401
Cattle	45	61	14	0	18	11	0	0	18	166
Camels	7	18	14	0	0	0	0	0	0	40
Quality of animals sold										
Shoats low quality	161	343	191	17	67	44	0	45	45	912
Shoats export quality	331	528	294	27	103	69	0	69	69	1489
Cattle low quality	39	46	9	0	0	7	0	0	0	101
Cattle export quality	6	15	5	0	18	4	0	0	18	65
Camel low quality	7	18	4	0	0	0	0	0	0	29
Camel export quality	0	0	10	0	0	0	0	0	0	10
Animal sales (US$ × 10^3)										
By animal quality	3222	6854	3812	347	1333	889	1242	0	891	18,239
Shoats low quality	828	13,211	7348	668	2570	1713	777	0	1718	37,225
Shoats export quality	1	7781	1566	0	0	0	0	0	0	17,297
Cattle low quality	6708	3246	980	0	3886	0	0	0	3746	13,834
Cattle export quality	1199	3906	871	0	0	0	4621	0	0	6311
Camel low quality	1533	0	2190	0	0			0	0	2190
Camel export quality	0	34,998	16,767	1015	7788			0	6355	95,096
Total sales	20,944	20,065	11,159	3903	2602			2609	2609	55,464

Table B.9. *Animal holdings and sales by household type (× 10^3 heads).*

	Pastoralists			Agro-pastoralists			Sedentary farmers			
	Poor	Middle	Better-off	Poor	Middle	Better-off	Poor	Middle	Better-off	Total
Total sales value by species	11,503	11,027	2546	3886	2019			0	3746	31,131
Shoats	7908	3906	1015	0	0			0	0	8501
Cattle	1533	3062	0							
Camels			0							

Note: Livestock prices, in 1998, are US$ 25 for export quality sheep; US$ 20 for low quality sheep; US$ 214 and 171 for export quality and low quality cattle respectively.
Source: Regional Office of Population of the Somali National Regional State (SNRS) and Save the Children (UK).

Table B.10. *Final destination of animal sales.*

	Kenya	Somalia/Arab countries	Domestic	Highlands	Total
Final destination of animal sales (× 10^3 heads)					
Low quality					
Shoats	0	0	512	400	912
Cattle	0	0	57	44	101
Camel	0	0	19	23	43
Export quality					
Shoats	145	1344	0	0	1489
Cattle	28	37	0	0	65
Camel	0	12	0	0	12
Final destination of animal sales (US$ × 10^3)					
Low quality					
Shoats	0	0	10,234	8005	18,239
Cattle	0	0	8400	6571	14,971
Camel	0	0	3569	4362	7931
Export quality					
Shoats	3617	33,608	0	0	37,225
Cattle	4714	6340	0	0	11,054
Camel	0	2520	0	0	2520
Total sales (US$ × 10^3)	8331	42,468	22,203	18,938	91,940
Distribution of sales (%)	10	46	24	20	100

Sources: Shank (1997), Ahrens (1998), FEWS (1998).

Table B.11. *Sales and production of milk by different household types.*

	Production (× 10^3 litres)	Sales (× 10^3 litres)	Sales (US$ × 10^3)	US$/household	Litres
Agro-pastoralists					
Poor	26,869	12,036	2528	94	448
Middle	44,781	32,614	6849	153	728
Better-off	17,912	19,462	4087	228	1086
Sedentary farmers					
Poor	29,603	1942	408	14	66
Middle	69,074	20,698	4347	63	300
Better-off	34,537	3257	684	20	94

Source: Save the Children (UK).

Table B.12. *Land use in Somali Region by zone (× 10^3 ha).*

	Cropped	Woodland	Grazing	Unproductive	Total
Shinile	20	284	126	3116	3546
Jijiga	422	678	612	8	1720
Fiq	–	190	1506	204	1900
Degehabur	–	698	1988	634	3320
Korahe	–	1332	1351	186	2869
Gode	8	966	1632	334	2940
Afder	–	2026	2106	2804	6936
Warder	–	2766	2428	122	5316
Liben	–	1135	2204	138	3477
Total	450	10,075	13,953	7546	32,024

Source: Regional Office of Population of the Somali National Regional State (SNRS) and Save the Children (UK).

Table B.13. *Area, yield, production, sales and consumption of grains in the Somali Region by household type.*

	Area cultivated (ha)	Yield/ha (kg)	Output (kg)	Seeds (kg)	Other (kg)	Sold (kg)	Consumed (kg)
Agro-pastoralists							
Poor	0.4166667	600	250	5.0			245
Middle	1.0	660	660	19.8		132	508.2
Rich	1.5	660	990	29.7	99	207.9	653.4
Sedentary farmers							
Poor	1.25	900	1100	37.5	0	455	600
Middle	2.3333333	900	2040	65	100	1025	850
Rich	5.0	900	4400	150	300	2325	1425

Source: Authors using information from Save the Children (UK).

Table B.14. *Aggregated area, production, sales and consumption of grains in the Somali Region by household type.*

	Area cultivated (ha)	Output (t)	Sold (t)	Consumed (t)	Output (US$ × 10^3)	Sold (US$ × 10^3)	Consumed (US$ × 10^3)
Agro-pastoralists							
Poor	7463	4478		4389	851	0	834
Middle	44,781	29,555	5911	22,758	5616	1123	4324
Rich	40,303	26,600	5586	17,556	5054	1061	3336
Total agro-pastoralists	92,547	60,633	11,497	44,702	11,520	2184	8493
Sedentary farmers							
Poor	37,004	32,563	13,469	17,762	6187	2559	3375
Middle	161,172	140,911	70,801	58,713	26,773	13,452	11,155
Rich	172,685	151,962	80,298	49,215	28,873	15,257	9351
Total sedentary farmers	370,861	325,436	164,568	125,690	61,833	31,268	23,881
Total	463,408	386,070	176,065	170,392	73,353	33,452	32,374

Source: Elaborated by authors based on information from Save the Children (UK).

Table B.15. *Cost structure and total value of output for different activities (US$ × 10^3).*

	Livestock	Grain	Non-food	Transport	Services	Labour	Capital	Total
Pastoralists								
Poor			3436			18,696	5965	28,097
Middle	3926		11,796			19,295	16,922	51,939
Better-off	2455		11,792			8047	7410	29,704
Agro-pastoralists								
Poor		17	0			4765	4551	9333
Middle	3577	257	4			12,474	10,758	27,070
Better-off	4502	359	8			7733	6603	19,205
Sedentary farmers								
Poor		230	0			5310	1666	7206
Middle	4684	1105	3			16,339	16,600	38,732
Better-off	4813	1291	7			16,920	19,262	42,292
Non-rural activities								
Traders	4264	551	5566	8800	644	11,216	10,510	41,550
Services			4388	1429	1952	100,366	44,474	152,608

Source: Authors based on information from Save the Children (UK).

Table B.16. *Transport cost for livestock and livestock traders return.*

	Exports (Birr/head)	US$	Domestic (Birr/head)	US$
Trekking	10.0	1.41	5.0	0.7
Five days feed/water	0.2	0.03	0.1	0.01
Holding animals (shade, forage, water)	2.0	0.28	1.0	0.14
Trucking to Berbera	4.0	0.56	–	–
Maize/sorghum fodder	1.4	0.2	–	–
Vaccination	0.3	0.04	–	–
Trader's return	3.88	0.55	1.05	0.15
Total	21.78	2.52	7.015	0.99

Source: Shank (1997).

Appendix C. Investments and costs of compliance

Investments: Buildings and construction

Quarantine centres (holding or collecting grounds): The reference cost for construction used is US$ 1 to US$ 1.5 per shoat. With a maximum monthly animal flow of 243,663 heads in March 1997, the necessary surface to handle quarantine in Ethiopian territory, particularly during the last 30 days imposed by OIE, will require a total investment between US$ 250 thousand and US$ 375 thousand. Watering facilities should be included in those costs although specific location may lead to extra costs for proper borehole construction. As an additional indication the international standard for housing animals is four shoats per square metre shade and should illustrate standards for quarantine grounds. Studies in Somaliland have considered that a fence area of 4 km^2 should be enough for one collecting ground. There should be some costs for protecting insects in some scenarios (unvaccinated), but we have considered that the protection are inherent to buildings and that we do not make differences between characteristics of quarantine buildings in vaccinated and non-vaccinated scenario. This is a capital to be invested at the beginning of the financial study time line.

Quarantines should be maintained by officially designated veterinarians to ensure the required 30 days of constant clinical examination. Therefore, building costs as calculated hereafter are for quarantine. Traders have their own collecting grounds and no building cost is required here. They take the collecting ground for a period of 30 days at their own risk and liability, and are visited by veterinary staff or certification company in their own collecting ground where preliminary tasks are achieved. Feeding costs are still to be paid by traders during the period when the animals are in collecting ground or at quarantine during period of the OIE pathway. Locations of the construction site and the number of buildings is not discussed in depth: it is recommended to diversify the location and spread the location risk into three main collecting grounds to serve as holding grounds and quarantine depending upon the step reached in the certification chain.

Veterinary centre

A semi-professional solar cold chain for 3000 blood sample storage at a cost of US$ 3000 and additional clinics building at a cost of US$ 137,647 per clinic are needed for implementing the programme. Based on the assumption that three new facilities should be implemented we reach US$ 415,941 for additional construction including the solar cold chain.

Information system

Another crucial aspect of the certification is the information system that relies on identifying animals and database management, data entry and information circulation. Therefore, a highly computerised system is required to comply with OIE rules. Computers

network (laptops plus listing printers) are needed (two laptops and printers per collecting ground, clinic or quarantine centre results in a total of six). Given recommended shelf life they should be renewed after every 5 years and for the period of 20 years of the time horizon. Replacements should occur at year 5, 10 and 15. One computer is estimated to be US$ 2300 and each printer US$ 1200 adding to a total of US$ 3500.

Vehicles

We include investment in vehicles considering that certification encompasses visits to traders in their collecting grounds when identification is achieved and with some preliminary task like animal testing. We take the basic cost of a pickup model (US$ 29.4 thousand duty free for one item as a reference: two vehicles per quarantine centre, for 3 centres equals 6 vehicles requested for a total of US$ 176.4 thousand). We assume a shelf life of 10 years and vehicles should be invested as capital cost at year 0 and replaced at year 10.

Variable costs: Fuel and vehicle maintenance

Fuel and maintenance costs for the vehicles (lubricants fuel, repairs and insurance) are assumed to cost US$ 11.8 per day. For 6 vehicles the total cost per month is US$ 2117.64 during the whole period.

Paper work

Commercial market prices duty paid in Addis Ababa (from stationary) are as follows: pack of 500 A4 paper (US$ 4.7) to serve for 5000 animals (10 animals per page equals US$ 235 for 250 thousand animals per month), plus printer ink (US$ 120 to serve 50 packs of 500 forms each form for 10 animals). The total paper work cost of certification is US$ 355 for 250 thousand animals or US$ 0.00142 per animal certified.

Feeding and watering costs

According to OIE regulations no free grazing is allowed, and during the 60-day period of control and quarantine required by the treatments, the animals should be fed and watered in the ground. Shank (1997) estimated feeding costs/head per day at US$ 0.05 with maize and sorghum fodder and water delivered by truck to animals being held at the Port of Berbera (Table A.1). The cost per month per animal equals US$ 1.48. The estimated cost of water is from SCF-UK who provides information of better-off pastoralists owning water reservoirs and selling water as part of their income. We estimate the cost of water per animal per month to be US$ 0.20. Total costs of feeding and watering animals amount to US$ 1.68 per animal per month.

Identification costs: Tagging all animals in the process

All exportable animals should be identified. Tagging with simple plastic ear tags is the minimum required and should be applied to all animals. There are other options like code bars on plastic to make data entry easier and avoid cheating but are not considered here. Ear tags are available duty paid in Addis at a cost of US$ 0.29 to 0.59 per ear tag applied to each animal (holder cost included in clinic equipment). This item is extremely expensive since all animals should be identified in the certification process if we want to ascertain testing or vaccination with official forms. There should be efforts to reduce this item unit cost to the minimum. A duty free policy on such item should reduce the cost to US$ 0.12 and we use this value in our benefit–cost analysis.

Testing cost: Sampling and diagnostic

Only a percentage of exportable animals should be sampled after a random selection. The sampling rate will affect the cost and have also consequences with respect to capacity of laboratories in the region. Sampling rate is debatable and as a rough first scenario we will take 1% when testing. Materials include sampling material, vaccutainer glass tubes, tube holder, needles, aliquots tubes with screw tightening caps for sera, tips cones for sera separation. A total blood sampling cost per animal sampled without labour of US$ 0.49164 will be the reference cost. Diagnostic is made with use of commercial Elisa kit, which is chosen because of its appropriateness to the study and adapted to local staff work. There is still some uncertainty on productivity to undertake such analysis. A total cost of analysis per animal (diagnostic plus laboratory based labour) of US$ 1.57 is estimated. (BDSL Ltd provides the test at international market price of US$ 1500 for 1000 sera and Elisa cost plus US$ 0.07 labour cost per test will be taken in the reference scenario (without fixed cost of the laboratory and without transportation cost for samples). The total per head sampled testing and sampling cost is therefore US$ 2.06.

Vaccination costs

In our study we have taken the Smithburn strain live and attenuated vaccine as the only option used and scientifically recognised to provide a good level of immunity (protection). The vaccine cost is US$ 0.25 per vaccinated animal including transport from South Africa to Addis Ababa Airport, Ethiopia. This is a cost without labour. Vaccination will be stopped if outbreak occurs to facilitate target testing and to not interfere with results of surveillance. The vaccine use with attenuated live vaccine is supposed to have side effects and would have abortive effects in females if mass vaccination were implemented. Since most of animals exported are males we did not envisage extra costs for the vaccination side effects with the Smithburn strain.

Staff wages in collecting grounds and clinic

Cost of staff taking into account the current negotiated wages of veterinary staff in Ethiopia as provided by the Ethiopian Veterinary Association (EVA) and other sources are addressed. The figures correspond to staff we consider should be involved in the system for tasks like identification and tagging, counting, blood sampling, clinical examination, vaccination as described in the OIE pathway for RVF. Cost of labour for staff visiting the collecting grounds and running quarantine is US$ 8110 per month.

For the vaccination and non-vaccination schemes the tasks are different but we have considered the same staff structure since there are major common tasks that should be undertaken. Based on historical data, assuming a peak number of animal to be certified being 240 thousand a month and assuming that two staff could manage 1000 animals a day during 26 working days a month, we need a minimum staff structure that includes: 3 chief veterinarians, 18 assistant veterinarians, 12 animal health technicians, 4 senior laboratory technicians and staff in support activities. To have a better service and attract the best staff, wages are defined above the current level for the same job.

Table C.1. *Surmised marketing costs and profit from 'illegal trade' of Blackhead sheep bought in Fik and sold in Jeddah, Saudi Arabian markets.*

Trader expenditure	Cost (Ethiopian birr)	Accumulated cost
Producer price	100–150/head (Seasonal)	150
		200–220 during Haj and Id
Trekking from Fik to Hargeisa	10.00/head	160
2.5 days feed/water	0.20/head	160.2
Holding in Hargeisa (shade, forage, water)	2.00/head	162.2
Trucking to Berbera	4.00/head	166.2
Two truckloads of maize/sorghum fodder (4 days)	1.40/head	167.6
Vaccination/brucellosis test/veterinarian fees	0.30/head	167.9
Somaliland Port tax	49.00/head	216.9
Shipping to Jeddah	42.00/head	258.9
Marketing costs	3.50/head	262.4
Market price	350.00/head	350
		(490.00 during the Haj)
Gross profit	87.6	
Death loss assuming 5%	13.12	
Net profit	74.48	
Profit margin (%)	21.4	

Source: Shank (1997).