Screwworms

Shizhuo Wang

August 2025

Abstract

I show how farmers amplify the benefits of disease control in agriculture by changing their production techniques. Specifically, I examine the eradication of the screwworm, a deadly livestock parasite, in the southwestern United States. Exploiting spatial variation in infestation, I find that livestock production increased by 60 percent in initially heavily infested counties relative to less infested ones. This increase was driven by feedlot adoption, as farmers shifted to a technology which had been unviable under disease pressure. I estimate that this adaptation accounted for more than four-fifths of the total output gain.

New York University, shizhuo.wang@nyu.edu. I thank Martin Rotemberg for his advice and guidance. I am grateful to Arielle Bernhardt, Rajeev Dehejia, William Easterly, James Fenske, Raquel Fernández, Eyal Frank, Jacob French, Florian Grosset-Touba, Richard Hornbeck, Jonathan Morduch, Minu Philip, Debraj Ray, Paul Scott, Claudia Steinwender, Sharon Traiberman, Anna Vitali, and Daniel Waldinger for helpful comments and discussions. All errors are my own.

1 Introduction

Interventions have direct effects, as well as indirect effects driven by economic agents' adjustments. In human populations, disease elimination improves health directly and raises outcomes such as education and income through people's endogenous responses (Miguel and Kremer, 2004; Bleakley, 2007). In agriculture, there is evidence that farmers adjust to changes in property rights, climate, and access to information (Hornbeck, 2010; Kantor and Whalley, 2019; Grosset-Touba, Papp and Taylor, 2024), but we know less about their responses to disease eradication. This intersection of disease and agriculture is important: diseases cause 9 percent of agricultural production losses in low- and middle-income countries, and the burden is worsening under climate change (FAO, 2015, 2021).

In this paper, I examine the impacts of the 1960s screwworm eradication, one of the largest and most successful pest control efforts in the history of modern agriculture. I find that the eradication increased livestock production in the southwestern United States, largely through the adoption of feedlot technology. The increase in production reflects both direct and indirect gains: direct gains stem from improved animal health in the absence of infection, while indirect gains arise from farmers' adaptation – specifically, adopting feedlot systems. I show that these indirect gains are responsible for more than four-fifths of the total increase in output. Most of the growth therefore reflects farmers' endogenous response to a disease-free environment, which made it feasible to adopt intensive production technologies that hold high animal density and are otherwise risky in the presence of disease.

Screwworms were once the most damaging livestock pest in the United States (USDA, 2000). The larvae of this insect caused livestock weight loss, reduced milk production, and even death. Without prompt treatment, infestations could spread rapidly to other animals. Direct losses from screwworm-related animal health conditions reached up to $100 million a year in the southwestern United States by the 1950s (Baumhover, Husman and Graham, 1966), around 11% of the region's total livestock production at the time.

Due to the heavy livestock health losses, in 1962 the U.S. government initiated a large-scale eradication campaign in Arizona, California, Louisiana, New Mexico, and Texas. I digitize historical maps for these states, which provide information on screwworm infestation levels prior to eradication for each county. The campaign sharply reduced disease prevalence, and screwworm populations subsequently fell to near zero across all counties. I exploit spatial variation in initial exposure to screwworms: counties with higher infestation had greater exposure to the intervention than those with lower levels. By comparing these two groups before and after eradication, I estimate the causal effect of eradication on livestock production using a difference-in-differences strategy (Bleakley, 2007; Frank and Sudarshan,

2024).

I show that heavily infested counties experienced an average 60% increase in the value of livestock products over the 25 years following eradication, relative to lightly infested counties. Since the animal health losses caused by screwworms were about 11% of the production, the direct benefits accounted for only 18% of the total gains from eradication. I show that the remainder is due to changes in production techniques.

Specifically, farmers endogenously adopted feedlot practices in response to improved health conditions. Feedlots are a type of production technology that houses animals at high densities. By reducing the disease risk associated with dense stocking, screwworm eradication enabled farmers to adapt their production techniques to support higher densities. I focus on this endogenous response and present evidence of a shift from traditional grazing toward more intensive feedlot practices. Two features characterize this transition: more efficient use of land and greater reliance on feed. This is because grazing requires large areas of pastureland, whereas feedlots confine animals in smaller spaces, support higher stocking density, and depend on purchased feed. I find that, following eradication, counties with heavier infestation experienced larger increases in livestock output per acre of farmland, which shows improved land use efficiency, and also increased their feed expenditures, which shows greater reliance on feed.

I examine whether screwworm eradication led to broader agricultural adjustments alongside the rise in feedlot practices, including changes in land use, crop production, farm inputs, and the distribution of farms. Compared to counties with low infestation, those with high pre-eradication screwworm levels show no differential change in farmland used for pasture, and also do not experience a differential shift from crop to livestock production. This is consistent with the interpretation that livestock growth was driven by feedlot adoption rather than expansion of traditional grazing, which depends on natural pastureland. In terms of farm inputs, heavily infested counties exhibit a relative increase in capital expenditures but not in labor, because feedlot operations require capital investments such as equipment and infrastructure. The farm size distribution also shifted: counties with higher infestation saw a greater rise in the number of large-scale farms, measured by sales, consistent with the scalability of feedlot systems.

The impacts of screwworm eradication on livestock production are larger in areas with geography favorable to feedlot practices and in areas with better transport access. Since feedlot adoption drives the rise in output, an area better suited to feedlot systems has an advantage in livestock production once disease is eliminated. I construct a measure of feedlot suitability using machine learning methods, and find that the effect of eradication is indeed larger in counties with above-median suitability, using a triple-differences approach. As a

placebo test, I show that counties with higher pasture suitability do not experience larger gains. I also consider transport access, an important factor in the movement of livestock. I show that counties with direct connections to the interstate highway system see larger effects.

My results are robust to multiple checks and alternative specifications, including different definitions of pre-eradication infestation and various control sets. Since my identification strategy relies on geographic variation in screwworm infestation, I account for other geographic factors that could influence local livestock production, such as latitude, longitude, temperature, and precipitation. I also construct an exogenous "screwworm suitability" measure based on how favorable a county's climate is for screwworm survival, in line with the use of suitability measures in studies like Alsan (2015) as well as Frank and Sudarshan (2024). Using this measure as the treatment variable, I find results that are qualitatively similar to the main estimates.

My work relates to the research on the crucial role of productivity in agricultural development. A large literature examines the economic and societal impacts of agricultural productivity growth, through the introduction of a field crop (Nunn and Qian, 2011), genetically engineered seeds (Bustos, Caprettini and Ponticelli, 2016), or high-yielding varieties (Gollin, Hansen and Wingender, 2021), as well as the potential declines in productivity caused by factors such as soil erosion (Hornbeck, 2012). In particular, much of the discussion on agricultural intensification has focused on crop-related technologies, like improved irrigation, fertilizer use, and tractors (Hornbeck and Keskin, 2014; Duflo, Kremer and Robinson, 2011; French, 2025). However, there has been little research on the livestock industry, which represents an increasingly larger share of consumption. Livestock farming introduces a factor not as relevant to crop intensification: the risk of disease spread due to high animal density. This is a unique challenge associated with animal agriculture. My study aims to fill the gap in the literature by exploring its implications for animal husbandry intensification.

Controlling pests is a key element of agricultural management, with broader implications for natural ecosystems and public health (Frank, 2024; Frank et al., 2024). My paper links pest control to technology adoption, building on the insight of Alsan (2015), who shows that the presence of the tsetse fly hindered African development by limiting the use of draft animals and, in turn, the adoption of complementary technologies such as the plow. Instead of performing a cross-sectional analysis as in Alsan (2015), I use panel data to track how farmers respond to changes in pest status over time. A related literature studies the introduction of pests, notably the arrival of the boll weevil in the American South, which led to large and persistent declines in cotton output and induced shifts toward other crops (Lange, Olmstead and Rhode, 2009). My results speak to the opposite case: pest eradication

can generate substantial gains, magnified by farmers' adaptive responses.

A large literature studies the barriers to technology adoption and diffusion (e.g., Hornbeck et al. 2024). In agriculture, despite widespread recognition of the potential for improved technologies to raise output, adoption rates remain low in many settings (Evenson and Gollin, 2003). To address this puzzle, studies have attempted to explore potential constraints and proposed policies to encourage uptake (Foster and Rosenzweig, 1995; Duflo, Kremer and Robinson, 2011; Suri, 2011; Burlig and Stevens, 2024). My paper identifies an additional mechanism, which argues that disease can inhibit adoption by increasing the risk and thus limiting the return to technology use. Pest control, in turn, can ease this constraint.

Higher livestock density serves as a useful analogy for human crowding, offering insights into addressing the spread of infectious diseases in human populations. Recent attention has highlighted the burden of such diseases as a barrier to economic development, emphasizing the need for collective action to establish and sustain environments free from infection as a vital public good (Miguel and Kremer, 2004; Bleakley, 2007). Increased density, whether in livestock or human populations, amplifies the risks of disease transmission. This issue becomes even more pronounced with urbanization, as the negative externalities associated with higher density – such as the spread of disease – pose serious challenges in cities (Glaeser, 2014; Frank and Sudarshan, 2024). Addressing these externalities is crucial to managing the public health risks linked to rising urban density (Alsan and Goldin, 2019). My study draws lessons from livestock management to provide parallels for tackling the challenges tied to urbanization.

The remainder of this paper is organized as follows. In the next section, I provide background information and describe screwworm eradication that serves as the natural experiment in this study. In Section 3, I detail the data sources and describe the data construction. Section 4 outlines the econometric approach and presents the specifications. Section 5 reports the results, including estimates of the impact of screwworm eradication on livestock production and intensification, along with a summary of robustness checks and alternative specifications. Section 6 concludes.

2 Background

2.1 Screwworms

The New World screwworm, *Cochliomyia hominivorax*, is a parasitic insect that threatens livestock health and productivity (Wyss, 2000). Its larvae cause screwworm myiasis by entering open wounds, where they grow and feed on living flesh, progressively enlarging the wound (Knipling, 1960; Novy, 1991). This condition leads to severe consequences for

affected livestock, including weight loss, reduced milk production, and, without treatment, death within seven to fourteen days (Spickler, 2015). Wounds as small as a tick bite can attract female screwworm flies to lay eggs. The eggs hatch into larvae that burrow into the wound, which makes early infestations difficult to detect (Knipling, 1960; Spickler, 2015). If infestations are not promptly recognized and treated, the larvae can mature into adult flies within ten days, continuing the cycle by introducing new parasites into the area and affecting other livestock (Hall, 1991; Spickler, 2015). Screwworm populations thrive in warm, wet weather, which provides ideal conditions for their reproduction and survival (Gutierrez and Ponti, 2014). Historically, the geographic distribution of screwworms spanned North, Central, and South America, as well as the Caribbean, making it a pervasive challenge in regions reliant on livestock (Hall, 1991).

Screwworms posed a serious challenge to livestock farmers in the United States, especially in the Southwest.[1] By the 1930s, farmers struggled to protect their herds, with screwworms becoming a particularly severe production-limiting pest for larger farms. Treating infested livestock was labor-intensive, requiring frequent inspections for wounds, immediate treatment – such as manually removing larvae – and often confinement to prevent the spread of infestation to healthy animals. Despite these efforts, screwworms caused 180,000 livestock deaths in 1935 across fewer than half of Texas counties (USDA, 2000). Animal deaths were just one aspect of the losses, which also involved pesticide expenses, additional labor, reduced animal value, and increased susceptibility to other diseases (Agricultural Research Service, 1959). By the 1950s, livestock producers in the Southwest faced annual losses estimated between $50 million and $100 million due to screwworm infestations (Baumhover, Husman and Graham, 1966).

2.2 Screwworm Eradication

The method developed to eradicate screwworms is known as the Sterile Insect Technique (SIT). It works by suppressing wild populations through the mass release of sterile males. Since females that mate with sterile males produce nonviable eggs, continued releases drive the population to collapse, conditional on the ability to rear and release sterile males at scale (Knipling, 1955). Prior to the invention of the SIT, screwworm infestations were managed with pesticide-based wound treatments. Chemical control required frequent and careful inspection of animals. This approach was costly and not always effective, as infestations were often severe by the time they were noticed.[2] Knipling (1955) proposed that a more

[1] Screwworms were endemic to the Southwest initially, but then spread to the Southeast in 1933 when producers shipped infested livestock there (USDA, 2000).

[2] Although not a major concern at the time, active ingredients in common wound treatments such as benzene and diphenylamine are toxic and environmentally harmful.

effective solution was to eliminate the screwworm population itself, and he developed and implemented the SIT together with other USDA scientists.

The screwworm eradication program using the SIT marked the first large-scale effort to use an insect species for its own eradication (Knipling, 1960). The approach has several features worth noting. First, the technique requires mass production of flies and laboratory sterilization using radiation. This eradication method must be coordinated by the government, as it is not accessible to individual farmers. Second, screwworms spread easily across animals and farms. One-time local elimination is insufficient, as reinfestation from nearby areas is almost certain. Continuous release can suppress local screwworm infestations, but doing so involves substantial costs. These characteristics make eradication a public good. The transmission mechanism creates externalities, which provides a natural justification for collective action to eradicate screwworms.

With support from federal and state governments and producer alliances, eradication in the Southwest began in 1962.[3] Screwworm populations declined rapidly after 1962, and the number of screwworm myiasis cases fell sharply by orders of magnitude (Bushland, 1985).[4] Subsequently in 1963, many livestock owners reported finding no screwworm-infested animals on their ranches for the first time in memory (Novy, 1991). In 1966, the U.S. was officially declared free of indigenous screwworms.[5] Note that despite large variation in infestation levels before the campaign, screwworm populations fell to zero or near-zero across all counties shortly after eradication.[6]

Following the successful eradication of screwworms in the U.S., the program expanded southward to guard against their return. Because of the characteristics of the SIT, preventing reinfestation requires a maintained barrier zone where continued release of sterile flies suppresses the spread of wild populations from endemic areas. As the eradication campaign extended through North and Central America, the barrier was pushed to Panama in 2006, where it has blocked screwworms from moving into eradicated areas for two decades and costs $15 million annually to maintain (USDA-APHIS, 2017).[7] These successful eradication

[3]Before the campaign in the Southwest, the USDA team implemented the SIT in the field on a smaller scale, first in Curaçao (1954-1955), and then in the Southeast (1958-1959), with a focus on Florida.

[4]Due to limited time and sterile flies, screwworms continued to breed in 1962, with 51,592 cases reported. As the eradication program expanded, cases dropped to 7,111 in 1963 and just 395 in 1964 (Novy, 1991).

[5]Between 1966 and 1982, there were still reported cases of screwworms that migrated from areas in Mexico where screwworms had not yet been eradicated. Cases were typically in much smaller numbers than before eradication, though 1972 saw a large outbreak. The last reported southwestern U.S. case was in 1982.

[6]For example, Val Verde County in Texas, previously heavily infested, reported 995 cases in 1962 and just 4 in 1964. Jefferson County, previously lightly infested, reported 30 cases in 1962 and none in 1964 (Agricultural Research Service, 1959; USDA, 2000).

[7]The risk of screwworm outbreaks in previously eradicated regions has recently increased. There has been a surge in reported cases in Central America and Mexico since 2023 (USDA-APHIS, 2025).

efforts have also encouraged countries in South America to begin developing a coordinated sub-regional plan to eliminate screwworms further south (IAEA, 2020).

2.3 Feedlots as Intensification Technology

Livestock production in the United States expanded substantially between the end of World War II and the 1980s. In 1945, the total value of livestock output was approximately $8.6 billion (or $54 billion in 1987 dollars). By 1987, this number had risen to $77 billion, an increase of 43 percent over four decades. This growth was accompanied by a rise in the intensification level of livestock farming.

Agricultural intensification, defined as increasing output per unit of input, plays a central role in raising production from a given area of land. In livestock production, one common form of intensification is feedlot practices, where animals are raised at high densities on limited land. In the United States, the use of feedlots can be traced back to the early nineteenth century. The modern livestock feeding industry emerged in the 1920s and expanded rapidly after World War II (Mintert, 2003).

Feedlots are a land-efficient production technology. By concentrating animals in confined areas, they achieve much higher output per acre of land than grazing, the traditional extensive animal raising method, which relies primarily on natural resources such as pastureland. The standard land input for grazing is about two acres per animal (USDA, 2018). In contrast, feedlots operate at densities of roughly 100 head of cattle per acre (Boyer et al., 2017; USDA, 2013) and therefore require much less land to raise the same number of animals.

The primary inputs for feedlot practices and traditional grazing are different. In feedlots, cattle are fed with purchased feed, which makes feed the central and most necessary input. Grazing, on the other hand, depends on access to large areas of pastureland. The availability and quality of natural pasture are the main factors determining the viability of grazing systems. Feedlots also require capital investment, including buildings, equipment, and machinery. Grazing does not require the same capital outlays but still relies on labor to manage the herd. Because feedlots benefit from economies of scale, they are more conducive to large-scale operations with higher output and revenue.

Despite their potential for high output, feedlots carry greater risk of disease transmission due to the high density of animals. As the major livestock pests, screwworms posed a particular threat to these operations because infestations could spread quickly across animals in close quarters. Figure 1 shows average feedlot use over time for western states with high and low levels of screwworm infestation.[8] States with high infestation experienced greater

[8]I digitized data on the number of cattle in feedlots for available states from Cattle on Feed reports published by the USDA between 1945 and 1982 at `https://www.nass.usda.gov/Surveys/Guide_to_NASS_`

exposure to the eradication campaign, while those with low infestation had little exposure. In the post-World War II period through 1960, feedlot use was consistently lower in high-exposure states. After the eradication in 1962, these states began to close the gap and reached levels comparable to those in low-exposure states in the 1970s.

Screwworm eradication lowered disease risk among livestock and made higher stocking densities feasible, which increased the potential gains from adopting intensive feedlot technologies. In response, farmers began adapting their production methods gradually by transitioning from extensive grazing toward intensive feedlot practices. This endogenous response of farmers contributed to further growth in livestock output, over and above the immediate health improvements from eradication, such as reduced mortality and improved animal productivity.

3 Data

3.1 Pre-Eradication Screwworm Infestation Levels

My main sample consists of counties in five states in the southwest: Arizona, California, Louisiana, New Mexico, and Texas. These states were among those with the most serious screwworm problems and were central to the implementation of the eradication campaign. They also represent a sizable part of U.S. livestock production. Their share of national output was 11 percent in the 1940s and rose to 18 percent by the 1980s. Most importantly for my study, these are the states for which county-level data on screwworm infestation levels are available.

In 1959, the United States Department of Agriculture (USDA) conducted a survey to determine the level of average screwworm infestations for each county of the five states. They collected the survey data through interviews with County Agricultural Agents, local veterinarians, and stockmen in each county (Agricultural Research Service, 1959). The survey aimed to provide a general overview of the screwworm problem and an initial assessment of the scope of a potential eradication program. The survey report classifies infestation levels as heavy, medium, light, occasional, or none. I digitized these data on screwworm infesta-

`Surveys/Cattle_On_Feed/`. These cattle are primarily raised for beef production. I also obtained data on the number of beef cows from the USDA Quick Stats database at `https://www.nass.usda.gov/Quick_Stats/`. I construct the measure of feedlot use by dividing the number of cattle on feed by the number of beef cows. Since screwworm infestation was more severe in the south, here I assume that all southwestern states had high infestation levels and all northwestern states low levels. In my main analysis, I exploit county-level screwworm infestation levels determined by the USDA, as described in Section 3. Specifically, in Figure 1, the high-infestation states are Arizona, California, Colorado, Kansas, Missouri, New Mexico, Nevada, Oklahoma, Texas, and Utah, and the low-infestation states are Idaho, Iowa, Minnesota, Montana, North Dakota, Nebraska, Oregon, South Dakota, Washington, and Wyoming.

tion levels, and map them in Figure 2 using 1950 county boundaries (Manson et al., 2023).[9] There is large geographic variation, with more severe infestations concentrated in southern California, southern Arizona, and Texas. I leverage this variation as my treatment variable, using infestation levels as a measure of exposure to the subsequent eradication program.

The eradication campaign represents a common shock to all counties in the five states of my main sample, while variation in pre-eradication infestation levels allows for the assignment of counties into treated and control groups. Eradication is more relevant to counties with heavier pre-eradication infestations, which serve as the treated group, and less relevant to counties with less heavy pre-eradication infestations, which serve as the control group. In the main analysis, I classify medium to heavy infestation levels as treated, and I show robustness by using alternative treatment definitions.

The report by Agricultural Research Service (1959) also contains data on the density of screwworm hosts, defined as wild and domestic animals per square mile, for each county. I digitized this information as well and control for it in additional checks, since one concern is that population density of hosts susceptible to screwworms may influence the relative abundance of the insect.

As a robustness check, I construct measures of screwworm suitability based on temperature as alternative treatment variables. Following the model in Gutierrez and Ponti (2014), I compute screwworm development rates, mortality rates, and their difference. Appendix A provides further details.

3.2 Census of Agriculture

I examine the impact of screwworm eradication on livestock production and other agricultural outcomes using data from the United States Censuses of Agriculture, conducted every five years (Haines et al., 2010; Haines, Fishback and Rhode, 2018). My sample period spans 1945 to 1987. Key outcome variables include the value of farm products sold, farm expenditures, farmland use and acreage, and the number of farms. The empirical analysis focuses on a balanced panel of 378 counties with livestock production data available for every period. In robustness checks, I also use the full unbalanced panel of all 422 counties, and this does not substantively affect the results.[10]

The primary outcome of interest is livestock production, measured using the value of livestock products reported in the Census of Agriculture. Because direct data on feedlot use

[9]There are occasional changes in county boundaries between the 1950s and 1980s. Combining affected counties, adjusting outcome data, or excluding them has little effect on the results.

[10]Much of the missing data arises because the Census suppresses publication of data that could reveal information about individual operations – for example, when only one producer exists for a given commodity in a county. I also impute missing values as zero and the results remain robust.

are not available at the county level, I construct two proxies to capture feedlot practices.[11] First, since intensification technologies such as feedlots increase land-use efficiency, I divide livestock production by total farmland area to measure the intensity of land use. For supplementary analysis, I directly evaluate changes in farmland area, and also calculate cattle density as the number of cattle per acre of farmland. Second, because feed is an essential input for feedlots but not for traditional grazing, I compute the ratio of farm feed expenses to the number of cattle to capture feed intensity.

Livestock production and feedlot practices have implications for other agricultural outcomes. I use a range of variables from the Census of Agriculture to examine the effects of screwworm eradication on these outcomes. First, to study land used for pasture, I use data on the total area of pastureland in farms. I also compute the share of farmland used as pasture by dividing pasture area by total farmland. This allows me to test whether pasture use, associated with grazing, increases after eradication. For robustness, I also use additional data on specific types of farmland devoted to pasture. Second, to assess potential effects on crop production, I use two measures: the value of all crops sold and the total area of harvested cropland. These help test whether livestock production crowds out crop cultivation. At the same time, certain crop types closely tied to feedlot operations may benefit from more intensive livestock production. To evaluate this, I examine harvested acreage for two types of corn: corn for silage, which is used exclusively as animal feed, and corn for grain.[12]

Third, as feedlots require more capital investment than traditional grazing, I use data on farm expenditures for capital and labor to examine changes in farm inputs. Fourth, since feedlots are more likely to scale into larger operations, I use data on the number of farms by sales category to assess changes in farm size distribution. The Census reports the total number of farms along with counts by sales brackets. I classify small farms as those with sales below $1,000, medium farms as those with sales between $1,000 and $10,000, and large farms as those with sales above $10,000.[13] An alternative way to classify farm size is based on farm area. Because feedlots use land more efficiently, they do not necessarily require large acreage. As an additional check, I examine whether the distribution of farms by area changes. I define small farms as those with less than 100 acres, medium farms as those with 100 to 500 acres, and large farms as those with more than 500 acres.

[11] Data on cattle in feedlots used to construct Figure 1 are only available at the state level.

[12] Silage is fodder made from green foliage crops preserved through fermentation using the entire green plant.

[13] These cutoffs are consistently reported across Census years.

3.3 Additional Data

Geographic location and climate conditions can influence livestock production, with effects that may vary across time even within the same county. To account for this, I include pre-eradication county characteristics interacted with year fixed effects in some specifications to capture differential time trends. I obtain location data from the National Historical Geographic Information System (Manson et al., 2023), and measure county longitude and latitude using 1950 county centroids. County-level climate and topographic data come from the USDA Forest Service, which include monthly total precipitation, monthly mean daily temperature, and mean grid elevation (Coulson and Joyce, 2010). I use 1950–1959 averages of precipitation, elevation, and both the mean and variance of temperature as baseline climate controls in the analysis.

In addition to controlling for geographic factors when estimating the effects of screwworm eradication on livestock production, I also test whether these effects are larger in areas with conditions more favorable to feedlot practices. Environmental conditions such as temperature and humidity can influence the viability of feedlots, but the relationships are often nontrivial (EPA, 2012; Mader, Davis and Brown-Brandl, 2006). For example, while feedlots require access to water, excessive humidity can exacerbate heat stress in feedlot cattle. To capture feedlot suitability, I construct a machine learning prediction of feed intensity for each county based on geographic characteristics. The idea is that, in the absence of screwworm infestation, higher feed intensity reflects greater suitability for feedlot operations. To implement this, I focus on states where screwworms were never a significant concern – specifically, the low-infestation states shown in Figure 1. I train a machine learning model using data from counties in those states, with 1950 feed intensity as the outcome and geographic variables as predictors. I then apply the model to counties in my sample of five states to generate predicted feed intensity values. Finally, I define a binary indicator for high feedlot suitability equal to one if a county's predicted value is above the median.

Beyond geographic conditions, livestock production in a county also depends on its ability to transport animals to external markets. In the mid-20th century, trucks rapidly replaced railroads and became the dominant mode of livestock transportation (Skaggs, 1986). To test whether the effects of screwworm eradication are larger in areas with better transport access, I examine counties connected to the interstate highway system. I use the PR-511 database from Baum-Snow (2007), which reports interstate highway miles by county and year from 1950 to 1990.[14] I define a county as having highway access if it recorded positive mileage

[14]Most of the highway construction followed the national plan developed by the Interregional Highway Committee in 1947 (Baum-Snow, 2007), and is therefore unlikely to be endogenous to screwworm eradication or subsequent livestock production growth.

during my sample period.

If growth in livestock production is driven by increased adoption of feedlot technology rather than the expansion of grazing, then having a natural advantage in pasture may not contribute to higher production. I use pasture suitability data from FAO (2007) to compute an average suitability index for each county and classify a county as pasture-suitable if its index is above the median. As an alternative measure of pasture advantage, I also use the share of pastureland in farms in 1945, defining counties above the median as having high baseline pasture use.[15]

4 Empirical Specification

I use a difference-in-differences strategy to estimate the impact of screwworm eradication on agricultural outcomes. The 1962 eradication campaign in the southwestern United States serves as a shock that led to a sharp decline in screwworm prevalence, approaching zero across all counties. Using pre-eradication infestation levels, I compare counties with historically heavy infestations to those with lighter infestations, before and after the onset of eradication. I estimate the average effect of screwworm eradication using the following regression:

$$Outcome_{ct} = \beta\, Infestation_c \times Eradication_t + \gamma_c + \delta_{st} + \theta_t \mathbf{X}_c + \epsilon_{ct}. \tag{1}$$

Here, $Outcome_{ct}$ represents the outcome variables for county c in year t, such as value of livestock products. $Infestation_c$ is a dummy variable that equals one for counties with medium to heavy screwworm infestation, and zero otherwise. $Eradication_t$ is an indicator that is equal to one from 1962 onward, the year when the eradication campaign initiated in the southwestern U.S. γ_c and δ_{st} are county fixed effects and state-by-year fixed effects (which absorb year fixed effects), respectively. $\mathbf{X}_c$ are county characteristics, including a cubic polynomial of longitude and latitude, as well as climate controls including average temperature and precipitation for each county. I interact these county characteristics with year fixed effects. ϵ_{ct} is the error term.

β is my coefficient of interest, capturing the average treatment effect on livestock production after eradication. To account for growth along both extensive and intensive margins, I estimate Poisson Pseudo Maximum Likelihood (PPML) regressions (Silva and Tenreyro, 2006) when the outcome variable is a value or count.[16] PPML is my preferred estimation,

[15] The share of pastureland remains relatively stable throughout my sample period and does not change differentially between heavily and lightly infested counties. I use 1945 data to avoid potential contamination from later adaptations in land use for pasture, which, as the data indicate, were minimal.

[16] Formally, the specification is $\mathbb{E}[Outcome_{ct}] = \exp\left(\beta\, Infestation_c \times Eradication_t + \gamma_c + \delta_{st} + \theta_t \mathbf{X}_c\right)$ for the PPML model, and $\exp(\hat{\beta}) - 1$ is the estimated percentage change in the expected outcome due to

as it avoids the interpretive challenges that arise with transformations such as $\log(1+Y)$, which are sensitive to the units of the outcome (Chen and Roth, 2023). For robustness, I also report estimates using Ordinary least squares (OLS) with log-transformed outcomes.

To isolate residual variation unexplained by time-invariant county characteristics or common time trends, I include county fixed effects and year fixed effects. County fixed effects account for persistent differences across counties, such as land availability for pasture, historical agricultural practices, and geographic conditions that could contribute to suitability for livestock production. Year fixed effects account for shocks that are common across all counties, such as federal agricultural policies. I also control for time trends using state-by-year fixed effects, which absorb common shocks and policy changes at the state level. This allows for comparisons between counties with heavy and low infestation levels within the same state. I will show that my results remain robust to controlling for state fixed effects.

A potential concern is that the same county-specific characteristics that determined the initial presence of screwworm might have also led to different growth rates in livestock production across counties. To address this, I control for differences in potential time trends based on observables. These include geographic location, which I account for by including a polynomial of latitude and longitude, as well as climate, which I control for using temperature and precipitation. This helps mitigate concerns that, for example, heavily infested counties may have had climate conditions more suitable for livestock production, with this advantage growing over time. I will show that my results are not sensitive to the inclusion of these various time trends.

The error term ϵ_{ct} captures any unobserved variation. I report standard errors clustered by county to account for correlation in ϵ_{ct} over time and within counties. I also compute Conley (1999) standard errors that adjust for spatial correlation across counties as a robustness check.

The key identifying assumption of my empirical design is that, absent screwworm eradication, livestock production trends in heavily and lightly infested counties would have followed parallel trajectories over time. To test this assumption, I estimate the following regression specification using an event-study approach:

$$Outcome_{ct} = \sum_{\tau \neq 1959} \beta_\tau \, Infestation_c \times \mathbb{1}\{t = \tau\} + \gamma_c + \delta_{st} + \theta_t \mathbf{X}_c + \epsilon_{ct}. \tag{2}$$

This specification is similar to equation (1), but instead of using a dummy variable indicating post eradication, I interact the treatment variable $Infestation_c$ with year dummies, with 1959 as the baseline year. The year-by-year coefficients on the interaction terms, β_τ,

eradication.

capture the dynamic response of the outcome variables, such as value of livestock sold, to screwworm eradication. Each coefficient measures the difference in livestock production between high- and low-infestation counties in a given year, before and after eradication. The year 1959, the final pre-treatment period, is omitted and serves as the reference year, so its coefficient is normalized to zero. Under the identifying assumption of parallel trends, we should expect to see no systematic differences between the two groups of counties prior to 1962, the year when the screwworm eradication campaign bagan. If eradication increases livestock production, the coefficients should diverge from zero after 1962, with potential further divergence over time as farmers adjust, expand production, and adopt more intensive farming practices.

The mechanisms through which screwworm eradication affects livestock production point to the adoption of feedlot practices, which makes the suitability of the local environment for feedlots a key factor. To examine whether the effects of eradication vary with local conditions, I run the specification below using a triple-differences approach.

$$\begin{aligned} Outcome_{ct} = &\beta_1 \, Infestation_c \times Eradication_t \times FeedlotSuitable_c \\ &+ \beta \, Infestation_c \times Eradication_t + \gamma_c + \delta_{st} + \theta_t \mathbf{X}_c + \epsilon_{ct}. \end{aligned} \tag{3}$$

Here, I include a triple interaction term involving $FeedlotSuitable_c$, an indicator equal to one if county c's predicted feedlot suitability – based on geographic characteristics and generated by the machine learning model – is above the median. The coefficient on the triple interaction term, β_1, represents how much larger the effect of screwworm eradication is in feedlot-suitable counties compared to less-suitable counties.

Another relevant dimension of heterogeneity is access to transport infrastructure, which is critical for moving livestock. To explore differential effects between counties with relatively high and low levels of transport access, I estimate an alternative version of equation (3) in which I replace $FeedlotSuitable_c$ with $HighwayAccess_c$, a dummy equal to one if county c is connected to the interstate highway system during my sample period.

Similarly, to test for heterogeneous effects related to natural advantages for pasture, I include a triple interaction term using either $PastureSuitable_c$ or $HighPastureShare_c$. The former is an indicator for whether county c has an above-median pasture suitability index, and the latter indicates whether county c has an above-median baseline share of farmland in pasture.

5 Results

In this section, I present the main findings from the difference-in-differences estimation, showing that livestock production increased by more than 50 percent following screwworm eradication. I then provide evidence that this growth was driven by increased adoption of feedlot practices. Next, I examine the implications of expanded feedlot use for other agricultural outcomes. I also report heterogeneity in effects of eradication from the triple-differences estimation. Additionally, I show that my results are robust to alternative specifications and definitions of treatment.

Note that my identifying assumptions do not require high- and low-infestation counties to be balanced at baseline. Nonetheless, it is informative to compare the two. Table 1 reports baseline values of outcome variables and a set of additional covariates for each group. On average, high-infestation counties exhibited more farm activity at baseline, though some differences are modest. In terms of climate, high-infestation counties were warmer and drier. Since these conditions may affect livestock production, I present results that allow for differential effects of temperature and precipitation.

5.1 Livestock Production

I first show that livestock production increased more in counties with heavier pre-eradication screwworm infestations. Figure 3 presents the event-study estimates from equation (2), showing no evidence of pre-trends. Counties with high and low screwworm infestations did not have systematically different trends in livestock production between 1945 and 1954, relative to 1959. This justifies the parallel trends assumption.

After eradication began in 1962, I find that the value of livestock products increased in counties with higher pre-eradication infestation levels. In 1964, the first post-eradication year in my data, livestock production was 25% higher in these counties compared to those with lower infestation levels.[17] In the 1980s, this difference had grown to approximately 80%.

I next turn to the aggregate specifications in equation (1). Table 2 presents these results using different time trends and fixed effects. Instead of year-by-year coefficients from the event study, these specifications aggregate the effect into a single post-eradication indicator for years after 1962. Column 1 reports estimates from a model with only county fixed effects and year fixed effects, which account for county-specific factors that may influence livestock production, including regional and national macroeconomic conditions. On average, the

[17] The estimate in 1964 is 0.22. Since I use PPML, this estimate implies an increase of 25% ($e^{1+0.22} - 1 = 0.25$) in the outcome. For all PPML estimates reported in the remainder of the paper, I convert the coefficients using $\exp(\hat{\beta}) - 1$ to express them as percentage changes in the outcome.

value of livestock products is 53% higher in high-infestation counties.

A potential concern is that county-specific characteristics may have differential effects on livestock production over time, which are not fully accounted for by county and year fixed effects. These factors include geographic conditions or state-level policies. To address this, columns 2-4 in Table 2 present estimates with additional controls, showing that the results remain robust to the baseline specification in column 1, with similar magnitudes. Column 2 includes latitude and longitude interacted with year fixed effects, while column 3 further adds state-by-year fixed effects, yielding a 60% increase in livestock production. Column 4 further incorporates temperature and precipitation interacted with year fixed effects to capture time-varying geographic influences not accounted for by location, producing an estimate of 56%. In the remainder of the paper, I report results using specifications from both columns 3 and 4 whenever possible to estimate the effects of eradication on different outcome variables.

I also estimate OLS specifications using the logarithm of livestock production as the outcome variable, and report results in Appendix Table A.1. The estimates range from 0.32 to 0.42 across specifications. In Appendix Table A.2, I report Conley (1999) standard errors, which adjust for spatial correlation under the assumption that counties are independent beyond a specified distance cutoff. The Conley standard errors are relatively stable across distance cutoffs of 100 km, 200 km, 500 km, and 1000 km, and are slightly smaller than standard errors clustered at the county level.

In the 1950s, total livestock production for the five states in my sample was approximately $900 million per year. At the time, estimated annual losses from screwworm infestations ranged from $50 to $100 million (Baumhover, Husman and Graham, 1966). This implies that the direct health gains from eradication, through reduced mortality and improved animal health, amounted to between 5 and 11 percent of annual production. My estimates show that eradication raised livestock output by roughly 60 percent. These numbers suggest that health improvements explain less than one-fifth of the total gains. The bulk of the effect appears to reflect farmers' endogenous response, which I discuss next.

5.2 Intensification through Feedlots: Land Efficiency and Feed Intensity

I now examine whether screwworm eradication led to increased adoption of feedlot practices. While the previous results show a rise in total livestock production, this increase could reflect either an expansion of traditional grazing or the adoption of feedlot technologies. Because direct county-level data on feedlot use are unavailable, I proxy feedlot adoption with two features that distinguish feedlots from grazing systems: more efficient land use, reflected in higher production per acre of farmland, and greater feed intensity, measured by increased feed expenditures.

First, if the increase in livestock production is driven by the adoption of feedlots – a more intensive production technology – then we would expect to observe higher livestock output per unit of land. Columns 1 and 2 of Table 3 support this prediction by showing estimates of per-acre production, without and with geographic controls. I find in column 1 that screwworm eradication increased livestock output per acre of farmland by 53 percent in heavily infested counties relative to those with light infestation. The magnitude of this per-acre effect closely matches the range of estimates for total production reported in Table 2, which implies that there was no differential change in farmland area between the two groups following eradication. I present this null result for farmland in Appendix Table A.3. In addition, Appendix Table A.4 shows that both total cattle population and cattle per acre increased more in counties with higher levels of pre-eradication infestation. These findings are consistent with the idea that feedlots, which operate at higher stocking densities, were less viable when screwworm risk was high. After eradication, the increased feasibility of feedlot adoption led to higher livestock output on a given amount of land.

Second, feedlot practices depend heavily on purchased feed, unlike grazing, which relies on wild vegetation. As a result, increased feedlot use should be reflected in higher feed expenditures per animal. I test feed use intensity in columns 3 and 4 of Table 3, which report estimates for the ratio of farm feed expenses to cattle population. Column 3 shows that, following eradication, counties with higher pre-eradication screwworm infestations experienced a 36 percent increase in feed use intensity relative to counties with lower infestation levels. This result remains robust to the inclusion of geographic controls in column 4. Together with the evidence on land-use efficiency, the increase in feed intensity supports the interpretation that farmers shifted toward more intensive feedlot practices after eradication.

5.3 Broader Agricultural Adjustments

Screwworm eradication increased the adoption of feedlot technology, which could have impacts on agricultural outcomes beyond livestock production. I next examine how land use, crop production, farm input, and the distribution of farms evolved following eradication.

Pastureland is a critical input for grazing but not for feedlot operations. The fact that increased feedlot use drove livestock growth implies that screwworm eradication should have little effect on pastureland. In Table 4, I test whether farmland used for pasture changed differentially between heavily and lightly infested counties following eradication. The outcome in columns 1 and 2 is total pastureland area, and in columns 3 and 4, the share of pastureland in total farmland. Across all four regressions, the estimated effects are small and imprecise. I further confirm this null result by examining the share of specific land types, woodland and cropland, used for pasture in Appendix Table A.5, which similarly shows no

meaningful change. These findings suggest that farmland allocated to pasture did not shift following eradication, since feedlot adoption rather than grazing expansion was the primary driver of increased livestock production.

Changes in land use may also appear through effects on crop production. If grazing expansion contributed to the rise in livestock production, it could have displaced crop farming by competing for land. However, since the evidence points to feedlot adoption as the main driver and pastureland did not expand, we should expect no negative effect of screwworm eradication on crop production. I present this result in Table 5. Columns 1 and 2 show estimates for the value of crop production. Unlike the findings for livestock, the estimates here are small and statistically insignificant, showing no differential effect on crop output between heavily and lightly infested counties. Consistent with this, columns 3 and 4 show that there was little impact on harvested cropland area. Therefore, screwworm eradication did not lead to pasture expansion at the expense of cropland. Appendix Table A.6 shows that acres of corn harvested for silage increased substantially following eradication, while corn harvested for grain did not.

Besides land and feed, feedlot-based and grazing-based livestock systems also differ in their use of other farm inputs. Feedlots tend to require greater investment in implements and machinery, so they are more capital intensive, whereas traditional grazing relies more heavily on labor. I examine capital and labor inputs in Table 6. Columns 1 and 2 show that after eradication, counties with higher pre-eradication screwworm infestations invested around 25 percent more in capital inputs than counties with lower infestations. In contrast, columns 3 and 4 report small and statistically insignificant effects on labor expenses.

Feedlots scale readily to larger operations, owing to their efficient use of land, high capital intensity, and low reliance on labor. An expansion of feedlot practices following eradication would suggest the emergence of farms producing at a larger scale. I examine the change in the distribution of farms by estimating equation (1) using the number of farms with small, medium, or large sales as the outcome. Table 7 presents the results. Column 1 shows that screwworm eradication led to limited increase in the total number of farms. Columns 2 and 3 report estimates for farms with small and medium sales; both are close to zero and imprecisely estimated. In contrast, column 4 shows a 32 percent increase in the number of farms with large sales in heavily infested counties relative to those with lighter infestations. These findings suggest that screwworm eradication shifted the farm size distribution by increasing the number of farms with large sales. Appendix Table A.7 confirms that the results still hold when including geographic controls. A similar analysis using categories based on farm acreage, rather than sales, shows no comparable effect on the number of farms with large land area (Appendix Table A.8). This is consistent with the idea that

feedlots do not require large tracts of land to sustain high levels of output.

Finally, since the distribution of farms can shape the distribution of farm income, I exploit individual-level farm income data from Ruggles et al. (2025) to provide evidence that incomes rose for medium- and high-income farmers in high-infestation counties after eradication, while incomes for low-income farmers remained comparable to those in low-infestation areas (see Appendix B for details).

5.4 Heterogeneity in Effects of Screwworm Eradication

Next, I turn to the role of geographic and transport conditions in shaping the response of livestock production to screwworm eradication. In Table 8, I report estimates from the triple-differences specification in equation (3). Columns 1 and 2 show that, following eradication, counties with high screwworm infestation that also have geographic conditions suitable for feedlot practices experienced larger increases in livestock production, relative to counties with lower feedlot suitability. Columns 3 and 4 report similar patterns for highway access: counties with high infestation and direct connection to interstate highways saw larger gains than counties without such access. These results suggest that favorable environmental conditions and transport connectivity supported the adoption of feedlot practices and contributed to the observed growth in livestock output.

I also test whether natural advantages for pasture contributed to livestock production growth. Appendix Table A.9 presents the results. The negative and imprecise estimates show that there were no differentially larger gains for counties with higher pasture suitability or higher baseline pastureland share. If grazing expansion drove the rise in livestock output, we would expect stronger effects in areas better suited for pasture. These results instead support the interpretation that feedlot adoption played the central role, as livestock production increased more in counties favorable to feedlots, but not in those favorable to grazing.

5.5 Additional Checks

I evaluate the robustness of the main results through several tests. First, while my main analysis uses a balanced sample of counties, I show that the results remain consistent when using the full unbalanced sample (Appendix Table A.10) or when imputing missing values as zero (Appendix Table A.11). Second, I verify that dropping one state at a time does not substantially alter the results, which implies that no single state drives my findings (Appendix Table A.12). Third, I include two additional controls – the density of potential screwworm hosts and baseline livestock production – interacted with year fixed effects, to further account for time trends (Appendix Table A.13). One concern is that screwworm

prevalence may correlate with livestock population, so heavy infestation could reflect more livestock activity. To address this, I include the additional controls and find that my results remain robust.

My main analysis focuses on five southwestern states due to data limitations on county-level screwworm infestation levels before eradication. However, northern neighboring states also experienced screwworm infestations, though typically at lower levels (Agricultural Research Service, 1959). I expand my sample to include seven additional states: Kansas, Missouri, Arkansas, Oklahoma, Colorado, Nevada, and Utah, assuming that all counties in these states had light or lower infestation levels and thus belong in the control group. Reestimating equation (1) with this expanded sample, I continue to find positive and significant effects of screwworm eradication on livestock production (Appendix Table A.14). The estimated coefficients are smaller than in my main results, which is expected. Since I classify all counties in these additional states as part of the control group, some may actually have high pre-eradication infestation levels, leading to misclassification. This would bias the estimates downward, making them a lower bound of the true effect of screwworm eradication.

I also examine whether alternative methods of identifying treatment status affect my results using three approaches. First, instead of classifying counties with "light" infestation levels as part of the control group, I designate them as treated. As shown in Appendix Table A.15, this reclassification does not change my main findings. Second, I include multiple infestation levels in the same regression to allow the intensity of treatment to vary, and I show in Appendix Table A.16 that the effect of eradication is larger in counties with heavier infestation levels. Third, I construct a measure of screwworm suitability based on geographic conditions favorable to screwworm survival (Gutierrez and Ponti, 2014). Appendix Figure A.1 presents a map of the suitability index. I reestimate equation (1) using this measure as the treatment variable. Appendix Table A.17 shows that eradication increased livestock production more in counties more suitable for screwworm survival, so my main results remain qualitatively consistent.

6 Conclusion

In this paper, I examine how disease elimination can raise livestock production by enabling farmers to adopt feedlot technologies. Using a difference-in-differences strategy, I compare counties with heavy and light pre-eradication screwworm infestations, before and after the eradication campaign, in the southwestern United States. I find that counties with heavier infestations – those more exposed to the shock of disease elimination – saw a 60 percent increase in livestock production on average over the 25 years following eradication. I further

provide evidence that this growth was driven by a shift toward intensive feedlot practices.

Screwworm eradication is an ongoing battle. Since 2023, several outbreaks have occurred in regions where the pest had previously been eliminated. In response, the USDA has committed $109.8 million to contain the outbreak, with the goal of eradicating screwworms in Central America and Mexico and restoring the barrier zone in Panama (USDA-APHIS, 2025). In addition, screwworms are still prevalent in parts of South America and the Caribbean. As control efforts move forward, it is important to consider the potential indirect gains from farmers' endogenous responses when evaluating the full benefits of disease eradication programs.

Agricultural intensification is a key pathway for meeting rising global food demand, particularly the persistent growth in demand for animal products (OECD/FAO, 2024). Yet the development of intensive livestock systems remains limited in many low- and middle-income countries (Lam et al., 2016). These regions often face constraints in both technology adoption and disease control. My findings suggest that disease eradication could generate sizable gains in such settings, beyond the direct benefits to animal health. Furthermore, while not the focus of this paper, intensive systems such as feedlots may also help reduce deforestation pressures by limiting the land needed for pasture, an especially relevant concern in areas where extensive grazing contributes to forest loss (Scott et al., 2024).

References

Agricultural Research Service, U.S. Dept. of Agriculture. 1959. "Report, the screwworm problem in the southwestern United States and northeastern Mexico, with comments on control and eradication."

Alsan, Marcella. 2015. "The Effect of the TseTse Fly on African Development." *American Economic Review*, 105(1): 382–410.

Alsan, Marcella, and Claudia Goldin. 2019. "Watersheds in Child Mortality: The Role of Effective Water and Sewerage Infrastructure, 1880–1920." *Journal of Political Economy*, 127(2): 586–638.

Baumhover, Alfred H., Chester N. Husman, and Andrew J. Graham. 1966. "Screwworms." In *Insect Colonization and Mass Production.* , ed. Carroll N. Smith, 533–554. New York, NY, USA:Academic Press.

Baum-Snow, Nathaniel. 2007. "Did Highways Cause Suburbanization?" *The Quarterly Journal of Economics*, 122(2): 775–805.

Bleakley, Hoyt. 2007. "Disease and Development: Evidence from Hookworm Eradication in the American South." *The Quarterly Journal of Economics*, 122(1): 73–117.

Boyer, W., J. Davidson, H. George, R. Graber, J. P. Murphy, and J. Harner. 2017. "Guidelines for Planning Cattle Feedlots." Kansas State University Agricultural Experiment Station and Cooperative Extension Service.

Burlig, Fiona, and Andrew W. Stevens. 2024. "Social networks and technology adoption: Evidence from church mergers in the U.S. Midwest." *American Journal of Agricultural Economics*, 106(3): 1141–1166.

Bushland, R. C. 1985. "Eradication Program in the Southwestern United States." In *Symposium on Eradication of the Screwworm from the United States and Mexico.* , ed. O. H. Graham, 12–15. Entomological Society of America.

Bustos, Paula, Bruno Caprettini, and Jacopo Ponticelli. 2016. "Agricultural Productivity and Structural Transformation: Evidence from Brazil." *American Economic Review*, 106(6): 1320–1365.

Chen, Jiafeng, and Jonathan Roth. 2023. "Logs with Zeros? Some Problems and Solutions." *The Quarterly Journal of Economics*, 139(2): 891–936.

Conley, Timothy G. 1999. "GMM estimation with cross sectional dependence." *Journal of Econometrics*, 92(1): 1–45.

Coulson, David P., and Linda A. Joyce. 2010. "Historical Climate Data (1940-2006) for the Conterminous United States at the County Spatial Scale Based on PRISM Climatology."

Duflo, Esther, Michael Kremer, and Jonathan Robinson. 2011. "Nudging Farmers to Use Fertilizer: Theory and Experimental Evidence from Kenya." *American Economic Review*, 101(6): 2350–2390.

EPA. 2012. "NPDES Permit Writers' Manual for Concentrated Animal Feeding Operations." United States Environmental Protection Agency.

Evenson, Robert E., and Douglas Gollin. 2003. "Assessing the Impact of the Green Revolution, 1960 to 2000." *Science*, 300(5620): 758–762.

FAO. 2007. "Suitability of global land area for pasture (FGGD)."

FAO. 2015. "Climate change and food security: risks and responses."

FAO. 2021. "The impact of disasters and crises on agriculture and food security: 2021."

Foster, Andrew D., and Mark R. Rosenzweig. 1995. "Learning by Doing and Learning from

Others: Human Capital and Technical Change in Agriculture." *Journal of Political Economy*, 103(6): 1176–1209.

Frank, Eyal, and Anant Sudarshan. 2024. "The Social Costs of Keystone Species Collapse: Evidence from the Decline of Vultures in India." *American Economic Review*, 114(10): 3007–3040.

Frank, Eyal G. 2024. "The economic impacts of ecosystem disruptions: Costs from substituting biological pest control." *Science*, 385(6713): eadg0344.

Frank, Eyal G., Shaoda Wang, Xuebin Wang, Qinyun Wang, and Yang You. 2024. "Campaigning for Extinction: Eradication of Sparrows and the Great Famine in China." *Working Paper*.

French, Jacob. 2025. "Technological Change, Inequality, and Intergenerational Mobility: The Case of Early 20th Century Agriculture." *Working Paper*.

Glaeser, Edward L. 2014. "A World of Cities: The Causes and Consequences of Urbanization in Poorer Countries." *Journal of the European Economic Association*, 12(5): 1154–1199.

Gollin, Douglas, Casper Worm Hansen, and Asger Mose Wingender. 2021. "Two Blades of Grass: The Impact of the Green Revolution." *Journal of Political Economy*, 129(8): 2344–2384.

Grosset-Touba, Florian, Anna Papp, and Charles Taylor. 2024. "Rain follows the forest: Land use policy, climate change, and adaptation." *Working Paper*.

Gutierrez, Andrew Paul, and Luigi Ponti. 2014. "The new world screwworm: prospective distribution and role of weather in eradication." *Agricultural and Forest Entomology*, 16(2): 158–173.

Haines, Michael, Price Fishback, and Paul Rhode. 2018. "United States Agriculture Data, 1840 - 2012."

Haines, Michael R., Inter university Consortium for Political, Social Research, et al. 2010. "Historical, Demographic, Economic, and Social Data: The United States, 1790-2002."

Hall, M. J. R. 1991. "Screwworm flies as agents of wound myiasis." *World animal review*, 1991: 8–17.

Hornbeck, Richard. 2010. "Barbed Wire: Property Rights and Agricultural Development." *The Quarterly Journal of Economics*, 125(2): 767–810.

Hornbeck, Richard. 2012. "The Enduring Impact of the American Dust Bowl: Short- and Long-Run Adjustments to Environmental Catastrophe." *American Economic Review*, 102(4): 1477–1507.

Hornbeck, Richard, and Pinar Keskin. 2014. "The Historically Evolving Impact of the Ogallala Aquifer: Agricultural Adaptation to Groundwater and Drought." *American Economic Journal: Applied Economics*, 6(1): 190–219.

Hornbeck, Richard, Shanon Hsuan-Ming Hsu, Anders Humlum, and Martin Rotemberg. 2024. "Gaining Steam: Incumbent Lock-in and Entrant Leapfrogging." *Working Paper*.

IAEA. 2020. "Proposal for a Strategic Plan for the Eradication of the Myiasis Caused by the New World Screwworm in South America."

Kantor, Shawn, and Alexander Whalley. 2019. "Research Proximity and Productivity: Long-Term Evidence from Agriculture." *Journal of Political Economy*, 127(2): 819–854.

Knipling, Edward F. 1955. "Possibilities of Insect Control or Eradication Through the Use of Sexually Sterile Males." *Journal of Economic Entomology*, 48(4): 459–462.

Knipling, Edward F. 1960. "The Eradication of the Screw-Worm Fly." *Scientific American*, 203(4): 54–61.

Lam, Yukyan, Jillian P. Fry, Emily Hu, Brent F. Kim, and Keeve E. Nachman. 2016.

"Industrial Food Animal Production in Low- and Middle-Income Countries: A Landscape Assessment." *Center for a Livable Future Report, Johns Hopkins.*

Lange, Fabian, Alan L. Olmstead, and Paul W. Rhode. 2009. "The Impact of the Boll Weevil, 1892–1932." *The Journal of Economic History*, 69(3): 685–718.

Mader, Terry L., M. S. Davis, and Tami Brown-Brandl. 2006. "Environmental factors influencing heat stress in feedlot cattle." *Journal of Animal Science*, 84(3): 712–719.

Manson, Steven, Jonathan Schroeder, David Van Riper, Katherine Knowles, Tracy Kugler, Finn Roberts, and Steven Ruggles. 2023. "IPUMS National Historical Geographic Information System: Version 18.0 [dataset]."

Miguel, Edward, and Michael Kremer. 2004. "Worms: Identifying Impacts on Education and Health in the Presence of Treatment Externalities." *Econometrica*, 72(1): 159–217.

Mintert, James. 2003. "Beef feedlot industry." *Veterinary Clinics: Food Animal Practice*, 19(2): 387–395.

Novy, James E. 1991. "Screwworm control and eradication in the southern United States of America." *World animal review*, 10: 18–27.

Nunn, Nathan, and Nancy Qian. 2011. "The Potato's Contribution to Population and Urbanization: Evidence From A Historical Experiment." *The Quarterly Journal of Economics*, 126(2): 593–650.

OECD/FAO. 2024. "OECD-FAO Agricultural Outlook 2024–2033."

Ruggles, Steven, Sarah Flood, Matthew Sobek, Daniel Backman, Grace Cooper, Julia A. Rivera Drew, Stephanie Richards, Renae Rodgers, Jonathan Schroeder, and Kari C. W. Williams. 2025. "IPUMS USA: Version 16.0 [dataset]."

Scott, Paul, Eduardo Souza-Rodrigues, Skand Goel, and Ted Rosenbaum. 2024. "Cows and Trees." *Working Paper.*

Silva, J. M. C. Santos, and Silvana Tenreyro. 2006. "The Log of Gravity." *The Review of Economics and Statistics*, 88(4): 641–658.

Skaggs, Jimmy M. 1986. *Prime cut: Livestock raising and meatpacking in the United States, 1607-1983.* Texas A&M University Press, College Station.

Spickler, Anna Rovid. 2015. "Screwworm Myiasis."

Suri, Tavneet. 2011. "Selection and Comparative Advantage in Technology Adoption." *Econometrica*, 79(1): 159–209.

USDA. 2000. "STOP Screwworms: Selection from the Screwworm Eradication Collection."

USDA. 2013. "Feedlot 2011." USDA–APHIS–VS–CEAH–NAHMS.

USDA. 2018. "Review of Normal Grazing Periods and Carrying Capacities for NAP, LFP, and ELAP." United States Department of Agriculture Farm Service Agency.

USDA-APHIS. 2017. "Sterile Fly Release Programs."

USDA-APHIS. 2025. "New World Screwworm Outbreak in Central America and Mexico."

Wyss, John H. 2000. "Screwworm Eradication in the Americas." *Annals of the New York Academy of Sciences*, 916(1): 186–193.

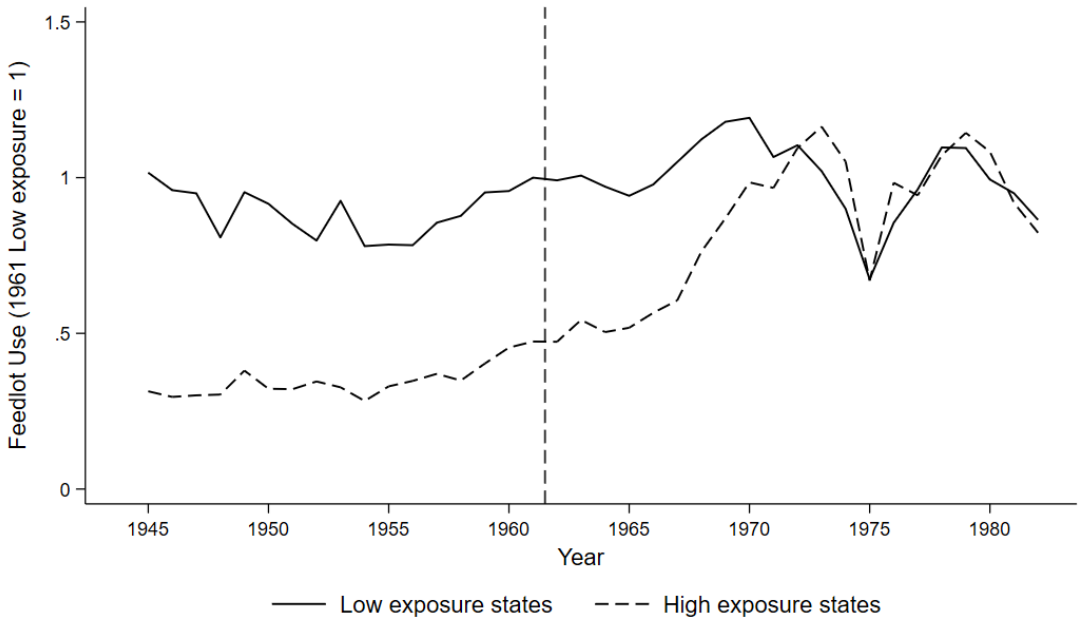


Figure 1: Average Feedlot Use at the State Level

Notes: This map shows average feedlot use between 1945 and 1982 for western states with high and low levels of screwworm infestation. Data are drawn from USDA Cattle on Feed reports and the USDA Quick Stats database. I measure feedlot use as the ratio of cattle on feed to the number of beef cows. I normalize feedlot use for low exposure states in 1961 to 1. Low exposure states include Idaho, Iowa, Minnesota, Montana, North Dakota, Nebraska, Oregon, South Dakota, Washington, and Wyoming. High exposure states include Arizona, California, Colorado, Kansas, Missouri, New Mexico, Nevada, Oklahoma, Texas, and Utah.

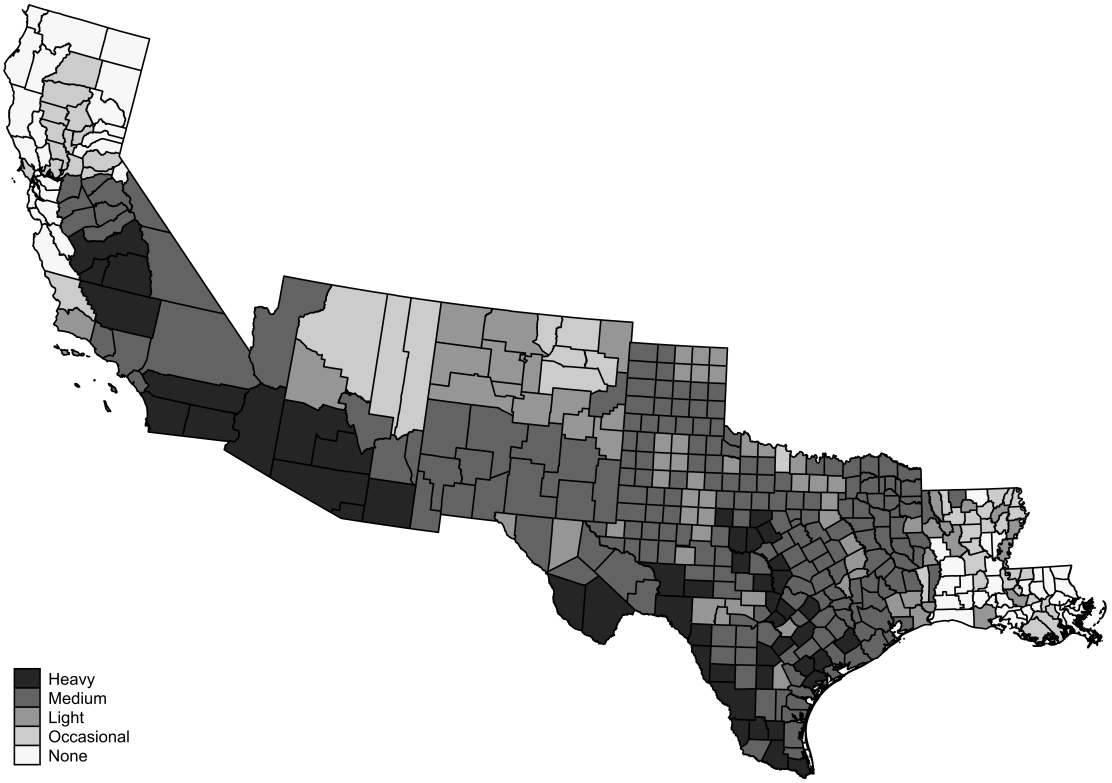


Figure 2: Average Screwworm Infestations

Notes: This map shows my sample counties in Arizona, California, Louisiana, New Mexico, and Texas, shaded according to their average level of annual screwworm infestation prior to the eradication campaign. Darker shades denote more infestations. There are five infestation levels: heavy (darkest gray), medium, light, occasional, and none (lightest gray).

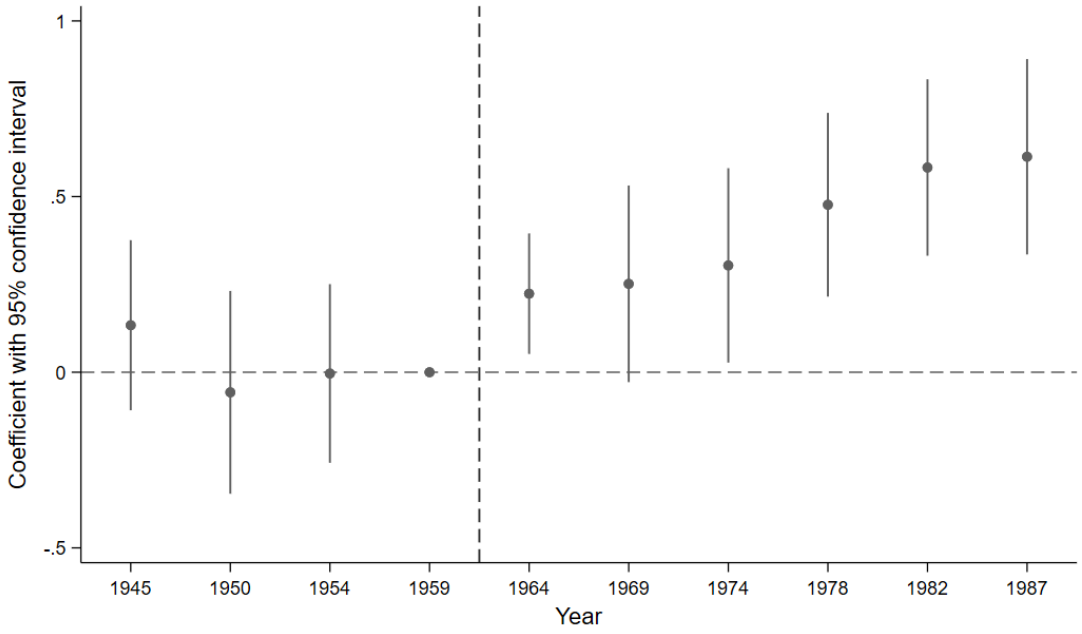


Figure 3: Effects of Screwworm Eradication on Livestock Production by Year

Notes: This figure shows event-study estimates based on equation (2). The outcome variable is the value of livestock products. The sample period is 1945–1987. I control for county FE, state × year FE, and a year-interacted cubic polynomial of longitude and latitude. The omitted comparison event-year is 1959, the year before screwworm eradication. The dashed curves indicate the 95% confidence bands. Robust standard errors are clustered at the county level.

Table 1: Baseline County Characteristics by Pre-Eradication Screwworm Infestation Level

	Group Means		Δ: (2)–(1)	N
Infestation Level	*Low*	*High*		
	(1)	(2)	(3)	(4)
Value of livestock products (US$ millions)	2.036	2.747	0.7111	378
	(0.257)	(0.336)	(0.423)	
Value of crops (US$ millions)	3.866	5.091	1.225	378
	(0.473)	(0.827)	(0.953)	
Farmland (thousand acres)	598.6	662.8	64.16	378
	(63.5)	(39.8)	(74.9)	
Pastureland (thousand acres)	465.1	519.1	53.93	378
	(63.6)	(40)	(75.1)	
Harvested cropland (thousand acres)	93.25	114.4	21.12	378
	(7.77)	(7)	(10.5)	
Number of farms	1,706	1,828	122.3	378
	(103)	(118)	(157)	
Feed expenses (US$ millions)	0.9612	1.326	0.3643	378
	(0.183)	(0.244)	(0.305)	
Capital expenses (US$ millions)	0.262	0.4199	0.158	378
	(0.0319)	(0.0457)	(0.0557)	
Labor expenses (US$ millions)	1.172	1.456	0.284	378
	(0.166)	(0.238)	(0.29)	
Temperature mean (degrees Celsius)	16.45	18.24	1.785	378
	(0.301)	(0.184)	(0.352)	
Temperature variance	52.48	57.51	5.034	378
	(1.38)	(0.892)	(1.65)	
Monthly precipitation (millimeters)	76.81	53.35	-23.46	378
	(3.3)	(1.6)	(3.66)	
Elevation (meters)	545.5	498	-47.51	378
	(53.3)	(31.7)	(62)	

Notes: This table reports the means of outcome variables and county characteristics at baseline for low- and high-infestation counties (columns 1 and 2), along with their differences (column 3). The sample includes counties with balanced livestock production data from 1945 to 1987. Climate variables are averaged over the 1950-1959 period. Feed expenses and capital expenses are values for 1950, as data are unavailable for 1945. All other variables are data in 1945. Robust standard errors are in parentheses.

Table 2: Effects of Screwworm Eradication on Livestock Production

	Value of livestock products			
	(1)	(2)	(3)	(4)
Infestation×Eradication	0.424	0.523	0.468	0.445
	(0.125)	(0.101)	(0.104)	(0.108)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	No	Yes	Yes	Yes
State-by-year FE	No	No	Yes	Yes
Geography controls	No	No	No	Yes
Observations	3780	3780	3780	3780

Notes: This table shows the estimated effects of screwworm eradication on the value of livestock products. All columns report PPML estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. The sample is a balanced panel of 378 counties. Robust standard errors clustered by county are in parentheses.

Table 3: Effects of Screwworm Eradication on Per-Acre Production and Feed Intensity

	Production per acre		Feed Intensity	
	(1)	(2)	(3)	(4)
Infestation×Eradication	0.426	0.403	0.306	0.279
	(0.122)	(0.120)	(0.101)	(0.102)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes
State-by-year FE	Yes	Yes	Yes	Yes
Geography controls	No	Yes	No	Yes
Observations	3750	3750	3276	3276

Notes: This table shows the estimated effects of screwworm eradication on per-acre livestock production and feed use intensity. The outcome in columns 1 and 2 is the value of livestock products per acre of farmland. The outcome in columns 3 and 4 is the ratio of feed expenditure to the number of cattle. All columns report PPML estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. The sample for columns 1 and 2 is a balanced panel of 375 counties. The sample for columns 3 and 4 is a balanced panel of 364 counties. Data on feed expenditure are not available in 1945. Robust standard errors clustered by county are in parentheses.

Table 4: Effects of Screwworm Eradication on Pastureland

	Pastureland area		Pastureland share	
	(1)	(2)	(3)	(4)
Infestation×Eradication	-0.018	-0.032	-0.0088	-0.0077
	(0.029)	(0.035)	(0.0100)	(0.010)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes
State-by-year FE	Yes	Yes	Yes	Yes
Geography controls	No	Yes	No	Yes
Observations	3690	3690	3670	3670

Notes: This table shows the estimated effects of screwworm eradication on pastureland. The outcome in columns 1 and 2 is pastureland area in farms. The outcome in columns 3 and 4 is the share of pastureland in total farmland. Columns 1 and 2 report PPML estimates. Columns 3 and 4 report OLS estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. The sample for columns 1 and 2 is a balanced panel of 369 counties. The sample for columns 3 and 4 is a balanced panel of 367 counties. Robust standard errors clustered by county are in parentheses.

Table 5: Effects of Screwworm Eradication on Crops

	Value of all crops		Harvested cropland	
	(1)	(2)	(3)	(4)
Infestation×Eradication	0.091	0.022	0.046	0.044
	(0.108)	(0.100)	(0.040)	(0.039)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes
State-by-year FE	Yes	Yes	Yes	Yes
Geography controls	No	Yes	No	Yes
Observations	3300	3300	3320	3320

Notes: This table shows the estimated effects of screwworm eradication on crop production and harvested cropland. The outcome in columns 1 and 2 is the value of all crops. The outcome in columns 3 and 4 is harvested cropland area in farms. All columns report PPML estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. The sample for columns 1 and 2 is a balanced panel of 330 counties. The sample for columns 3 and 4 is a balanced panel of 332 counties. Robust standard errors clustered by county are in parentheses.

Table 6: Effects of Screwworm Eradication on Capital and Labor Inputs

	Capital		Labor	
	(1)	(2)	(3)	(4)
Infestation×Eradication	0.22	0.23	0.055	0.0076
	(0.093)	(0.093)	(0.12)	(0.12)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes
State-by-year FE	Yes	Yes	Yes	Yes
Geography controls	No	Yes	No	Yes
Observations	2952	2952	3740	3740

Notes: This table shows the estimated effects of screwworm eradication on farm capital and labor inputs. The outcome in columns 1 and 2 is farm expenditure on machinery and equipment. The outcome in columns 3 and 4 is farm expenditure on hired labor. All columns report PPML estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. The sample for columns 1 and 2 is a balanced panel of 369 counties. The sample for columns 3 and 4 is a balanced panel of 374 counties. Data on farm expenditure on machinery and equipment are not available in 1945 or 1969. Robust standard errors clustered by county are in parentheses.

Table 7: Effects of Screwworm Eradication on the Number of Farms by Sales

	Number of farms			
	(1) Total	(2) Small	(3) Medium	(4) Large
Infestation×Eradication	0.070	0.033	-0.037	0.28
	(0.054)	(0.072)	(0.066)	(0.075)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes
State-by-year FE	Yes	Yes	Yes	Yes
Geography controls	No	No	No	No
Observations	3024	3024	3024	3024

Notes: This table shows the estimated effects of screwworm eradication on the number of farms. The outcome in column 1 is the total number of farms. The outcomes in columns 2 to 4 are the number of farms by value of sales: small farms with sales less than $1,000 (column 2), medium farms with sales between $1,000 and$10,000 (column 3), and large farms with sales more than $10,000 (column 4). All columns report PPML estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. The sample is a balanced panel of 378 counties. Data are not available in 1954 or 1959. Robust standard errors clustered by county are in parentheses.

Table 8: Heterogeneous Effects of Screwworm Eradication on Livestock Production, by Feedlot Suitability and Highway Access

	Value of livestock products			
	(1)	(2)	(3)	(4)
Infestation×Eradication×FeedlotSuitable	0.302	0.443		
	(0.196)	(0.206)		
Infestation×Eradication×HighwayAccess			0.444	0.383
			(0.164)	(0.166)
Infestation×Eradication	0.351	0.295	0.256	0.270
	(0.138)	(0.143)	(0.131)	(0.131)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes
State-by-year FE	Yes	Yes	Yes	Yes
Geography controls	No	Yes	No	Yes
Observations	3780	3780	3780	3780

Notes: This table shows the estimated effects of screwworm eradication on the value of livestock products. All columns report PPML estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. The sample is a balanced panel of 378 counties. Robust standard errors clustered by county are in parentheses.

Appendix

A Screwworm suitability based on temperature

Gutierrez and Ponti (2014) study the population dynamics of screwworms across geographic regions using weather data. Their model includes several key parameters, including screwworm development rates and mortality rates that depend on temperature.

The rate of development per hour is

$$R(T) = \frac{a(T - T_L)}{1 + b^{T - T_U}} = \frac{0.00065(T - 14.5)}{1 + 1.75^{T-40}}$$

The adult mortality rate per day is

$$\mu_(T) = 0.00036 \times (T - T_{\text{opt}})^2 + 0.0035 \quad \text{with } T_{\text{opt}} = 27.2°C$$

I plug in the 1950-1959 average temperature for each county to derive screwworm development and mortality rates. For development rates, I multiply the original rate by 24 to convert it to the rate per day. I then calculate the difference between the development and mortality rates. Appendix Figure A.1 shows the geographic distribution of the difference rates in five states. Comparing this map to Figure 2, we see that areas with high screwworm suitability, such as most of Texas, southern Arizona, and southern California, also tend to have high screwworm infestation levels reported by Agricultural Research Service (1959).

These three temperature-based screwworm suitability measures reflect potential screwworm infestation levels in a county. Using each as a treatment variable, I estimate difference-in-differences regressions to test whether screwworm eradication increases livestock production more in counties with higher development rates (or lower mortality rates), relative to those with lower development (or higher mortality).

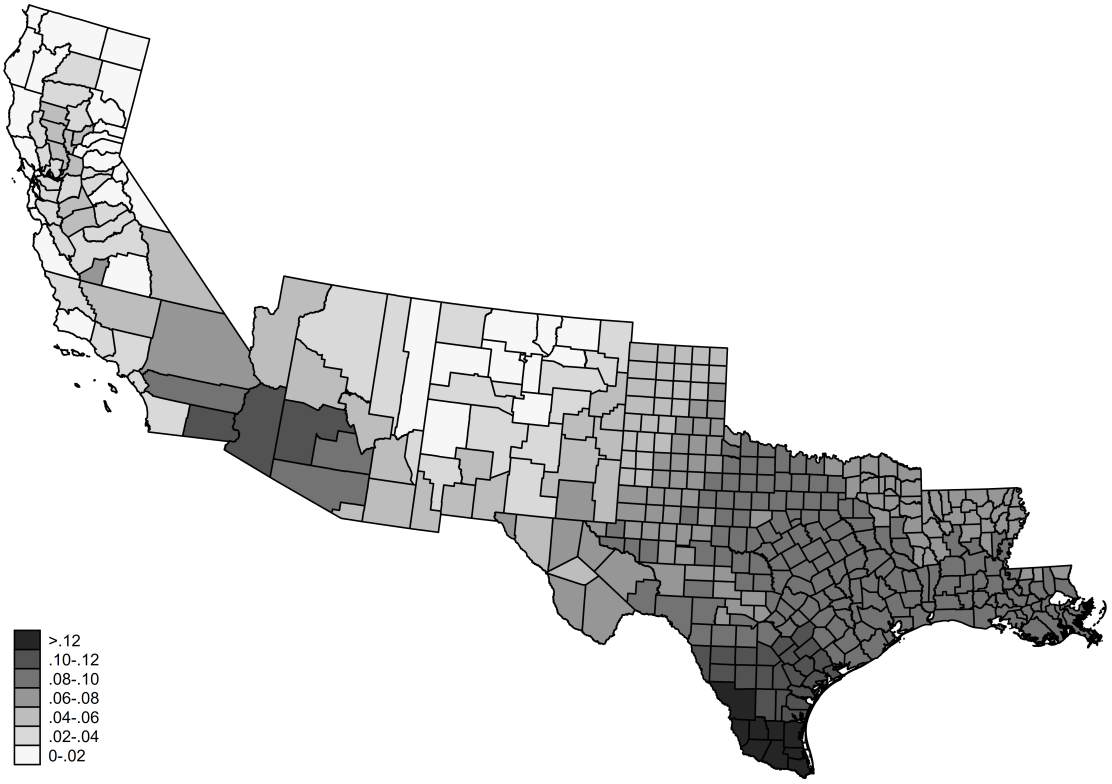


Figure A.1: Screwworm Suitability

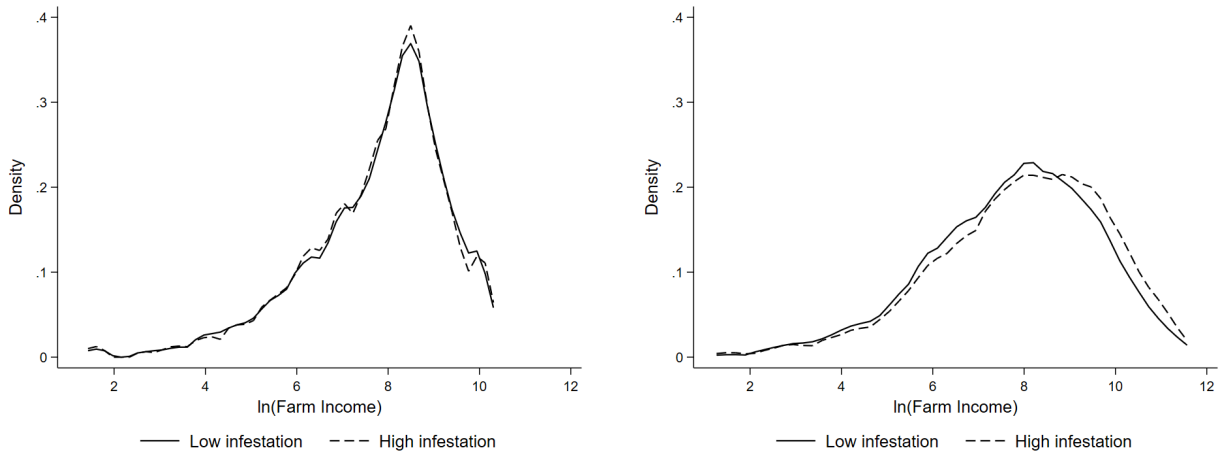
Notes: This map shows one screwworm suitability measure, the difference between the development and mortality rates, for counties in Arizona, California, Louisiana, New Mexico, and Texas. Darker shades represent high suitability and lighter shades represent low suitability.

B Farm Income Distribution

I show in my main results that livestock production rose after screwworm eradication. An increase in livestock sales should raise farm income, but this alone does not reveal how the distribution of farm income changed. I have shown that the number of farms with large sales increased, while the number of farms with medium or small sales remained stable. I now examine whether the pattern of farm income growth aligns with these shifts in farm structure.

I access individual-level data on farm income from the Census microdata records in the IPUMS USA dataset (Ruggles et al., 2025). The IPUMS samples that I use are 1960 5% and 1980 5%. Although the county where the household was enumerated is unavailable in the public-use microdata after 1950, IPUMS recovers county information where possible using lower-level geographic identifiers. I restrict the sample to individuals in counties listed as identifiable by IPUMS. I plot kernel density estimates of the log value of farm income in Appendix Figure A.2, separately for individuals in counties with high and low screwworm infestation, in both 1960 and 1980.

In 1960, before eradication, the two distributions are nearly identical and overlap throughout. By 1980, the distribution for individuals in high-infestation counties (dashed line) has shifted to the right relative to the distribution for those in low-infestation counties (solid line). Note that this shift is not concentrated only at the upper tail but is apparent across most of the distribution. The pattern suggests that eradication raised incomes for a broad set of farmers in high-infestation counties, including those with medium and high incomes. Low-income farmers in these counties do not appear to have lost ground relative to their counterparts in low-infestation counties. This mirrors the earlier findings on farm size distribution: the number of farms with large sales increased, while the number of small farms remained unchanged.



(a) Farm Income in 1960

(b) Farm Income in 1980

Figure A.2: Farm Income Distributions

Notes: This figure shows the distribution of farm income for individuals in low-infestation counties (solid line) and high-infestation counties (dashed line). Panels (a) and (b) plot kernel density estimates in 1960 and 1980, respectively. Data source: IPUMS USA 1960 5% sample and 1980 5% sample.

Table A.1: Effects of Screwworm Eradication on Livestock Production: OLS Estimates

	ln(Value of livestock products)			
	(1)	(2)	(3)	(4)
Infestation×Eradication	0.315	0.420	0.372	0.325
	(0.088)	(0.100)	(0.101)	(0.099)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	No	Yes	Yes	Yes
State-by-year FE	No	No	Yes	Yes
Geography controls	No	No	No	Yes
Observations	3780	3780	3780	3780

Notes: This table shows the estimated effects of screwworm eradication on the log value of livestock products. All columns report OLS estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. Robust standard errors clustered by county are in parentheses.

Table A.2: Effects of Screwworm Eradication on Livestock Production: OLS Estimates with Conley Standard Errors

	ln(Value of livestock products)			
	(1)	(2)	(3)	(4)
Infestation×Eradication	0.315	0.420	0.372	0.325
(Cutoff: 100 km)	(0.069)	(0.068)	(0.066)	(0.065)
(Cutoff: 200 km)	(0.073)	(0.075)	(0.069)	(0.065)
(Cutoff: 500 km)	(0.074)	(0.080)	(0.079)	(0.071)
(Cutoff: 1000 km)	(0.074)	(0.087)	(0.081)	(0.071)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	No	Yes	Yes	Yes
State-by-year FE	No	No	Yes	Yes
Geography controls	No	No	No	Yes
Observations	3780	3780	3780	3780

Notes: This table shows the estimated effects of screwworm eradication on the log value of livestock products. All columns report OLS estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. I report Conley (1999) standard errors that are allowed to be spatially correlated up to 100 km, 200 km, 500 km, and 1000 km, respectively.

Table A.3: Effects of Screwworm Eradication on Farmland Area

	Land in farms			
	(1)	(2)	(3)	(4)
Infestation×Eradication	0.0077	0.015	-0.0044	-0.0071
	(0.022)	(0.022)	(0.020)	(0.023)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	No	Yes	Yes	Yes
State-by-year FE	No	No	Yes	Yes
Geography controls	No	No	No	Yes
Observations	3750	3750	3750	3750

Notes: This table shows the estimated effects of screwworm eradication on land in farms. All columns report PPML estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. Robust standard errors clustered by county are in parentheses.

Table A.4: Effects of Screwworm Eradication on Cattle

	Cattle population		Cattle density	
	(1)	(2)	(3)	(4)
Infestation×Eradication	0.122	0.105	0.161	0.152
	(0.046)	(0.050)	(0.052)	(0.052)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes
State-by-year FE	Yes	Yes	Yes	Yes
Geography controls	No	Yes	No	Yes
Observations	3730	3730	3730	3730

Notes: This table shows the estimated effects of screwworm eradication on cattle population and density. The outcome in columns 1 and 2 is the total number of cattle. The outcome in columns 3 and 4 is the number of cattle per acre of farmland. All columns report PPML estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. Robust standard errors clustered by county are in parentheses.

Table A.5: Effects of Screwworm Eradication on Specific Types of Pastureland

	Woodland for pasture		Cropland for pasture	
	(1)	(2)	(3)	(4)
Infestation×Eradication	0.011	0.019	0.0036	0.0091
	(0.019)	(0.020)	(0.020)	(0.020)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes
State-by-year FE	Yes	Yes	Yes	Yes
Geography controls	No	Yes	No	Yes
Observations	3397	3397	3616	3616

Notes: This table shows the estimated effects of screwworm eradication on specific types of land used for pasture. The outcome in columns 1 and 2 is the share of pastured woodland in total woodland. The outcome in columns 3 and 4 is the share of cropland for pasture in total cropland. All columns report OLS estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. Robust standard errors clustered by county are in parentheses.

Table A.6: Effects of Screwworm Eradication on Corn Fields

	Corn for silage		Corn for grain	
	(1)	(2)	(3)	(4)
Infestation×Eradication	0.62	0.58	0.11	-0.029
	(0.17)	(0.18)	(0.20)	(0.21)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes
State-by-year FE	Yes	Yes	Yes	Yes
Geography controls	No	Yes	No	Yes
Observations	2523	2523	2827	2827

Notes: This table shows the estimated effects of screwworm eradication on harvested cropland for corn production. The outcome in columns 1 and 2 is the area of harvested corn fields for silage. The outcome in columns 3 and 4 is the area of harvested corn fields for grain. All columns report PPML estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. Robust standard errors clustered by county are in parentheses.

Table A.7: Effects of Screwworm Eradication on the Number of Farms by Sales, with Geography Controls

	Number of farms			
	(1) Total	(2) Small	(3) Medium	(4) Large
Infestation×Eradication	0.048	0.017	-0.029	0.22
	(0.051)	(0.068)	(0.069)	(0.075)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes
State-by-year FE	Yes	Yes	Yes	Yes
Geography controls	Yes	Yes	Yes	Yes
Observations	3024	3024	3024	3024

Notes: This table shows the estimated effects of screwworm eradication on the number of farms. The outcome in column 1 is the total number of farms. The outcomes in columns 2 to 4 are the number of farms by value of sales: small farms with sales less than $1,000 (column 2), medium farms with sales between $1,000 and$10,000 (column 3), and large farms with sales more than $10,000 (column 4). All columns report PPML estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. Data are not available in 1954 or 1959. Robust standard errors clustered by county are in parentheses.

Table A.8: Effects of Screwworm Eradication on the Number of Farms by Acres

	Number of farms					
	(1) Small	(2) Small	(3) Medium	(4) Medium	(5) Large	(6) Large
Infestation×Eradication	0.093	0.015	0.073	0.074	0.038	0.028
	(0.085)	(0.082)	(0.047)	(0.046)	(0.038)	(0.038)
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes	Yes	Yes
State-by-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Geography controls	No	Yes	No	Yes	No	Yes
Observations	3024	3024	3024	3024	3024	3024

Notes: This table shows the estimated effects of screwworm eradication on the number of farms by area. The outcome in columns 1 and 2 is the number of small farms with area less than 100 acres. The outcome in columns 3 and 4 is the number of medium farms with area between 100 and 500 acres. The outcome in columns 5 and 6 is the number of large farms with area more than 500 acres. All columns report PPML estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. Robust standard errors clustered by county are in parentheses.

Table A.9: Heterogeneous Effects of Screwworm Eradication on Livestock Production, by Pasture Suitability

	Value of livestock products			
	(1)	(2)	(3)	(4)
Infestation×Eradication×PastureSuitable	-0.287	-0.235		
	(0.174)	(0.187)		
Infestation×Eradication×HighPastureShare			-0.192	-0.265
			(0.215)	(0.199)
Infestation×Eradication	0.565	0.527	0.549	0.566
	(0.129)	(0.139)	(0.146)	(0.148)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes
State-by-year FE	Yes	Yes	Yes	Yes
Geography controls	No	Yes	No	Yes
Observations	3780	3780	3780	3780

Notes: This table shows the estimated effects of screwworm eradication on the value of livestock products. All columns report PPML estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. Robust standard errors clustered by county are in parentheses.

Table A.10: Effects of Screwworm Eradication on Livestock Production: All Counties

	Value of livestock products			
	(1)	(2)	(3)	(4)
Infestation×Eradication	0.413	0.532	0.467	0.437
	(0.122)	(0.099)	(0.100)	(0.105)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	No	Yes	Yes	Yes
State-by-year FE	No	No	Yes	Yes
Geography controls	No	No	No	Yes
Observations	4164	4164	4164	4164

Notes: This table shows the estimated effects of screwworm eradication on the value of livestock products. All columns report PPML estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. The sample is an unbalanced panel of all counties with non-missing livestock production data at any point during the sample period. Robust standard errors clustered by county are in parentheses.

Table A.11: Effects of Screwworm Eradication on Livestock Production: Imputing Missing Data

	Value of livestock products			
	(1)	(2)	(3)	(4)
Infestation×Eradication	0.415	0.535	0.468	0.438
	(0.122)	(0.099)	(0.101)	(0.106)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	No	Yes	Yes	Yes
State-by-year FE	No	No	Yes	Yes
Geography controls	No	No	No	Yes
Observations	4210	4210	4210	4210

Notes: This table shows the estimated effects of screwworm eradication on the value of livestock products. All columns report PPML estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. The sample is a balanced panel of all counties, with missing livestock production data imputed as zero. Robust standard errors clustered by county are in parentheses.

Table A.12: Effects of Screwworm Eradication on Livestock Production: Dropping One State at a Time

	Value of livestock products				
	(1) Arizona	(2) California	(3) Louisiana	(4) New Mexico	(5) Texas
Infestation×Eradication	0.423	0.446	0.469	0.459	0.680
	(0.104)	(0.113)	(0.104)	(0.114)	(0.185)
County FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes	Yes
State-by-year FE	Yes	Yes	Yes	Yes	Yes
Geography controls	No	No	No	No	No
Observations	3660	3260	3260	3490	1450

Notes: This table shows the estimated effects of screwworm eradication on the value of livestock products, when dropping one state at a time: Arizona (column 1), California (column 2), Louisiana (column 3), New Mexico (column 4), and Texas (column 5). All columns report PPML estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. Robust standard errors clustered by county are in parentheses.

Table A.13: Effects of Screwworm Eradication on Livestock Production, with Additional Controls

	Value of livestock products			
	(1)	(2)	(3)	(4)
Infestation×Eradication	0.505	0.480	0.535	0.520
	(0.107)	(0.109)	(0.128)	(0.123)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes
State-by-year FE	Yes	Yes	Yes	Yes
Geography controls	No	Yes	No	Yes
Host density	Yes	Yes	No	No
Baseline value	No	No	Yes	Yes
Observations	3780	3780	3780	3780

Notes: This table shows the estimated effects of screwworm eradication on the value of livestock products. All columns report PPML estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. Columns 1 and 2 include the density of screwworm hosts interacted with year fixed effects. Columns 3 and 4 include the baseline value of livestock products interacted with year fixed effects. Robust standard errors clustered by county are in parentheses.

Table A.14: Effects of Screwworm Eradication on Livestock Production in Twelve States

	Value of livestock products			
	(1)	(2)	(3)	(4)
Infestation×Eradication	0.347	0.296	0.417	0.459
	(0.102)	(0.118)	(0.115)	(0.112)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	No	Yes	Yes	Yes
State-by-year FE	No	No	Yes	Yes
Geography controls	No	No	No	Yes
Observations	8300	8300	8300	8300

Notes: This table shows the estimated effects of screwworm eradication on the value of livestock products in twelve states, including Arizona, California, Louisiana, New Mexico, Texas, Kansas, Missouri, Arkansas, Oklahoma, Colorado, Nevada, and Utah. All columns report PPML estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. Robust standard errors clustered by county are in parentheses.

Table A.15: Alternative Definition of Screwworm Infestation

	Value of livestock products			
	(1)	(2)	(3)	(4)
Infestation×Eradication	0.610	0.620	0.535	0.530
	(0.118)	(0.186)	(0.190)	(0.206)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	No	Yes	Yes	Yes
State-by-year FE	No	No	Yes	Yes
Geography controls	No	No	No	Yes
Observations	3780	3780	3780	3780

Notes: This table shows the estimated effects of screwworm eradication on the value of livestock products. The treatment variable is an indicator for heavy, medium, or light screwworm infestation. All columns report PPML estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. Robust standard errors clustered by county are in parentheses.

Table A.16: Levels of Screwworm Infestation

	Value of livestock products			
	(1)	(2)	(3)	(4)
Infestation(Heavy)×Eradication	0.573	0.798	0.789	0.822
	(0.138)	(0.228)	(0.262)	(0.245)
Infestation(Medium)×Eradication	0.679	0.620	0.582	0.582
	(0.150)	(0.204)	(0.200)	(0.212)
Infestation(Light)×Eradication	0.429	0.207	0.211	0.241
	(0.163)	(0.213)	(0.203)	(0.202)
County FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Location controls	No	Yes	Yes	Yes
State-by-year FE	No	No	Yes	Yes
Geography controls	No	No	No	Yes
Observations	3780	3780	3780	3780

Notes: This table shows the estimated effects of screwworm eradication on the value of livestock products. The treatment variables are three indicators for heavy, medium, and light screwworm infestation. All columns report PPML estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. Robust standard errors clustered by county are in parentheses.

Table A.17: Screwworm Suitability Measure

	Value of livestock products		
	(1)	(2)	(3)
DevelopmentRate×Eradication	0.172		
	(0.092)		
MortalityRate×Eradication		-0.226	
		(0.114)	
DifferenceRate×Eradication			0.178
			(0.093)
County FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Location controls	Yes	Yes	Yes
State-by-year FE	Yes	Yes	Yes
Geography controls	No	No	No
Observations	3780	3780	3780

Notes: This table shows the estimated effects of screwworm eradication on the value of livestock products. The treatment variables are the standardized screwworm development rate (column 1), mortality rate (column 2), and their difference (column 3). All columns report PPML estimates. Location controls are a cubic polynomial of longitude and latitude interacted with year fixed effects. Geography controls include the mean and variance of temperature, as well as average precipitation and elevation, all interacted with year fixed effects. Robust standard errors clustered by county are in parentheses.