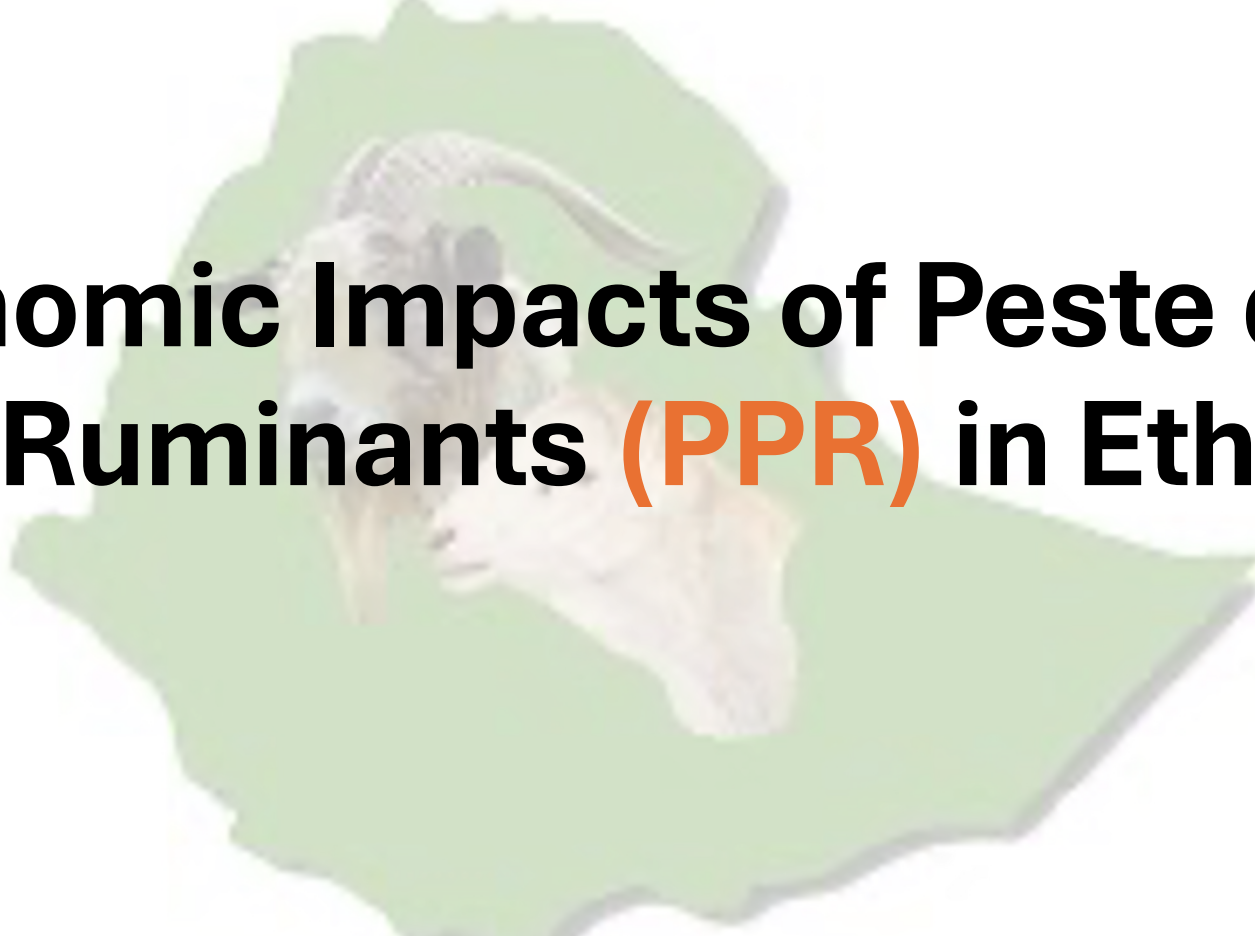




Economic Impacts of Peste des Petits Ruminants (PPR) in Ethiopia

Golam Saroare Shakil

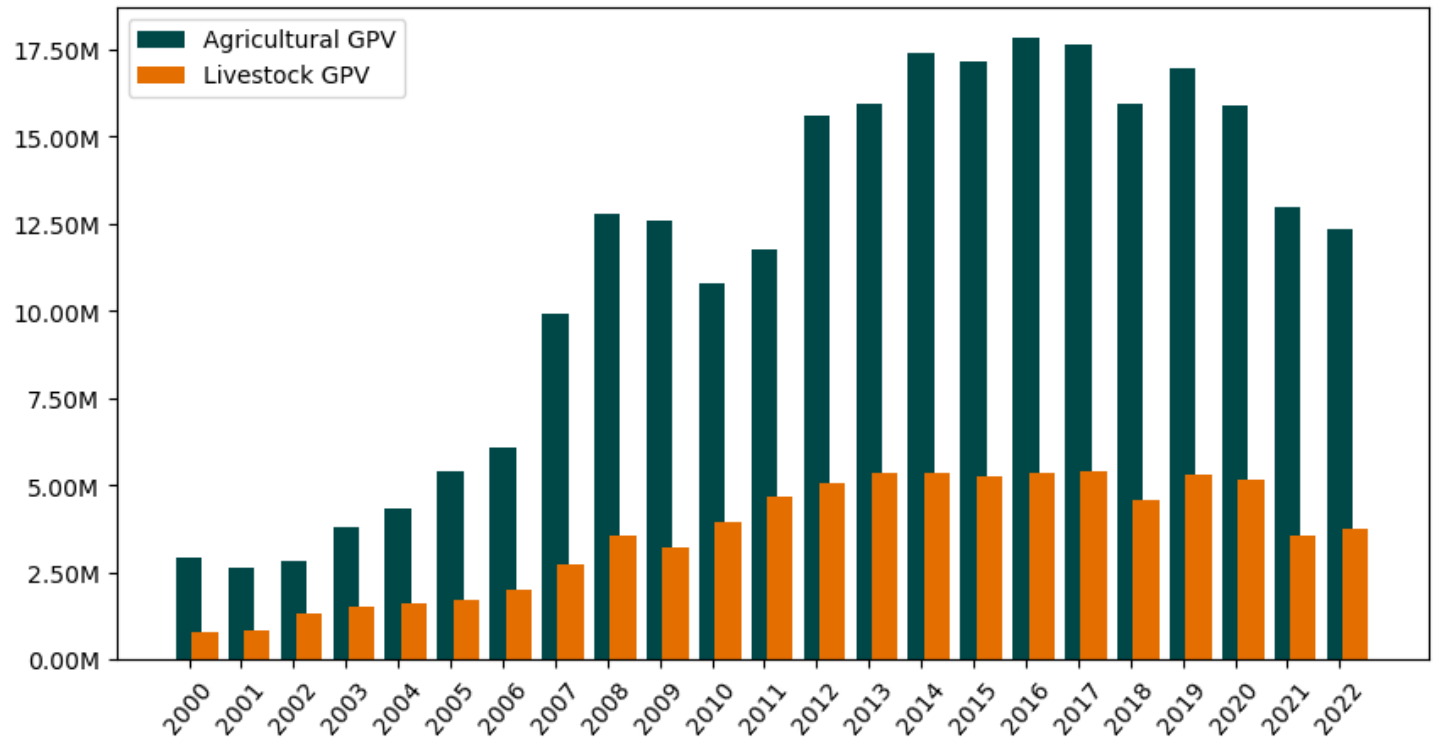
Amanda Countryman

Thomas Marsh

Introduction

- The livestock sector contributes to 40% to the agricultural GDP of Ethiopia (Dessie, 2022).
- Ethiopia is a top producer of small ruminants in Africa with 40 million sheep and 51 million goats.

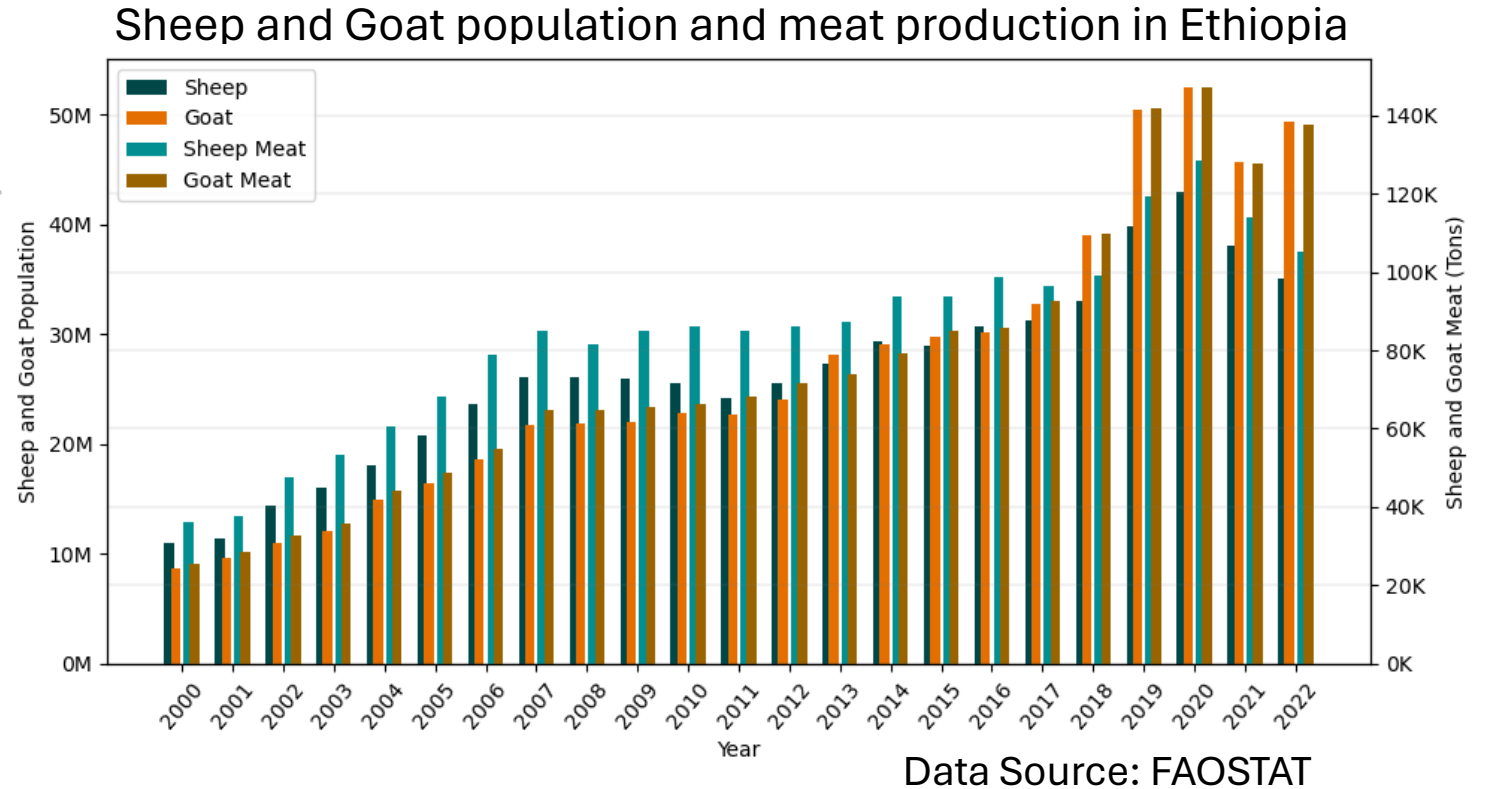
Livestock contribution to Agricultural GDP (in USD) in Ethiopia



Data Source: FAOSTAT

Introduction

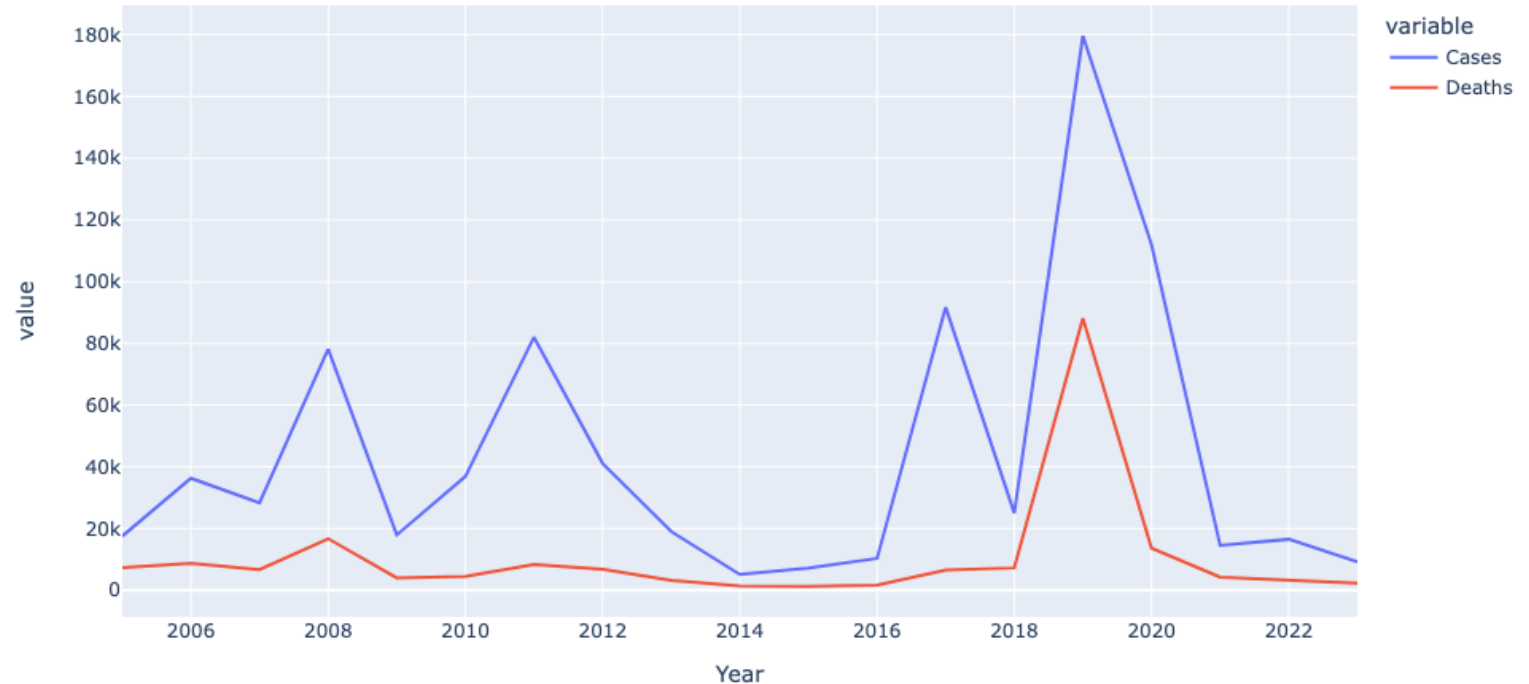
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Background

- Animal health is a major challenge for the livestock sector of Ethiopia (Ayele et al., 2021; Hooper, 2016).
- Peste des Petits Ruminants (PPR) is one of the most important diseases in Ethiopia (2015 Ethiopia Livestock Master Plan).
- PPR is associated with high morbidity and mortality of up to 90% (Kotchofa et al., 2021).
- Reported economic losses of PPR in Ethiopia are equivalent to 14% of annual household income (Jemburu, 2022).

Animal disease incidences in Ethiopia over the years

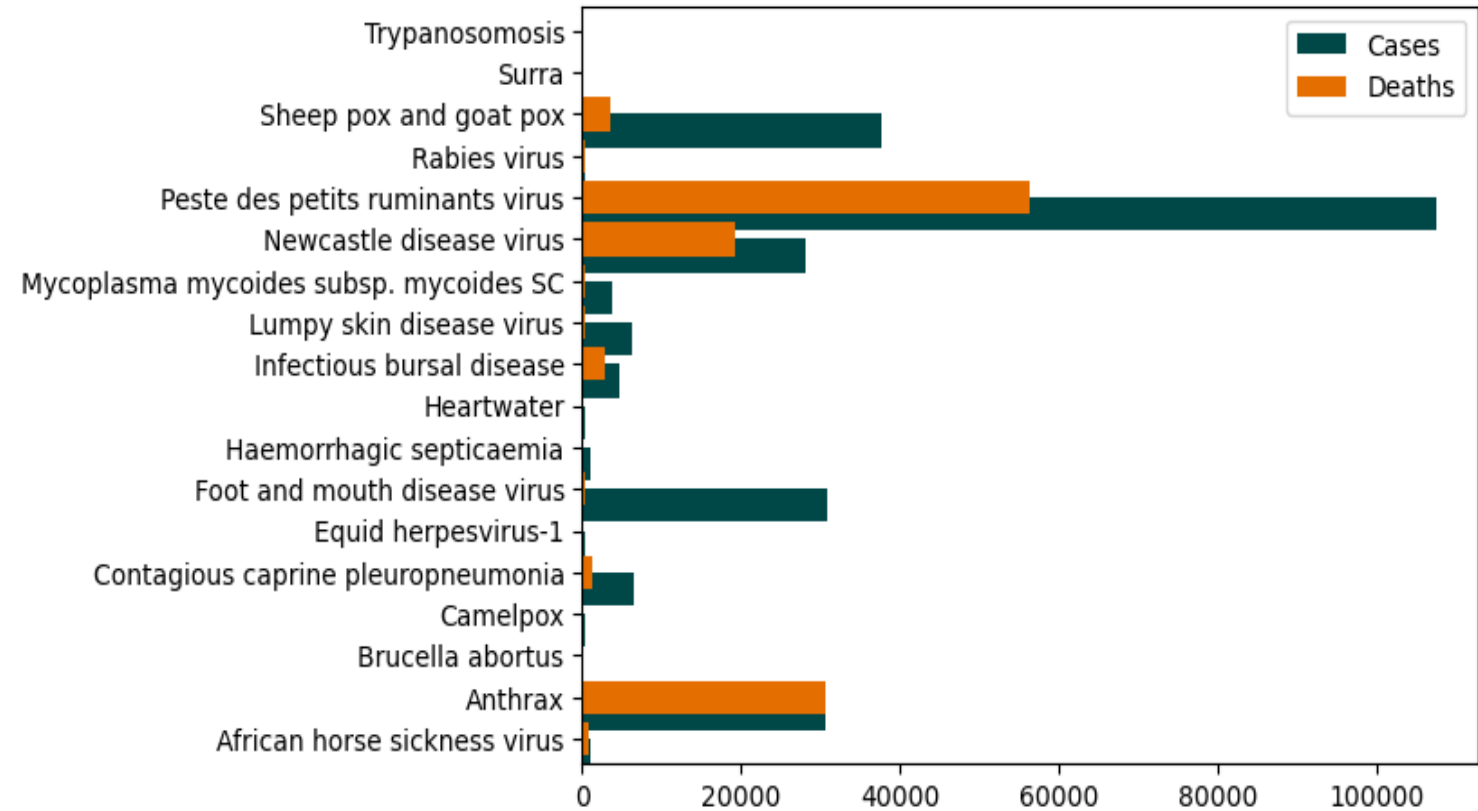


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Impact of major animal diseases in Ethiopia in the year 2019

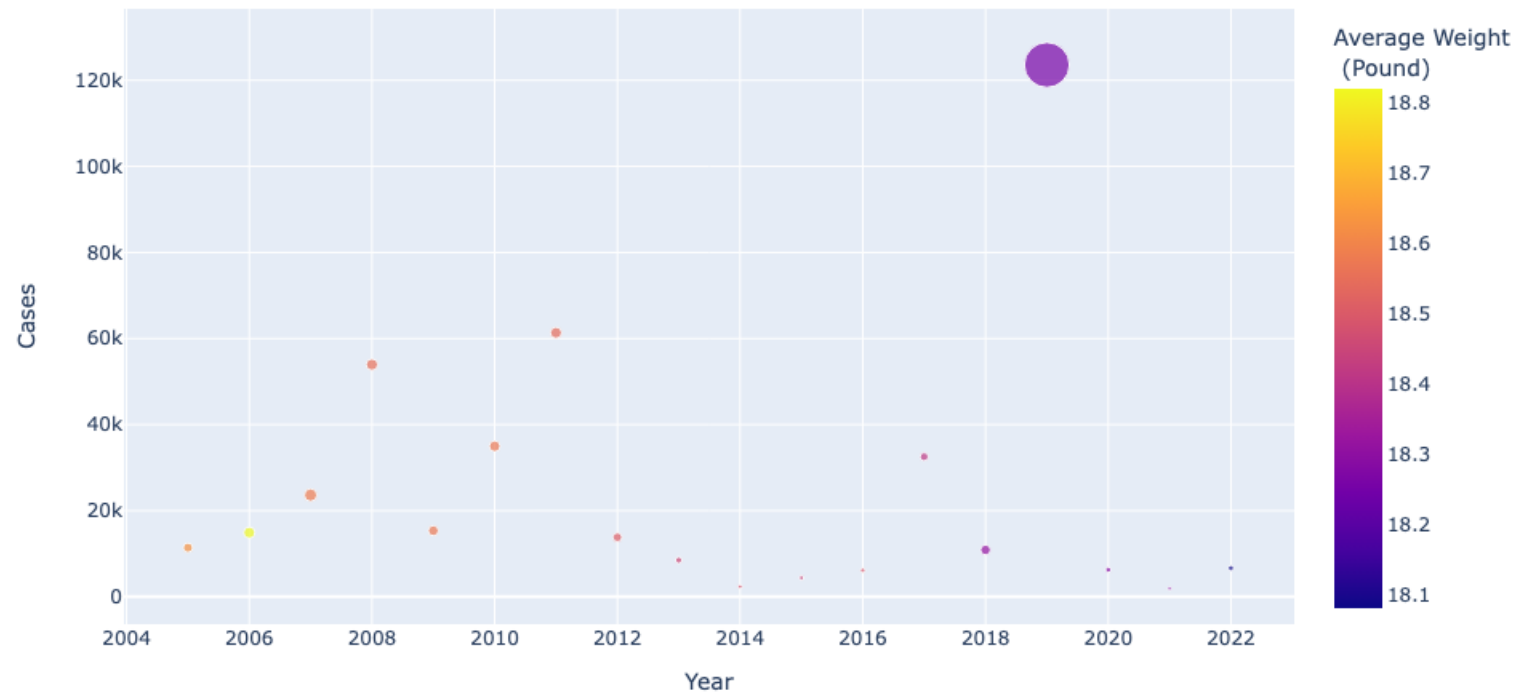


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Impact of small ruminant diseases on sheep and goat meat production in Ethiopia

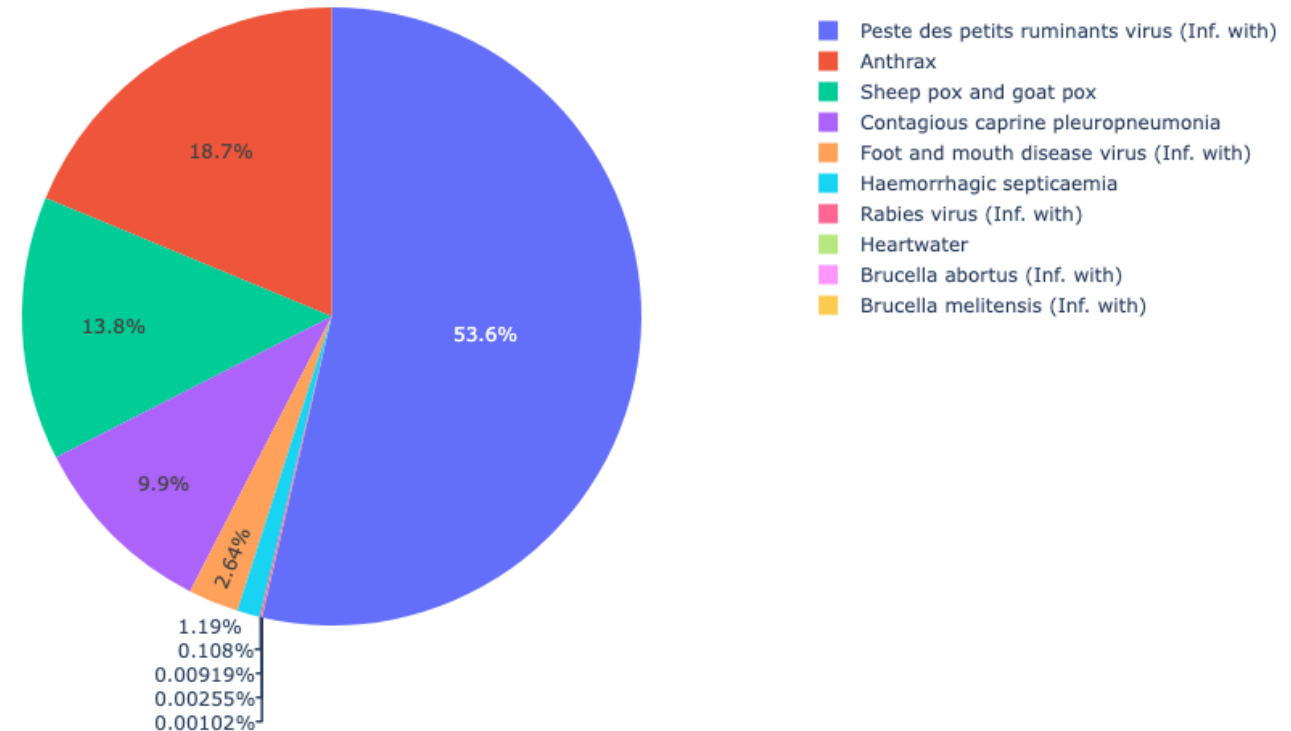


Data Source: FAOSTAT & WAHIS

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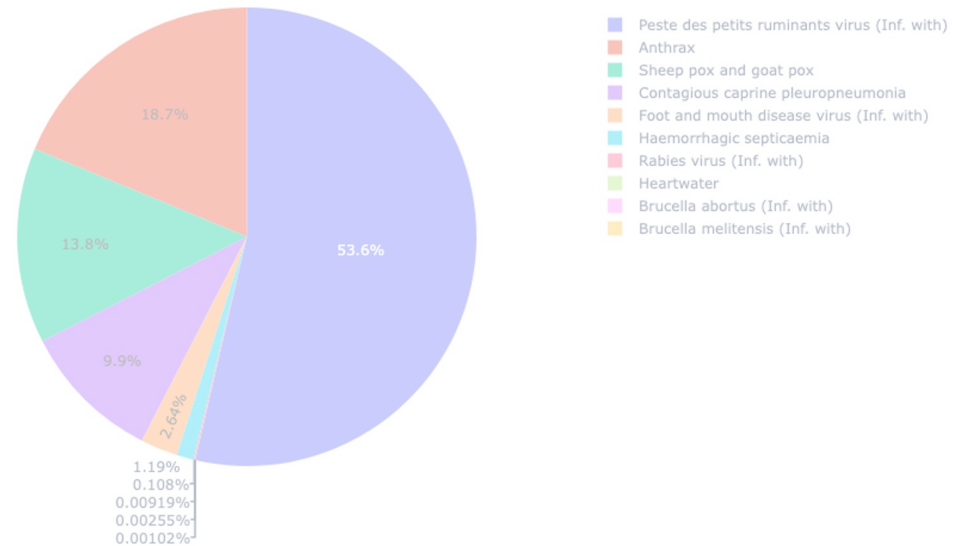
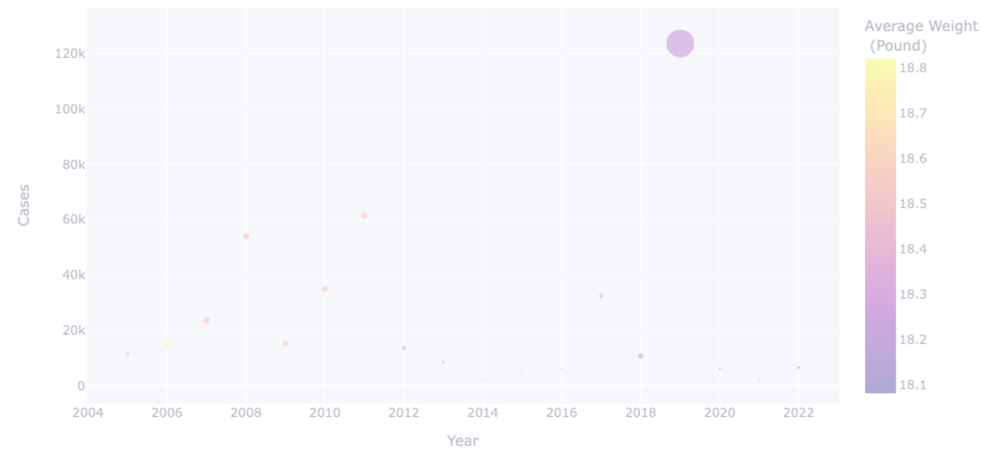
Small ruminant deaths due to diseases in Ethiopia



Data Source: WAHIS

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Objective

- This research investigates the macroeconomic impacts of PPR on the Ethiopian economy.
- We employ a computable general equilibrium model in tandem with animal health loss envelope (AHLE) estimates from the Global Burden of Animal Diseases (GBADs) compartmental livestock population model to simulate the economic impact of PPR in Ethiopia.
- This study is different than the existing literature in several aspects.
 - First, this study considers the fact that livestock life span is dictated by market forces and thus losses and costs arise in both the productivity and trade of animals and animal products along the value chain (Hennessy & Marsh, 2021).
 - Second, this study uses outputs from a compartmental livestock population model to calculate shocks in live animal production and simulate its impact on various sectors of the economy as well as regional and domestic trade effects.

Related Literature

- Existing studies focus on the investigation of the potential costs of the disease as well as the benefits of eradicating the disease.
- Lhermie et al., (2021) use a bioeconomic household production model to estimate income loss at the household level in sub-Saharan Africa, which ranged from 2 to 40% depending on the livestock income share of total annual household income.
- Jones et al. (2016) adopt a benefit-cost analysis and suggested strong economic returns from the global eradication of PPR with a benefit-cost ratio of 33.8 and an internal rate of return of 199%.
- Jemburu et al. (2022) estimate losses and costs with a fixed price.
- Kotchofa et al. (2021) use a macroeconomic model to determine the economic impact of PPR in Ethiopia and Burkina Faso with a hypothetical shock on the value of small ruminants.
- Countryman et al. (2023) simulate different scenarios for disease burden to understand the effects of improved animal health.

Economic Modeling Framework

- Computable General Equilibrium Model (GTAP)
- GTAP v11 database 2017 updated to 2022
 - Observed changes in population and real GDP
- 5 Regions
 - Country under consideration: Ethiopia
 - Major trade partners: Sub-Saharan Africa (SSA), North America, Middle East and North Africa (MENA)
 - Rest of the world
- 13 Sectors
 - Ruminant livestock & meat : Bovine cattle, sheep and goats, bovine meat products
 - Other livestock product and agriculture: Other livestock products, dairy products, plant, fiber and grains
 - Inputs to livestock sector: Cereal grains, crops, food products and pharmaceutical products
 - Other industries

Scenario Design

- The GBADs compartmental livestock population model compares two scenarios: disease-free small ruminants versus those impacted by PPR, highlighting differences in fertility, mortality, and carcass yield.
- In the PPR scenario, small ruminants experience increased mortality, while fertility and livestock conversion rates remain similar to the disease-free scenario.
- Shocks are derived from the dynamic population model outputs, using percentage change in output between the two scenarios and sector share-weighted methods to introduce these shocks in the live animal sector.
- The small ruminant industry share in the ruminant sector is calculated using data from the Food and Agricultural Organization (FAO) database.

Results

- The live ruminant sector is directly impacted by PPR with indirect effects on the ruminant meat industry as well as non-ruminant livestock industries.
- PPR disease free small ruminant sector of Ethiopia increases its live animal supply by 0.33% and meat supply by 0.06%.
- In the meat sector, output increase by 0.06% with a price decrease by 0.02%.

Sectors	Output (% Δ)	Price (% Δ)
Ruminant Live Animal	0.33	-1.98
Meat of Ruminant	0.06	-0.02
Other Livestock	0.07	-0.05
Feed	0.06	-0.02
Other Agriculture	0.11	-0.03
Health	0.03	0.01
Other Industries	0.03	0.02

Results

- Due to the increase in the domestic live animal supply, exports increase by 4.46%
- Imports drop by 3.56% in domestic live animal.
- In meat sector, exports increase by 0.1% and imports decrease by 0.03%.

Sectors	Exports (%Δ)	Imports (%Δ)
Live Animal	4.46	-3.56
Meat of Ruminant	0.10	-0.03
Other Livestock	0.28	-0.08
Feed	0.11	0.02
Other Agriculture	0.24	-0.06
Health	0.01	0.05
Other Industries	-0.04	0.08

Welfare Effects

- Equivalent Variation (EV) of Ethiopia increased by USD 59.37 million
- GDP of Ethiopia increased by USD 14 million.
- Total world EV increased by USD 60.33 million.

Regions	EV (Million USD)	GDP (Million USD)
Ethiopia	59.37	14
North America	0.06	-2
MENA	0.65	2
SSA	0.05	0
Rest of the World	0.20	1

Welfare Decomposition

- Technological change is the key driver for overall welfare effects in Ethiopia
 - Productivity change in the live ruminant animal sector in the model.
- Regional terms of trade and the change in savings cancel each other
- The positive change in welfare is attributed to the gain in allocative efficiency and technological change.

Regions	Allocative Efficiency	Technological Change	Terms of Trade	Savings and Investment	Total
Ethiopia	8.06	52.3	-0.312	-0.656	59.4
North America	0.257	0	-0.292	0.095	0.059
MENA	-0.019	0	0.675	-0.007	0.65
SSA	-0.005	0	0.054	0.002	0.05
Rest of the World	-0.24	0	-0.125	0.566	0.201
Total	8.06	52.3	0	0	60.3

Conclusion

- During an outbreak period from September 2017 to the end of January 2018 in northwest Ethiopia, losses for per affected animal were USD 13.4 for sheep and USD 12.9 for goat (Jemburu et al., 2022).
- Dynamic population model of GBADs estimates an approximate USD 50 million loss in morbidity and mortality due to PPR in the small ruminant livestock sector of Ethiopia.
- In this study, we employ a computable general equilibrium modeling framework to show that the economy wide welfare gain of PPR free small ruminant sector of Ethiopia is about USD 59 million.
- This contributes USD 14 million to the GDP of Ethiopia, which is 1.51% of the per capita GDP of Ethiopia at the year 2021
- PPR free small ruminant sector in Ethiopia increases global welfare by USD 60.30 million.

Limitations and Future Work

- We assume only Ethiopia has a disease-free state, but other countries do not.
- We use a global modeling framework, GTAP, for this analysis focusing on a single country.
- GTAP live ruminant sector includes both cattle and small ruminants.
- This study is intended to offer policymakers a baseline metric for the economy-wide effects of PPR.
- Future research is warranted to consider a more detailed sectoral breakdown of small ruminants in the modeling framework.

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Thank You

