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Profitability and Competitiveness of Indigenous Horo Cattle Production in Ethiopia

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Abstract: The livestock sector plays an important role for livelihoods and economic security of farmers and rural communities in Sub-Saharan Africa. The sector contributes about 25 percent of total agricultural GDP and about11percent of national GDP of Ethiopia. However, much has not been done to improve performance of the sector, especially indigenous genetic resources that are at risk. The paper develops a Policy Analysis Matrix to examine the profitability and competitiveness of indigenous *Horo* cattle production in the Western Showa Zone in Ethiopia. We employ two-stage probability sampling techniques in selecting 150 farmers for interview. We then employ partial sensitivity analyses with various scenarios to assess the impacts of each policy strategy. The results show that both private and social profits from indigenous cattle production are positive; implying that indigenous *Horo* cattle production is profitable and competitive for livestock keepers in particular and for the country at large. The domestic resource cost coefficient, private cost ratio, effective protection coefficient and profitability coefficient values also indicate a comparative advantage of indigenous *Horo* cattle production in the country. Policy recommendations for improved conservation, management and sustainable use of indigenous animal genetic resources are provided.

Key words: livestock; indigenous animal genetic resources; profitability and competitiveness; Policy Analysis Matrix; economic efficiency

JEL codes: D13, C83, E31, F10, M21, M31, M40, O13, Q12, Q13, Q17, Q18

1. Introduction

The livestock sector plays a significant role in economies of Sub-Saharan African countries. It is estimated that more than 70 percent of the rural poor depend on livestock as a component of their livelihoods (FAO, 2000). Studies show that Ethiopia has the largest livestock resource among all African countries (FAO, 2011; Asresie & Zemedu, 2015) and ranks as the tenth largest livestock inventory globally (USAID, 2013). The total private holdings cattle population of the country was estimated about 53.99 million in 2013 (CSA, 2013). This subsector has significant contribution in Ethiopian economy, which ranges from draught power to livelihoods and food

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security (Delgado et al., 1999; FAO, 2011; USAID, 2013). Empirical findings show that this subsector contributes about 11% of national GDP and 25% of total agricultural GDP with an estimate of 45% to agricultural GDP if the value of ploughing services considered (IGAD, 2013). According to National Bank of Ethiopia (NBE) (2015), the livestock subsector's contribution to the country's total export was $2,374.8 million in 2013, $2,405.08 million in 2014 and $2,387.91 million in 2015. Livestock production in the country mainly relies on indigenous animal genetic resources, however, much has not been done to improve the performance of these resources. Therefore, these resources are threatened by pressure of economic development that could be at risk of loss due to genetic erosion (IBC, 2004; Legesse, 2007; Alemayehu, 2010; CCAFS, 2014; Mekuriaw & Kebede, 2015; Mulualem et al., 2015). In addition, the subsector is characterized by inadequate feed and nutrition, widespread disease, poor health, lack of livestock policy and infrastructure (Degefe & Nega, 2000; Legesse, 2007; Alemayehu et al., 2010; FAO, 2011). With this background, the principal objective of this study is to examine profitability and competitiveness of indigenous cattle production to be able to address the potential risk of indigenous animal genetic erosion. The paper develops a Policy Analysis Matrix to examine the profitability and competitiveness of indigenous *Horo* cattle production in Western Showa, Ethiopia. We employ stratified probability sampling techniques in selecting 150 farmers for the interview. We then employ partial sensitivity analyses with various scenarios to assess the impacts of each policy strategy.

2. The Study Area

The study area is located about 250 km south-west of Addis Ababa and 125 km west of the town of Ambo, the capital city of West Shewa Zone of Oromia Regional State. The study area is classified into three agro-ecologies: Highland, which encompasses about 5 percent of the total land size and located above 2,200 meters above sea level (> 2,200 m. a. s. l.); Midland, which is about 80 percent of the total land mass and located between 1,500 and 2,200 meters above sea level (1,500-2,200 m. a. s. l.); and Lowland, which covers about 15 percent of the total land and located below 1,500 meters above sea level (< 1,500 m. a. s. l.). The district receives on average 900-1,400 mm annual rainfall and the annual mean temperature ranges from 15°C to 30°C. The study area is characterized by flat and plain topographical features, which represents about 90 percent of the total land coverage, followed by mountainous (8.3 percent) and Gorges (1.7 percent) topographical features (DBOA, 2006).

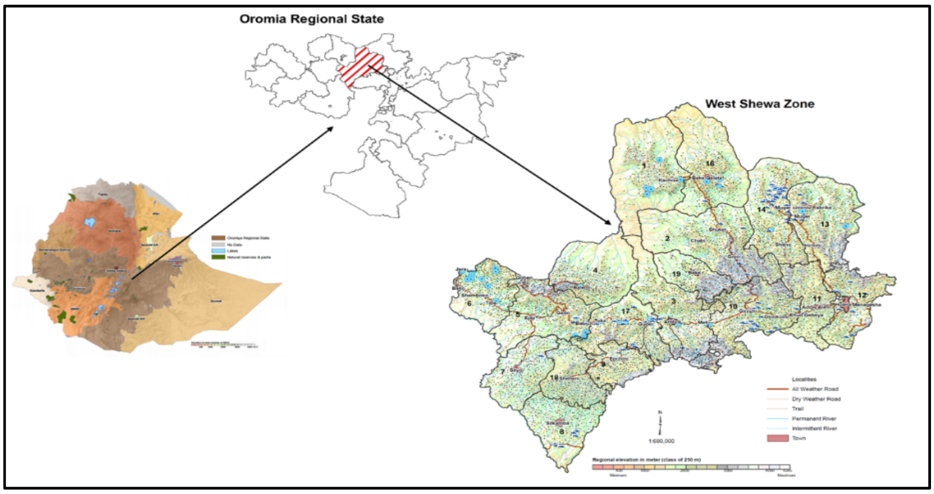

Figure 1 Map of the Study Area

Source: CSA, 2011

3. Methodology

3.1 Data Collection and Sampling Techniques

Socioeconomic, demographic, institutional, costs and benefits data collected from sampled farmers using structured questionnaires. We employed two-stage probability sampling techniques to in selecting sampled respondents. In the first stage, we employed stratified probability sampling techniques to select five study villages. Following, 30 farmers were selected from each village using systematic random sampling procedure. A total of 150 farmers were selected for the interview.

3.2 Theoretical Framework of the Policy Analysis Matrix (PAM)

Monke and Pearson (1989) developed PAM, a tool that measures profitability (the difference between revenues and costs) and effects of divergences (in revenues, costs and profits due to distorting policies and market failures, see Table 1). Monke and Pearson (1989), Legesse (2007) and Reig-Martínez et al. (2008) used PAM to measure the effects of transfers caused by a particular policy and inherent economic efficiency of the system.

Table 1 Policy Analysis Matrix

Particulars	Revenues	Costs		Profits
		Tradable Input	Domestic factor	
Privet Profits	A	B	C	D[1]
Social Profits	E	F	G	H[2]
Divergences	I[3]	J[4]	K[5]	L[6]

Note: [1] *Private Profit*, $D = A-(B+C)$
[2] *Social Profit*, $H = E-(F+G)$
[3] *Output Transfer*, $I = A-E$
[4] *Tradable Input Transfer*, $J = B - F$
[5] *Domestic Factor Transfer*, $K = C - G$
[6] *Net Transfer*, $L = D - H = I - (J + K)$

Source: Monk and Pearson (1989) and adopted by Joubert & van Schalkwyk (2000); Fang & Beghin (2000); Zeleke (2005); Legesse, (2007); Reig-Martínez et al. (2008).

The detailed formulas of the matrix components are presented below:

$$A=\sum_{c=1}^{k} P_c T_C \qquad B=\sum_{i=1}^{n} P_i Q_i \qquad C=\sum_{j=1}^{m} W_j L_j$$

$$E=\sum_{c=1}^{k} P_c(s) T_c \qquad F=\sum_{i=1}^{n} P_i(s) Q_i \qquad G=\sum_{j=1}^{m} W_j(s) L_j$$

Where: P_i and $P_i(s)$ = prices of tradable inputs (imported inputs) "*i*" in private and social prices respectively;

W_j and $W_j(s)$ = prices of domestic factors (non-imported inputs) "*j*" in private and social prices respectively;

P_c and $P_c(s)$ = prices of product "*c*" in private and social prices respectively;

T_c = quantity of product "*c*" produced per unit of average tropical livestock unit (TLU[1]);

Q_i, and L_j = quantity of tradable input "*i*" and domestic factor "*j*" used respectively;

k, n and *m* are number of outputs, tradable input and domestic inputs respectively.

The first row of the matrix represents *Private Profitability (D)* from indigenous *Horo* cattle production, which is given by:

[1] Tropical livestock unit is commonly taken to be an animal of 250 kg live weights (Storck et al., 1991), TLU conversion factors is presented in Appendix Table 2.

$$D = A-(B+C) = \sum_{c=1}^{k} P_c T_C - [\sum_{i=1}^{n} P_i Q_i + \sum_{j=1}^{m} W_j L_j]$$

Where *A*, *B* and *C* represent revenues, tradable inputs and domestic factors respectively.

The second row of the matrix represents *Social Profitability (H)*, which is given by:

$$H = E-(F+G) = \sum_{c=1}^{k} P_c(s) T_c - [\sum_{i=1}^{n} P_i(s) Q_i + \sum_{j=1}^{m} W_j(s) L_j]$$

Where *E*, *F* and *G*, represent revenues in social prices, tradable inputs in social prices and domestic factors in social prices respectively. *E*, *F* and *G* were estimated based on social opportunity costs of commodities produced and inputs used in indigenous cattle production.

In addition, the PAM allows us to compute *Policy Divergences* through disaggregating the divergences into *Output Transfer, Tradable Input Transfer, Domestic Factor Transfer* and *Net Transfer* to measure specific effects of policies, technologies or market failure (Monk & Pearson, 1989; Pearson et al., 2003). A number of ratios derived from PAM to analyze the effects of a policy scenario, among others, selected policy distortion indicators are discussed below (Monk & Pearson, 1989; Fang & Beghin, 2000; Nguyen, 2002; Nguyen & Heidhues, 2004; Zeleke, 2005; Legesse, 2007):

Nominal Protection Coefficient on Tradable Outputs (*NPCO*) and *Nominal Protection Coefficient on Inputs* (*NPCI*) serve as an alternative to *I* and *J* in the previous table respectively. The ratios express the divergence between livestock market price and the social price (free of any distortion) (Monk & Pearson, 1989).

$$NPCO = \frac{A}{E} = \frac{\sum_{c=1}^{k} P_c T_c}{\sum_{c=1}^{k} P_c(s) T_c} \quad NPCI = \frac{B}{F} = \frac{\sum_{i=1}^{n} P_i Q_i}{\sum_{i=1}^{n} P_i(s) Q_i}$$

Private Cost Ratio (*PCR*): It measures how much the sector can afford to pay for domestic factors and still remain competitive (Joubert & van Schalkwyk, 2000). The ratio shows the comparative advantage of indigenous cattle *Horo* production and its private profitability. Excess profit, in excess of nominal returns to domestic resources, is indicated by *PCR* less than 1.

$$PCR = \frac{C}{(A-B)} = \frac{\sum_{j=1}^{m} W_j L_j}{\sum_{c=1}^{k} P_c T_c - \sum_{i=1}^{n} P_i Q_i}$$

Domestic Resource Cost Coefficient (*DRC*) is social return to domestic resources. It indicates whether domestic factors are utilized efficiently.

$$DRC = \frac{G}{E-F} = \frac{\sum_{j=1}^{m} W_j(s) L_j}{\sum_{c=1}^{k} P_c(s) T_c - \sum_{i=1}^{n} P_i(s) Q_i}$$

Effective Protection Coefficient (*EPC*): The ratio of value added in livestock products/byproducts in private prices to social prices. It is an indicator of the net incentive or disincentive effects of policies (Monk & Pearson, 1989; Joubert & van Schalkwyk, 2000; Zeleke, 2005; Legesse, 2007). An *EPC* greater than 1 means that private profits are higher than they would be without commodity policies and an *EPC* less than 1 indicates the opposite result (Monk & Pearson, 1989).

$$EPC = \frac{A-B}{E-F} = \frac{\sum_{c=1}^{k} P_c T_c - \sum_{i=1}^{n} P_i Q_i}{\sum_{c=1}^{k} P_c(s) T_c - \sum_{i=1}^{n} P_i(s) Q_i}$$

Subsidy Ratio to Producers (*SRP*): The ratio of net transfer to the social value of revenues. It shows the level of transfers from divergences as a proportion of the undistorted value of the system's revenues. It also shows the extent to which an increase or decrease in the system's revenues due to policy (Monk & Pearson, 1989).

$$SRP = \frac{L}{E} = \frac{\sum_{c=1}^{k} P_c T_C - [\sum_{i=1}^{n} P_i Q_i + \sum_{j=1}^{m} W_j L_j]}{\sum_{c=1}^{k} P_c(s) T_c}$$

Profitability Coefficient (*PC*)[2]: It shows the extent to which private profits exceed social profit.

$$PC = \frac{D}{H} = \frac{\sum_{c=1}^{k} P_c T_C - [\sum_{i=1}^{n} P_i Q_i + \sum_{j=1}^{m} W_j L_j]}{\sum_{c=1}^{k} P_c(s) T_c - [\sum_{i=1}^{n} P_i(s) Q_i + \sum_{j=1}^{m} W_j(s) L_j]}$$

4. Results and Discussion

Estimation of shadow exchange rate (*SER*)[3], which is the rate that would have prevailed in the absence of any trade intervention (Gonzalese et al., 1993; Shahabuddin, 2000; Lagman-Martin, 2004; Legesse, 2007). It is the weighted average of the demand price for foreign exchange paid by importers and the supply price of foreign exchange received by exporters (Lagman-Martin, 2004). Gittinger (1984) and Tallec & Bockel (2005) pointed out that shadow exchange rate might be considered as the opportunity cost of foreign exchange, which is given by the following equation:

$$SER = \frac{OER}{SCF}$$

Where: *SER* is Shadow Exchange Rate, *OER* is Official Exchange Rate and *SCF* is Standard Conversion Factor.

Lagman-Martin (2004) suggested a methodological guideline for economic analysis of projects for Asian Development Bank that adapted by Tallec & Bockel (2005), Zeleke (2005) and Legesse (2007), assuming distortion in domestic market prices occurred due to tariffs. The mathematical form of Standard Conversion Factor (*SCF*) is given by:

$$SCF = \frac{X + M}{(X - t_x) + (M + t_m)}$$

Where: *X* is total export value of commodities, *M* is total import values of commodities, t_x is total tax on exports and t_m is total tax on imports.

We estimated *SCF* based on data obtained from National Bank of Ethiopia (NBE) annual report (2014/15), *X* valued at F.O.B and *M* valued at C.I.F, t_x was taken as zero because proclamation No. 38/1993 and No. 287/2002

2 The measure of net transfer, L, cannot be used for comparisons among systems producing unlike outputs (Monk & Pearson, 1989).

3 *SER* reflects the consumption worth of an extra unit of foreign exchange in terms of domestic currency that replaces market prices in theoretical calculations when market prices do not represent the true economic value of a particular good/service (Nguyen, 2002; Tallec & Bockel, 2005).

of the country canceled all export taxes. The *SCF* is estimated as follows:

$$SCF = \frac{3,019,300,000 + 16,500,000,000}{(3,019,300,000 - 0) + (16,500,000,000 + 2,673,657,880)} = 0.88$$

According to NBE (2015), the annual average *OER* rate of Ethiopian Birr (ETB) to US$ was 20.6688 and the *SER* was calculated based on Gittinger (1984):

$$SER = \frac{OER}{SCF} = \frac{20.6688}{0.88} = 23.49 ETB / US\$$$

Decomposition of tradable input costs: Farmers in the study area did not use any imported inputs for cattle production. We assumed some inputs such as land, labor and farm capitals as pure non-tradable cost items. As Mohanty et al. (2003) argued, we also assumed other inputs produced domestically and not available on the international market, which include manure and animal feed[4], treated as pure non-tradable cost items. The opportunity cost of manure was computed based on Kumsa (2002) who reported, on average, a single cattle could produce 1.8 kg of feces (2.1 kg dry matter in a dry season and 1.5 kg dry matter in a wet season) per day in Western Showa, Ethiopia.

Social prices of pure domestic resources: The social price of land suggested to be calculated at its highest net return on its competitive crops (Yao, 1997; Garcia et al., 2007). However, specialization in profitable crops was not observed because farmers in the study area preferred to engage in crop rotation to reduce risks. As an alternative, Ortmann (1987), Nguyen and Heidhues (2004), Zeleke (2005) and Legesse (2007) pointed out that market rent might be competitive and farmers could be free to make contractual agreements on land use. Basically, the private market rent might be considered as a proxy measure of the opportunity cost of land although the amount was much lower than the real value. In the study area, some farmers rent out their land in exchange for receiving part of the harvest (in kind) or in monetary values. We considered average values of formal and informal land rent values as good proxies for measuring the opportunity cost of land. The social value of labor and borrowed capital used in cattle production were estimated based on the conversion factors prepared by Ministry of Economic Development and Cooperation (MEDaC). Animal power, farm tools depreciation and manure have no conversion factors available. Therefore, we adapt Zeleke (2005) and Legesse (2007) by assuming their social values the same as their privet values. Social prices of domestic factors estimated at their opportunity costs (see Appendix Table 1).

Social valuation of tradable and non-tradable outputs: World prices represent a government's choice to permit consumers and producers either to import or export or produce goods domestically (Monk & Pearson, 1989; Morrison & Balcombe, 2002; Mohanty et al., 2003). We consider F.O.B per head as a starting point to derive social price (comparable world price) of indigenous *Horo* cattle, which was converted into local currency using shadow exchange rate. Subsequently, the price was adjusted based on transportation, handling and other transaction costs to get the export parity prices of indigenous *Horo* cattle at the farm get.

Export parity price of indigenous Horo cattle: As presented in Table 2, we calculated export parity price of indigenous *Horo* cattle[5] at the farm gate based on F.O.B as a starting point. All costs such as transportation, handling and other marketing costs incurred in the process of delivering indigenous *Horo* cattle were deducted from the F.O.B to arrive at the farm gate price. Social costs of transportation, interest paid for borrowed capital,

[4] According to CSA (2013), 57.49%, 29.61%, 7.05%, 4.72%, 0.91% and 0.22% of animal feed in Ethiopia are obtained from green fodder (grazing), crop residue (straw and chaff of cereals/pulses, etc.), hay (cut and dried grass), other feed sources, industrial byproducts (oil cake) and improved feed (alfalfa) respectively.

[5] Indigenous cattle usually exported in live form.

labor costs of loading and unloading were estimated based on standard conversion factors prepared by MEDaC in 1998.

We develop revenue and cost categories in private prices based on average farm budgets, which were constructed by using average farm inputs and outputs[6] data collected at a household level (see the system budget table in Appendix Table 1). The market prices of inputs and outputs were validated with District Agricultural/Rural Development Office Report, Central Statistical Agency Report and market prices of the nearest market. Few cost items such as local packaging materials, local storage, local churning device (*Ro'oo*), cleanings, ropes, overhead costs and other miscellaneous expenses were treated as pure non-tradable items. We converted all information into a common farm-level numeraire: land in a hectare, herd size in tropical livestock unit (TLU), family labor in adult/man-equivalent and a common time frame.

Table 2 Export Parity Price of Indigenous *Horo* Cattle

	Description	Private Price	Social Price
1	Exchange rate (ETB/$)	20.67	23.50
2	F.O.B ($/head)	534.67	534.67
3	F.O.B (ETB/head)	11050.99	12564.70
4	Port charge	199.47	170.99
5	Transportation	650.00	140.75
6	Feed	119.90	119.90
7	Loading and unloading	59.95	59.95
8	Overhead	70.00	70.00
9	Interest	106.57	106.57
10	Other expenses	211.00	211.00
11	Margin	3335.00	3335.00
12	Transport to the farm	93.90	57.17
13	Farm gate price (ETB per head)	6205.20	8293.37
14	Farm gate price (ETB per average cattle TLU)	33,508.06	44,784.18

Source: Survey data analysis, 2016.

As Legesse (2007) pointed out, we measured output in average cattle TLU (5.4 Cattle TLU) numeraire and we used information extracted from the system budget tablet of formulate PAM[7]. The PAM results show that both *private* and *social* profits of indigenous *Horo* cattle production to be positive at the given inputs, outputs, prices, technologies, existing government policies and market imperfections (Table 3). This result is consistent with literature (Monk & Pearson, 1989; Perdana, 2003; Legesse, 2007). The PAM results also reveal that social profitability (efficiency) of indigenous *Horo* cattle production is by far larger than private profit implying that the market prices paid to farmers are less by 14,375.36 ETB per average cattle in TLU than their social value or opportunity cost. This may occur due to overvalued exchange rate, market failures, undeveloped marketing infrastructures, institutional factors at district, zonal and regional levels or other externalities[8].

The *Output Transfer* (*I*) of indigenous *Horo* cattle production is negative, which implies livestock keepers obtain less price for their animal than the world market through implicitly paying more tax on *Horo* cattle. The *Non-tradable Input Transfer* (*K*) is positive implying that the opportunity costs of using domestic resources,

[6] Studies suggested to construct an input-output table (system budget table) as a first step in the PAM analysis (Perdana, 2003; Legesse, 2007; Reig-Martínez et al., 2008).
[7] See Appendix Table 5 for average products and average major inputs per year per household.
[8] Policy distortions are often introduced by decision makers that leads to inefficient use of resources (Alemayehu, 2007).

mainly unskilled labor, are lower than their private values. Thus, producers are implicitly taxed for the use of domestic resources. The *Net Transfer* (*L*) is negative implying that the government does not pay much attention for this subsector. This result suggests that, like the crop subsector, the government needs to also provide relevant inputs and output policies for this subsector.

Table 3 PAM for Indigenous Cattle Production in ETB Per Average Cattle TLU[9]

Peculiarities	Revenue	Costs		Profit
		Tradable inputs	Domestic factors	
Private price	51,470.90	0.00	9,918.94	41,551.96
Social price	62,390.87	0.00	6,463.55	55,927.32
Divergence	-10,919.97	0.00	3,455.39	-14,375.36

Source: Computed PAM results, 2016.

Policy Indicators: As shown in Table 4, the *NPCO* of indigenous *Horo* cattle production, is less than one. This implies that private revenue of cattle production is reduced through implicitly charging farmers about 18 percent of their product. Therefore, the overall impacts of existing policy influence the output side of the livestock market. *NPCI* = 0, implies absence of input policies and lack of institutional setup. This result suggests subsidizing producers' production costs is the only way for them to realize profits. *DRC*, which evaluate the importance of indigenous *Horo* cattle production relative to the international market in relation to economic efficiency, is less than 1. This result shows that the country has a relatively high comparative advantage in production and export of indigenous *Horo* cattle. This calls for fostering conservation and sustainable use of the sector. *EPC* = 0.82, implies that production can receive a higher return of 18% if appropriate polices are implemented. Therefore, it causes a net disincentive for cattle keepers because they are being taxed instead receiving subsidies as other sub sectors do. The *PCR* of 0.19 shows that marginal revenue is relatively larger as compares to domestic factor costs and the sector remains competitive. *SRP* = -0.23, implies that divergences have decreased the gross revenues of the system by 23%. PC = 0.74, shows that the policy transfers reduce private profits by 74% in comparison with social profits.

Table 4 Summary of Policy Indicators[10]

Indicators[11]	Amount	Indicators	Amount
NPCO	0.82	*EPC*	0.82
NPCI	0.00	*SRP*	-0.23
PCR	0.19	*PC*	0.74
DRC	0.10		

Source: Computed from the PAM's results, 2016.

Change in shadow exchange rate (*SER*): It is a unit change in exchange rate, which is a key variable for cattle pricing policy (ILRI, 2004) instituted by central authority. Change in the official exchange rate can affect *SER*, tradable inputs, cattle prices and the PAM. In this scenario, we simulated a 20 percent increase and a 20 percent decrease in SER in reference to the baseline scenario. The simulation shows that comparative advantage

[9] PAM for indigenous cattle production per head cattle TLU in ETB is presented in Appendix Table 4.
[10] See Appendix Table 5, for policy indicators of indigenous cattle production per head cattle TLU.
[11] *NPCO* = Nominal Protection Coefficient on Output; *NPCI* = Nominal Protection Coefficient on Inputs; *PCR* = Private Cost Ratio; *DRC* = Domestic Resource Cost Coefficient; *EPC* = Effective Protection Coefficient; *SRP* = Subsidy Ratio to Producers; and *PC* = Profitability Coefficient.

of indigenous *Horo* cattle production improves as *SER*. As presented in Table 5, ceteris paribus, a 20 percent increase in *SER* reduces the *NPCO* and *EPC* values by 17.1 percent. This means producers are more implicitly taxed on their products as the ETB value is socially depreciated.

Table 5 Policy Distortion Indicators for Sensitivity Analysis due to Change in SER

Indicators	Base line	20 percent increase	20 percent decrease
NPCO	0.82	0.68	1.05
NPCI	0.00	0.00	0.00
PCR	0.19	0.19	0.19
DRC	0.10	0.09	0.13
EPC	0.82	0.68	1.05
SRP	-0.23	-0.37	-0.02
PC	0.74	0.60	0.98

Source: Computed from PAM's simulation result, 2016.

A 20 percent decrease in the current SER policy might erase the 18 percent implicit taxation in the baseline scenario and producers receiving a subsidy of about 28 percent. This result reveals producers would be benefitting from reduced implicit taxation on their products as SER approaches OER. However, the NPCI value remains static due to an absence of tradable inputs. The DRC value decreases by 10 percent as SER increases by 20 percent, which implicitly indicates an improvement in social values added on indigenous *Horo* cattle production. Conversely, the DRC value deteriorates as SER decreases by 20 percent. Likewise, the PC value decreases and increases by 18.92 and 32.43 percent for a 20 percent increases and decreases in SER respectively.

Change in the world price of indigenous cattle: Demand and supply of indigenous cattle may fluctuate due to change in export prices (F.O.B) of indigenous cattle. Accordingly, we simulated impacts of change in export prices of indigenous cattle on NPCO, EPC, and DRC policy indicators (Table 6). The results show that a 20 percent increases in F.O.B price leads to an increase in NPCO from 0.82 to 1.02. This result underscores that producers are implicitly taxed by 24.4 percent. However, a 20 percent decreases in F.O.B price brings a decreases in NPCO from 0.82 to 0.63, they might be 23.17 percent subsidy. The EPC rises as export prices of indigenous cattle increases and vice versa, a change in from 0.82 to 1.02 (23.17 percent) for a 20 percent rise in F.O.B price. This result shows that the net disincentive effect might be minimized by an increase in F.O.B price. Change in export price may not affect DRC and NPCI with the existing level of technology. This result suggests comparative advantage of indigenous cattle production with a 20 percent increase in F.O.B price.

Table 6 Policy Distortion Indicators for Sensitivity Analysis (Change in the F.O.B) Price

Indicators	Base line value	20 percent increase in F.O.B price	20 percent decrease in F.O.B price
NPCO	0.82	1.02	0.63
NPCI	0.00	0.00	0.00
PCR	0.19	0.16	0.25
DRC	0.10	0.10	0.10
EPC	0.82	1.02	0.63
SRP	-0.23	-0.04	-0.42
PC	0.74	0.96	0.53

Source: Computed from the PAM's simulation results, 2016.

Assuming tradable inputs: In this scenario, we introduced tradable inputs such as improved animal feed, veterinary services, improved cattle barn, improved management system, training, etc. We arbitrary considered 50 percent of the domestic factors as tradable inputs. The corresponding private and social costs of tradable inputs might be 4,959.47 ETB and 3,231.78 ETB respectively, assuming other inputs remain constant. This simulation analysis shows that private and social profits are significantly positive with the given assumption of tradable inputs. This implies that indigenous *Horo* cattle production is profitable and competitive with an acceptable level of tradable inputs (Table 7).

Table 7 Simulated PAM for Indigenous *Horo* Cattle Production with Tradable Inputs (ETB/Average Cattle TLU)

Peculiarities	Revenue	Costs		Profit
		Tradable inputs[12]	Domestic factors	
Private price	51,470.90	4,959.47	9,918.94	36,592.49
Social price	62,390.87	3,231.78	6,463.55	52,695.55
Divergence	-10,919.97	1,727.70	3,455.39	-16,103.06

Source: Computed from the PAM's simulation results.

As presented in Table 8, *NPCO* < 1, implies the net effect of government intervention and market distortion are not corrected through effective policies. NPCI > 1, shows the overall impacts of government intervention (delivering tradable inputs). This impacts the input and output markets by creating an incentive to producers in the form of higher private prices relative to the baseline scenario. The EPC < 1, indicates input tariff creates a positive transfer. DRC < 1, indigenous cattle keeping found to be competitive and has a comparative advantage with the assumed tradable inputs.

Table 8 Policy Distortion Indicators for Sensitivity Analysis with Tradable Inputs

Indicators	Base line value {XE "Indicators}	With assumed tradable inputs
NPCO	0.82	0.82
NPCI	0.00	1.53
PCR	0.19	0.21
DRC	0.10	0.11
EPC	0.82	0.79
SRP	-0.23	-0.26
PC	0.74	0.69

Source: Computed from the PAM's simulation results, 2016.

Change in cost of domestic inputs: We examined impacts of change in domestic inputs prices on policy indicators, ceteris paribus (see Table 9). The simulation shows that change in the cost of domestic inputs doesn't have a direct impacts on NPCO, NPCI, and EPC with the given level of technology. However, DRC shows a slight change but less than one, which implies that indigenous *Horo* cattle production remains economically efficient with a 20 percent increase in domestic inputs, ceteris paribus.

[12] Assume tradable input = 50% of privet and social domestic costs.

Table 9 Sensitivity of PAM's Indicators for Change in Domestic Input Costs (in Private and Social Prices)

Indicators	Base line value	20 percent increase	20 percent decrease
NPCO	0.82	0.82	0.82
NPCI	0.00	0.00	0.00
PCR	0.19	0.23	0.15
DRC	0.10	0.12	0.08
EPC	0.82	0.82	0.82

Source: Computed from the PAM's simulation results, 2016.

Change in average cattle TLU: Change in average indigenous *Horo* cattle size in TLU was found not to impact NPCI and DRC, ceteris paribus (Table 10). However, NPCO changes from 0.82 to 0.93 (13.41%) for a 20 percent increase due to relative variation between private and social revenues and vice-versa. This simulation results indicate producers are slightly taxed on their products. This might be due to an increase in social revenue than private revenue. The PAM simulation results also show a 20 percent increase in TLU size leads to a decrease in PCR but increases EPC, ceteris paribus.

Table 10 Sensitivity of PAM's Indicators for Change in Average Cattle in TLU Equivalent

Indicators	Base line value	20 percent increase	20 percent decrease
NPCO	0.82	0.93	0.72
NPCI	0.00	0.00	0.00
PCR	0.19	0.17	0.22
DRC	0.10	0.10	0.10
EPC	0.82	0.93	0.72

Source: Computed from the PAM's simulation results, 2016.

5. Conclusion and Policy Implications

The study shows that both private and social profits from indigenous cattle production are positive. This implies that indigenous cattle production is profitable and competitive for livestock keepers in particular and for the country at large with the existing level of technology, market distortion and absence of effective policies. The study recommends the following set of policy tools:

(1) There is a need to provide technical support concerning animal feeds, drugs, and health services; market information system; and subsidize producers to promote the conservation and maximize socioeconomic benefits of indigenous cattle resources.

(2) There is a need to formulate appropriate inputs and outputs policies and strategies to measure economic performance, policy outcomes, incentives, government revenue and expenditures.

(3) Greater concern to technologies that improve indigenous cattle production quantity and quality should be given to meet export standards.

(4) Promote public awareness about the contribution of indigenous cattle towards food security, better nutrition, poverty alleviation and livelihood improvement.

References

Alemayehu B., Bogale A., Wollny C. and Tesfahun G. (2010). "Determinants of choice of market-oriented indigenous Horo cattle production in Dano district of western Showa, Ethiopia", *Tropical Animal Health Production*, Vol. 42, pp. 1723-1729.

Asresie A. and Zemedu L. (2015). "Contribution of livestock sector in Ethiopian economy: A review", *Advances in Life Science and Technology*, Vol. 29, p. 13.

CCAFS (2014). "Genetic erosion threatens resilience of Ethiopian Boran Cattle", Department of Plant and Environmental Sciences, University of Copenhagen, Denmark, available online at: https://ccafs.cgiar.org/blog/genetic-erosion-threatens-resilience-ethiopian-boran-cattle#.WH_EKxsrKUk.

CSA (2011). "Rural facilities and services ATLAS Oromia Regional State", Central Statistical Agency, Vol. 4, Addis Ababa, Ethiopia.

CSA (2013). "Agricultural sample survey: Livestock and livestock characteristics — Private peasant holdings", Central Statistical Agency, Statistical Bulletin 570, Vol. II, Addis Ababa, Ethiopia, p. 188.

DBOA (2006). "Socio economics and demographic characteristics of Dano district: Amahric version", District Bureau of Agriculture, Dano, Ethiopia.

Degefe B. and Nega B. (2000). "Annual report on the Ethiopian economy", Vol. 1, 1999/2000, The Ethiopian Economic Association.

Delgado C., Rosegrant M., Steinfeld H., Ehui S. and Courbois C. (1999). "Livestock to 2020: The next food revolution", *Food, Agriculture, and the Environment Discussion Paper 28*, IFPRI (International Food Policy Research Institute), Washington, DC, USA; FAO (Food and Agriculture Organization of the United Nations), Rome, Italy; ILRI (International Livestock Research Institute), Nairobi, Kenya, p. 72.

Fang C. and Beghin J. C. (2000). "Food self-sufficiency, comparative advantage, and agricultural trade: A policy analysis matrix for Chinese agriculture", Working Paper 99-WP 223, Center for Agricultural Development, Lowa State University.

FAO (2000). *World Watch List for Domestic Animal Diversity* (3rd ed.), Food and Agriculture Organization of the United Nations, Rome, Italy.

FAO (2011). *World Livestock 2011 — Livestock in Food Security*, Food and Agriculture Organization of the United Nations, Rome, FAO.

Garcia O., Hemme T., Reill A. and Stoll J. (2007). "Predicted impact of liberalization on dairy farm incomes in Germany, Vietnam, Thailand and New Zealand", International Farm Comparison Network IFCN, PPLPI (Pro-Poor Livestock Policy Initiative), Working Paper No. 42.

Gittinger J. P. (1984). *Economic Analysis of Agricultural Projects*, Economic Development Institute, The World Bank, p. 204.

Gonzalese A., Kasryo F., Perez N. D. and Rosegrant M. W. (1993). "Economic incentives and comparative advantage in Indonesia food crop production", Research Report 93, IFPRI (International Food Policy Research Institute), Washington, D.C.

IBC (2004). "The state of Ethiopia's farm animal genetic resources: Country report", A Contribution to the First Report on the State of the World's Animal Genetic Resources, Institute of Biodiversity Conservation, Addis Ababa, Ethiopia.

IGAD (2013). "The contribution of livestock to the Ethiopian economy", IGAD Centre for Patoral Areas and Livestock Development (ICPALD), Nairobi, Kenya.

ILRI (2004). "Improving the livelihood of poor livestock keepers in Africa through-Community based management of indigenous farm Animal Genetic Resource", International Livestock Research Institute: ILRI-BMZ project document, Addis Ababa, Ethiopia.

Joubert C. and van Schalkwyk H. D. (2000). "The effect of policy on the South African valencia industry", *Agrekon*, Vol. 39, No. 1, p. 8.

Kumsa T. (2002). "On-farm use of multi-purpose F1 crossbred cows in the mixed crop/livestock highland production systems in Ethiopia", Department of Animal Science and Animal Health, Royal Veterinary and Agricultural University, Frederiksberg, Denmark: RVAU, pp. 146-173.

Lagman-Martin A. (2004). "Shadow exchange rates for project economic analysis: Toward improving practice at the Asian Development Bank", ERD Technical Note No. 11.

Legesse B. A. (2007). "Policy and institutional analysis of smallholder cattle production in Dano District of Western Showa, Ethiopia", thesis presented to the School of Graduate Studies of Haramaya University, p. 116.

MEDaC (1998). "National economic parameters and conversion factors for Ethiopia: Economic value of goods and services", Ministry of Economic Development and Cooperation, Addis Ababa.

Mekuriaw G. and Kebede A. (2015). "A review on indigenous cattle genetic resources in Ethiopia: Adaptation, status and survival", *Online Journal of Animal and Feed Research*, Vol. 5, No. 5, pp. 125-137.

Mohanty S., Fang C. and Chaudhary J. (2003). "Economics and marketing assessing the competitiveness of Indian cotton production: A policy analysis matrix approach", *The Journal of Cotton Science*, Vol. 7, pp. 65-74.

Monk E. A. and Pearson S. R. (1989). *The Policy Analysis Matrix for Agricultural Development*, Cornell University Press: Ithaca and London.

Morrison J. and Balcombe K. (2002). “Policy analysis matrices: Beyond simple sensitivity analysis”, *Journal of International Development*, Vol. 14, pp. 459-471.

Mulualem T., Molla M. and Getachew M. (2015). “Assessment of livestock genetic resource diversity in Ethiopia: An implication for conservation”, *Journal of Genetic and Environmental Resources Conservation*, Vol. 3, No. 2, pp. 150-163.

NBE (2015). Annual Report 2014/15, National Bank of Ethiopia, Addis Ababa, Ethiopia.

Nguyen M. H. and Heidhues F. (2004). “Comparative advantage of Vietnam’s rice sector under different liberalization scenarios: A policy analysis matrix (PAM) study”, Institute for Agricultural Economics and Social Sciences in the Tropics and Subtropics (Ed.), *Forschung Zur Entwicklungsökonomie und–politik Research in Development Economics and Policy*, Discussion Paper No. 01/2004, Verlag Graver, Beuren and Stuttgart Germany.

Nguyen M. H. (2002). *Changing Comparative Advantage of Rice Production under Transformation and Trade Liberalization: a Policy Analysis Matrix Study of Vietnam’s Rice Sector*, Verlag Graver, Beuren and Stutgart, pp. 75-85.

Ortmann G. F. (1987). “Land rents and production costs in the South African sugar industry”, *The South African Journal of Economics*, Vol. 55, No. 3, pp. 163-169.

Pearson S., Gotsch C. and Bahri S. (2003). “Application of the policy analysis matrix in Indonesian agriculture”, available online at: http://www.Stanford.edu.

Perdana T. (2003). “Competitiveness and comparative advantage of beef cattle fattening in Bandung Regency”, Research Institute Padjadjaran University, Bandung.

Reig-Martínez E., Picazo-Tadeo A. J. and Estruch V. (2008). “The policy analysis matrix with profit-efficient data: Evaluating profitability in rice cultivation”, *Spanish Journal of Agricultural Research*, No. 3, pp. 309-319.

Shahabuddin Q. (2000). “Assessment of comparative advantage in Bangladesh agriculture”, *The Bangladesh Development Studies*, Vol. XXVI, No. 1, pp. 37-76.

Storck H., Emana B., Adnew B., Borowiecki A. and W/Hawariate S. (1991). “Farming systems and farm management practices of small holders in the hararghe highlands: Farming systems and resources economics in the tropics”, Wssenshaftsver lag vauk, Kiel, Germany, No. 11, pp. 41-48.

Tallec F. and Bockel L. (2005). “Commodity chain analysis impact analysis using shadow prices”, Food and Agriculture Organization of the United Nations, FAO, Rome, Italy.

USAID (2013). “Value chain analysis for Ethiopia: Meat and live animals hides, skins and leather and dairy — Expanding Livestock markets for the small-holder producers”, U.S. Agency for International Development, Agricultural Growth Project — Livestock Market Development, AID-663-C-12-00009, Addis Ababa, Ethiopia, p. 153.

Yao S. (1997). “Comparative advantage and crop diversification: Policy analysis matrix for Thai agriculture”, *Journal of Agricultural Economics*, Vol. 48, No. 2, pp. 211-222.

Zeleke F. (2005). “Assessment of comparative advantage of horse bean and lentil production in Basona Werana Woreda, North Shewa, Ethiopia”, M.Sc. thesis, School of Graduate Studies, Alemaya University, p. 106.

Appendix Tables

Table 1 System Budget Table of indigenous *Horo* Cattle Production in Private and Social Prices (ETB[13]/Average Cattle TLU)

Item	Private Price	Social Price
Revenue		
Main products		
Cattle	33508.06	44784.18
Butter	4545.55	4545.55
Milk	8100.00	8100.00
Cheese	1272.84	1272.84
Draft animal	2730.45	2374.30
Total main products	*50156.90*	*61076.87*
Byproduct		
Manure	1314.00	1314.00
Total revenue	**51,470.90**	**62,390.87**
Domestic Costs		
Animal feed	3080.91	3080.91
Farm tools	210.29	210.29
Storage	45.31	45.31
Shelter for cattle	395.60	395.60
Milk processing	309.20	309.20
Interest	106.57	106.57
Medication	269.37	269.37
Other expenses	46.25	46.25
Total domestic costs	*4463.50*	*4463.50*
Family labor	3310.45	1400.06
Hired labor	1800.00	150.00
Total labor costs	*5110.45*	*1550.06*
Land	345.00	450.00
Total domestic cost	**9,918.95**	**6,463.56**

Source: Survey data analysis, 2016.

Table 2 TLU Conversion Factors

Animal Category	Total TLU	Animal Category	Total TLU
Calf	0.25	Donkey (adult)	0.70
Weaned calf	0.34	Donkey (young)	0.35
Heifer	0.75	Camel	1.25
Cow and ox	1.00	Sheep and goats (adult)	0.13
Pigs	0.20	Sheep and goats (young)	0.06
Horse	1.10	Chicken	0.013

Source: Storck et al., 1991.

[13] Exchange rate (ETB/$) ≈ 20.67

Table 3 Average Yield and Average Major Inputs Used per Year per Household

Particulars	Amount
Yield	
Main products	
Average Cattle in TLU equivalent (in number)	5.4
Butter (in Kg) per cattle per year	8.6
Milk (in litter) per cattle per year	120
Cheese (in litter) per cattle per year	12.7
Draft animal (in hour) per cattle per 0.125 ha	96
Byproduct	
Manure (in kg) per cattle per year	657
Material inputs	
Animal feed (in ETB) per cattle per year	570.54
Farm tools (in ETB) per average CTLU per year	210.29
Storage (in ETB) per average CTLU per year	45.31
Shelter for cattle (in ETB) per average CTLU	395.60
Milk product processing (in ETB) per cattle year	57.26
Interest (ETB) per average CTLU	106.57
Labor	
Man-days family labor (in hour) per average CTLU equivalent per year	601.9
Hired labor per year in ETB per average cattle TLU	300
Land (in ha) used for average CTLU	0.384

Source: Computed based on survey data, 2016.

Table 4 PAM for Indigenous *Horo* Cattle Production/Head Cattle TLU in ETB

Peculiarities	Revenue	Costs		Profit
		Tradable inputs	Domestic factors	
Private price	9531.65	0.00	2773.08	6758.57
Social price	13488.48	0.00	3953.18	9535.30
Divergence	-3956.83	0.00	-1180.10	-2776.73

Source: Computed PAM results, 2016.

Table 5 Summary of PAM Indicators/Head Cattle TLU

Indicators	Amount
NPCO	0.71
NPCI	0.00
PCR	0.29
DRC	0.29
EPC	0.71
SRP	-0.21
PC	0.71

Source: Computed PAM results, 2016.