ESTIMATED IMPACTS OF MEXICAN REGIONAL TRADE RESTRICTIONS ASSOCIATED WITH BOVINE HEALTH CAMPAIGNS

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Bachelor of Science

Oklahoma State University

Stillwater, Oklahoma

2004

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
In partial fulfillment of
the requirements for
the Degree of
Master of Science
August, 2006

ESTIMATED IMPACTS OF MEXICAN REGIONAL TRADE RESTRICTIONS ASSOCIATED WITH BOVINE HEALTH CAMPAIGNS

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ACKNOWLEDGEMENTS

Graduate school has been a challenging and rewarding experience for me. I would like to thank the Oklahoma State Agricultural Economics faculty and staff for their support and help through my project.

I would also like to thank Univserdad Autonoma De Chihuahua faculty and students for their kindness and patience and for taking me in and teaching me Spanish and about Mexico.

I especially want to thank Dr. Derrell Peel for making me his personal project and giving me guidance in the past few years. He opened my eyes up to Mexico and the opportunities in international business. Thank you for giving me goals and helping me find my path in life.

I would like to thank Dr. James Trapp for encouraging me to continue in the Agricultural Economics program and helping me find international business. He always guided me through my undergraduate indecisiveness.

I would also like to thank my committee members, Dr. Francis Epplin and Dr. Bailey Norwood for their continuous support throughout this project. Another special thanks goes to Gracie Teague for her countless hours spent on formatting, her kindness, and help, Anna Whitney for keeping me organized and on time and for chatting during a much needed break from research.

Dr. David Henneberry and Dr. Adele Tongco for their support and help in my pursuit of international business.

I would like to thank my fellow graduate students for friendships made and all the fun times throughout school. A special thanks goes to Lewis, Karlee, Curtis, Lopez, and Joni for showing me the ropes at OSU graduate school. Another thanks goes to Jeri for putting up with my mess and madness in the office and Jennifer for being my solid rock to lean on over the final months of my project.

A very big thank you to my Mom and Dad for their support though my entire life especially my decision to move abroad. Thank you for always being just a call away. Thank you to my step-dad, Joe, for introducing me Mexico as a child.

I would also like to thank my grandparents for their support and understanding when I could not be at family functions because I was pursing my dream of international business. I would like to thank them for keeping me on the path to graduation even through tough times.

I would like to thank Jackie and MonaKaye, not only my brother and sister-in-law, but my best friends and rock for taking me under your wings and giving me direction in life. Thank you to Jill and Lewis, my sister and brother for keeping faith in me to finish my masters and being there no matter what I needed.

Most of all I would like to thank God because without him I would never have been able to accomplish any of this.

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CHAPTER I

INTRODUCTION

Problem Statement

With the implementation of the North American Free Trade Agreement (NAFTA), Mexico has become increasingly modernized. In addition to the changing laws of NAFTA, Mexicans' tastes and preferences have changed and the quantity of beef demanded has increased. This is due to the increase in income and the introduction of new products, including grain finished beef. In 2003, Mexicans consumed 18.13 kg of beef per person, an increase from 14.14 kg per person in 1993 (SAGARPA 2005). These changes in demand along with NAFTA are sources of the changes in the domestic cattle industry, trade policies, and regional relationships within Mexico.

Regional movement of cattle within Mexico was limited before NAFTA. Traditionally, grass-fed beef was finished on pastures near cow-calf production and moved directly to slaughter and consumption in urban centers. A growing demand for fed beef means that more cattle are being moved from regions of cow-calf and stocker production to different areas for finishing in feedlots. Rapidly changing market dynamics and improved infrastructure is causing increased cattle trade between regions thereby increasing the need for implementation of health campaigns in Mexico.

The increase of cattle trade between regions increases the possibility of spreading contagious disease among herds, which calls for a need to control infection. NAFTA has allowed easier entry of live cattle from Mexico into the United States (U.S.) (Skaggs et al.). Herd health varies widely in the different production regions of Mexico as demonstrated by the fact that the U.S. Department of Agriculture (USDA) maintains different zones, which affect acceptability of cattle from different regions due to prevalence of diseases, such as tuberculosis and brucellosis. Increased understanding in all these issues will be beneficial to producers, industry leaders, and policy makers in both the United States and Mexico. To begin to address the problem of disease risk due to regional cattle trade within Mexico one needs to understand the trading patterns. This leads us to the question: how do different levels of regional trade restrictions associated with bovine health campaigns for cattle in Mexico affect regional trade within Mexico and Mexico's international trade?

There is no literature about regional cattle trade within Mexico. Although Hayes studied regional livestock production systems in Mexico and demonstrated the importance of regional considerations, no one has investigated the implications of regional animal health campaigns on Mexican production and trade.

Objectives

<u>General Objective</u>

The overall objective of this research is to determine the impacts of successful Tuberculosis health campaigns within Mexico as shown through trade restrictions.

Specific Objectives

1. Estimate the impacts of various scenarios in which regional trade restrictions associated with Tuberculosis health campaigns within Mexico are removed in different regions in Mexico on average beef price, regional beef production levels, and interregional movement of cattle and beef.

Chapter two gives a brief background of the economic structure of Mexico, explains what tuberculosis is, gives U.S. import laws regarding cattle imports, shows tuberculosis statuses within Mexico, and tells about the climatic zones within Mexico. Chapter three explains the Ganaderia Mexicana (GANAMEX) model in full detail. Chapter four gives results for the Benchmark model, which was configured to represent the situation in Mexico in 2005. Chapter five explains the four scenarios and gives results for each. Chapter six gives general conclusions and conclusions for each scenario, as well as limitations in the model and suggestions for future work.

CHAPTER II

LITERATURE REVIEW

General Trade

To understand the importance of tuberculosis animal health campaigns in Mexico and their implications, one must understand the evolution of Mexican economic policy and the history of trade between the United States and Mexico. The next sections discuss how Mexico transitioned from a closed economy with isolationist policies to the country it has become today with the most signed free trade agreements in the world and its relationship with the U.S.

Mexican Economic/Trade Policies

Ejidos

Before the Mexican Revolution, fought in the early twentieth century, Mexico was controlled by large land holders, also known as hacendados. Most of the working class were employed by hacendados for wages below market value and were forced into servitude because of the debt they accumulated. After the Mexican revolution, private land holdings were limited to the amount of land that could support 500 head of cattle or the equivalent number of smaller livestock. Crop cultivation and cattle ranching were considered as separated activities and could not be produced on the same property. The land expropriated from the private land owners were given to the peasants in communal lands called ejidos (Hayes).

Ejidos differed from private land holdings in several ways. First, the ejido lands belonged to the nation meaning that they could not sell or mortgage their property. Secondly, the ejido lands were passed down from generation to generation, but the government could confiscate the land if it was thought that the land was abandoned or illegally leased out. Third, the ejido land must be passed down to single households intact, meaning that the land could not be further divided among the heirs. Fourth, ejiditarios, members of the ejido, were granted free access to communal grazing and forest lands belonging to the ejido (Hayes).

This land tenure system has proved to be inefficient and caused a disincentive for agricultural production. The private land owners had no incentive to improve their lands and become more efficient because that would result in more land being expropriated. The ejiditarios had no incentive to improve the land or invest in the land because if the land was confiscated they would receive no compensation for the improvements. Ejidos did not have funds to upgrade their lands, due to the lack of organized communal funds, and there were no fines for resource depletion within the ejidos causing the lands to be overgrazed and depleted of their resources (Hayes).

The stipulations on the ejidos have led to a more subsistence type of crop and livestock production. This has resulted in a poorer type of calf being used, which is fed on corn stalks and other crop residue. In many cases, animals were used primarily for traction, home milk production, and cull animals were used for meat. Commercial sales were limited to some milk from dual purpose production and occasional sales of excess calves or cull animals. Productivity was also very low with cows often producing a weaned calf at most every other year. In most ejidos there was little to no improvements in cattle genetics, managerial practices, and other technology. Due to limited use of purchased inputs and the availability of crop residue and communal grazing lands, variable cost of beef production was extremely low in many ejido systems.

In 1992, Article 27 of the Mexican Constitution was revised in an attempt to address this problem. Land could no longer be expropriated, and a process for privatization of ejidos was developed in order for the ability for ejiditarios to be able to rent or sell their lands (Hayes). The revision has changed many of the ejidos and given private land owners security to invest in their own property, although many of the ejiditarios are resisting change and are still subsistence farmers.

Economic Reconstruction

Traditionally Mexico exported raw materials and imported manufactured goods. Then in the late 1930's, Mexico began to develop industries due to a lack in available manufactured goods for Mexico to import as a result of increased consumption of all available goods in other countries during World War II. Mexico not only centralized many of the leading industries, but they imposed protective tariffs and quotas to help the new industries grow and become competitive. These tariffs and quotas were supposed to disappear as the industries grew, but because Mexico strived to be independent of all other nations many of them were not lifted (Jacques et al.).

After the 1980's, Mexico was forced to restructure its economy. The national debt of 1982 was almost $97 billion and the value of the peso declined. The Mexican government began to reverse its isolationist policies and developed an outward-oriented economic growth strategy. Under the new strategy Mexico joined the General Agreement on Tariffs and Trade (GATT) and North American Free Trade Agreement (NAFTA) (Garcia; Guerra and Eaton; Jacques et. al.).

In 1991, Mexico began to lower agricultural subsidies. Mexico adopted el El Programa de Apoyos Directos al Campo (PROCAMPO) in 1993. PROCAMPO was a fifteen year program developed in order to transition farmers while Mexico's agriculture was undergoing structural changes as a result of trade barrier elimination and compensated producers for the loss of input subsidies (Burfisher et al).

In various pieces of literature Mexico has been defined as a developing country. Lee defines Mexico as a middle-income developing county in 1991 (Lee et al.). In 2002, Burfisher claims that Mexico possesses all three characteristics of a developing county. Those characteristics include relatively high tariffs; a high trade dependency on the United States; and an extensive and pervasive system of farm support that was linked to trade restrictions (Burfisher et al.).

<u>International Free Trade Agreements</u>

Greenaway's research consistently supports the claim that free trade benefits GDP growth per capita. Exports and GDP appear to be highly correlated meaning that countries who trade openly appear to prosper more than those with many trade barriers (Greenaway et al.). International trade agreements are tools to reduce the risk of international commerce by agreeing to limit the ability of the governments involved to implement trade barriers and to make all trade barriers imposed transparent, causing the long-run negative externalities associated with trade barriers to be reduced. They include an escape clause to allow governments to be able to impose trade barriers due to domestic political pressure. All regional trade agreements must meet the international standards set by the World Trade Organization (WTO) (Kerr). As of 1998 over 90 countries had initiated trade reform, mainly due to World Bank's Structural Adjustment Program (SAP) (Greenaway et al.).

GATT / WTO

In 1986, Mexico joined the GATT (Casario). GATT has reformed international trade and has spurred a strong growth of international trade, while the WTO implemented a more forceful system to resolve disputes (Zhou and Vertinsky). The WTO is the international body that has control over the global rules of trade between nations. The rules that govern the trade between nations are formed through a set of agreements that are negotiated and signed by the member nations of the WTO (Evans). Mexico lowered tariffs and converted most import quotas to tariffs in 1988 because of GATT (Burfisher, et al.). In 2000, Fabiosa's study revealed that there was consistent evidence that the GATT reforms improved beef market efficiency (Fabiosa).

The Uruguay Round Agreement on Agriculture (URAA) function was to end trade-distorting policies. It not only expanded market access, but ensured market access and limited domestic support and export subsidies. The agreement proved successful by changing domestic and trade policies of some of the countries who have the largest roles in the beef world market including the European Union, the United States, Japan, Mexico, and South Korea (Fabiosa).

NAFTA

NAFTA is an international free trade agreement signed by Canada, the United States of America, and the United States of Mexico put into effect on January 1, 1994. It was developed to aid the countries of North America in competing in the global market, which is dominated by trading blocks (Young). Before NAFTA, Mexico and the United States had formed a series of bilateral trade pacts and Canada and the United States formed the U.S. Canada Free Trade Agreement, of which NAFTA is an extension (Casario). NAFTA eliminates all tariffs, quotas, and licenses that act as barriers to agricultural trade between the United States and Mexico (Hillman). NAFTA allows for the trade barriers to be phased out in ten years from the date the agreement became effective and allows for a 15 year transition period for some import sensitive products (Casario).

Kerr argues that the NAFTA's partners' lack of willingness to exceed the WTO's international standards suggests that they are not committed to the relationship of the agreement and it lacks the ability to force progress. It lacks this ability because there are not any deadlines and closures and is simply a method to raise discussion for various issues (Kerr).

Burfisher found that NAFTA caused trade to increase and when domestic farm program reforms were adopted, gains increased by an even greater amount. All three countries experience welfare gains, although Mexico only experiences gains when it removes domestic agricultural distortions. It also increased a sense of security in the adjustment process for Mexico by guaranteeing producers that have access to a large market (Burfisher et al.). NAFTA has proven to be successful in increasing U.S. agricultural trade significantly with Canada and Mexico (Mattson and Koo).

Mexico's agriculture will first experience NAFTA's benefits through the improvements in transportation, telecommunications, intellectual property and capital (Young). The majority of cattle imports from Mexico to the U.S. are from the northern region of Mexico. As transportation improves and consumer beef demand in Mexico continues to grow and change from grass-fed to grain-fed beef due to changing preferences and increasing income levels, there will be an influx of cattle from the central and southern regions (Leuck and Link; Peel 2003).

Trade Barriers

If borders did not exist, bans on movements of animal or animal products would be managed by the veterinary service using scientific management. However, borders do exist and divide governments and give countries the right to control their borders how they see fit. Economists and policy makers view border measures, which are policy instruments used to eliminate, to restrict, or tax the movement of goods and services, in different ways. Economists view border measures as a way to ensure economic protection, while policy makers view them as a tool to ensure public safety (Kerr).

Legitimate border measures ensure public safety. They include restricting flow of agriculture and its products, quarantining animals or testing them upon import are ways to reduce the spread of disease (Kerr).

Border measures put into place for legitimate reasons can abused and used for illegitimate reasons. Sometimes firms pressure governments for protection from international competition (Zhou and Vertinsky). Exports from a country may be banned even if the outbreak is regionalized or cannot thrive in an importing country (Kerr). The issue of animal health campaigns being a non-tariff trade barrier, instead of a way to protect humans, livestock, and plants arises every time new health campaigns are implemented. Non-tariff trade barriers (NTB) have become an issue in many of the free trade agreements and are a constant area of negotiations for the countries involved in the trade agreements. A survey of North Dakota businesses showed that exporters of agricultural commodities are experiencing increasing levels of NTB. NTB include any policies other than tariffs, which cause free trade to be obstructed (Mattson et al.). They are usually more complex and less transparent than traditional border measures and are only restricted by the inventiveness of bureaucrats (Kerr).

Non-tariff trade barriers often begin with a legitimate reason and then are abused and become illegitimate non-tariff trade barriers. Economic protection and political precaution are motives, which drive the imposition of illegitimate use of border measures. Often times voters will pressure their governments to impose illegitimate border measures on risks that are not scientifically based (Kerr).

One type of NTB is administrative trade barriers, which include sanitary and phytosanitary barriers. These trade barriers cause trade uncertainty, which occurs when a commodity may not be able to enter an import market due to regulations. If a commodity does not enter the import market, then prices will increase in the destination market and decrease in the market of origin (Gallagher). Although some protectionist policies cause a net welfare loss, Zhou and Vertinsky argue that minimum quality standards can improve a country's welfare and the world's welfare and if this is true then it is not an

NTB. If standards can be met with reasonable investments, then the imposition of the standard should not be argued (Zhou and Vertinsky). This argument could be made for sanitary and phytosanitary measures as well.

The WTO has attempted to address the problem of sanitary and phytosanitary regulations being used as a trade barriers with the negotiation of the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) at the GATT negotiations (Kerr). The SPS agreement was designed to protect human, animal and plant life or health from risks arising from the entry, establishment, or spread of pest, disease, disease carrying organisms, or disease causing organisms (Evans). The WTO recognizes the Office International des Epizootics (OIE) to be the international standards setting authority on the use of border measures. The WTO allows countries to set their own standards on health safety as long as they are based on scientific information. Exporting countries are allowed to challenge other countries importing health regulations, if there is not sufficient scientific evidence supporting the trade restriction. The SPS Agreement allows for sub-national disease free zones (Kerr, Mattson et al.).

In order to promote free trade while protecting borders and utilizing eradication methods the SPS Agreement formed five general principals. The first is harmonization to encourage the use of measures that conform to international standards, guidelines, and recommendations of international agencies. The second is equivalence, which includes a mutual recognition of different but equivalent measures to achieve international standards. The third is non-discriminatory, meaning that imports are treated no differently than domestic products. The fourth is transparency meaning nations are to notify their trading partners of changes in their SPS measures. The fifth is regionalization, which allows exports from disease free areas of affected countries (Evans).

Mexican – American Trade History

Mexico and the U.S. have a long history of trade. In recent years, Mexico and the United States have experienced a complementary livestock trade, where Mexico exports live animals to the U.S. and imports animal products from the U.S. (Rosson et al.).

Mexico became the fastest growing export market for the U.S. when U.S. exports to Mexico more than tripled from 1987 to 1996 (Casario). U.S. agricultural exports to Mexico slightly increased from 1982 to 1987, and then nearly doubled, shooting from $1,202 million to $2,234 million one year later. In 1988, Mexico imported $140 million in live cattle and $40 million of value-added beef (Lee et al.). In 2005, U.S. beef exports to Mexico were $551 million and U.S. Mexican cattle imports were $515 million (USDA-FAS).

NAFTA has had tremendous effects on trade between the United States and Mexico. It proved to be successful in 1994 and then in 1995 exports to Mexico from the U.S. declined sharply and imports to the U.S. from Mexico increased. The U.S. decreased beef exports to Mexico by 59 percent and increased Mexican cattle imports by 54 percent from 1994 to 1995 (Jacques et al.).

From 1997 to 2001, 12 percent of U.S. agricultural exports were sent to Mexico and 13 percent of U.S. agricultural imports were imported from Mexico (Mattson and Koo). Lee's research suggests that imports of live U.S. cattle and income in Mexico are negatively related, while U.S. preserved or prepared beef imports and per capita income in Mexico are positively related. He concludes that as income grows in Mexico, imports of U.S. fresh and frozen beef will increase (Lee et al.). The U.S. is concerned with the animal health status in Mexico because of the increasing agricultural trade between the two countries.

Animal Disease

Mexico's disease situation has greatly improved since the Mexican government restructured veterinary services. The New World screw worm has been eradicated, states have been declared free of swine fever and avian influenza, and there has been an increase in the number of farms declared free of bovine tuberculosis or brucellosis (Perez). Hillman argues that the Mexican disease control programs are not equal to the programs in the U.S. and that animal disease occurs at a higher prevalence rate.

Mexico acknowledges the importance of health campaigns. Since the National Campaign for the Eradication of Animal Brucellosis was implemented in Mexico there has been great progress towards eradicating brucellosis in Mexico. There is still room for health campaigns to improve because there is still variation in the status of animal disease among the states (Luna-Martinez and Mejia-Teran).

Health Concerns

Recently there has been concern about the potential health and economic impacts of animal disease outbreaks, especially concerning the livestock and meat industries (Skaggs et al). There is particular concern about cattle being imported from Mexico to the U.S. and the threat of brucellosis and tuberculosis (Hillman). Bovine tuberculosis can be transmitted from animals to humans and is a respiratory disease. If detected, Animal and Plant Health Inspection Services (APHIS) recommends herd depopulation (USDA-APHIS 2005). Brucellosis is also contagious to humans, although it is of not the focus to this research because it is only found in sexually intact animals. The U.S. federal and state governments have invested about $11 billion in the last 45 years to eliminate brucellosis (USDA-ARS).

<u>Tuberculosis (TB)</u>

There is eminent concern in the United States about the spread of bovine tuberculosis. Tuberculosis (TB) is a problem because it cannot only hinder trade of animals and animal products, but it can cause tremendous losses for farmers, increase food prices, and pose potential health risks (Faries and Adams). In 2000, cattle herds were valued at $67 billion and in 1999 cash receipts from the sale of cattle and cattle products were valued at $63.4 billion. A large outbreak of tuberculosis in the United States could prove to be catastrophic causing significant production and trade losses (USDA-APHIS 2004a).

In 2003 forty-eight states in the United States were considered TB free (Meyer). Scientists identified 400 cattle and deer infected with M. bovis from Canada, Texas, and Mexico in 2000, while some strands were unique to the area they were found in, most were shared by Texas and Mexico indicating that there is movement both ways between the two (Adams et al.). Since 1990, Texas' TB infection rate has increased in cattle and the majority of feedlot cases have been traced to Mexico. Since 1997, cattle imports have generally increased from Mexico (USDA-APHIS 2004a). Cattle are tested for TB before they are imported from Mexico to Texas and then retested when they enter Texas before they are allowed to come into contact with dairy cattle, breeding beef cattle, or stocker cattle (Faries and Adams).

General sources for the remainder of the Tuberculosis section are from the APHIS 2005, and Faries and Adams. Tuberculosis (TB) is caused by the Mycobacterium group of bacteria, which are classified into three types: Mycobacterium bovis, Mycobacterium avium, and Mycobacterium tuberculosis. M. avium is the only TB virus not infectious to humans, but it is infectious to all species of birds, hogs, and cattle. M. bovis, which causes Bovine TB, has the greatest range of hosts of any other TB organism; it is infectious to all warm blooded vertebrates, including humans and livestock and can be spread from one species to another, although it is rarely diagnosed in humans. Cattle, goats, and pigs are the most susceptible to M. bovis, while sheep and horses have a high natural resistance to the bacteria. TB can be transmitted from domestic livestock to wildlife and vise versa. It is usually transmitted through the air, where an infected animal exhales or coughs out the bacteria through aerosols, or invisible droplets of water, then a susceptible warm blooded vertebrate inhales the aerosol and is infected by the bacteria. It can also be contracted though bodily fluids, including feces, sputum, urine, vaginal and uterine discharges, and the consumption of unpasteurized milk of an infected animal. The M. Bovis bacteria can spread through the sharing of a common watering place contaminated with saliva and other bodily discharge from an infected animal or by feed contaminated by feces.

Mycobacteria causing TB cannot withstand prolonged exposure to the heat, direct sunlight, or dry conditions, therefore cannot survive outside a host's body for more than a few weeks, unless it is in cold, dark, moist conditions. Running water is not an important source of infection, but it can survive and be infectious in stagnant water up to 18 days after a TB-carrier animal uses it. TB can also be found in the feces from an infected animal six to eight weeks after the feces was dropped, and only one week if the weather is dry and pastures are harrowed. The disease can take many months to develop and is often not apparent until it reaches an advanced stage in cattle. The bacteria can lie dormant in the host's body for a lifetime without causing progressive disease, or it may not show any signs until slaughter, and be so infected that the carcass is condemned.

Bovine TB causes tubercles to develop in any organ in the host's body. Tubercles are tumor-like masses caused by the body's natural defense mechanism to localize the bacteria. Although lesions are difficult to find in the early stages of TB, they can be found on the organs and body cavity of an infected animal. Nodules become evident in the lungs and lymph nodes in later stages of the disease. Coughing, nasal discharge, and weight loss are signs of TB in cattle. Further diagnosis can be conducted by conducting a tuberculin skin test. Tuberculin is a sterile laboratory product made from TB bacteria. If the tuberculin is injected into an infected animal, swelling will occur at the injection sight about 72 hours after the injection occurred. In humans chest x-rays and sputum cultures are used to confirm the presence of bovine TB, while in animals the comparative cervical tuberculin test, serological tests, post mortem examinations, and other laboratory procedures are used.

Although it is not commonly used in the United States, there is a vaccine for TB called BCG, which is administered to infants and small children in countries where TB is prevalent. The vaccine is not 100% effective in the prevention of being infected with TB.

Humans may be infected with two types of TB: latent infections or active infections. Latent infections are when the body is able to stop the TB bacteria from growing. The host does not have any signs and cannot spread the disease, yet it can develop into an active TB infection if the host's immune system is depleted for any reason. Active TB is characterized by the common symptoms of a bad cough lasting more than two weeks, spitting up blood or sputum, chest pain, fatigue, weight loss, loss of appetite, chills, fever, sweating at night, and can be spread. There are medicines to cure active TB (DHHS). Treatment for bovine TB takes six to nine months and has a 95 percent success rate in humans.

Livestock infected with TB are considered to be incurable and are destroyed if they test positive for the bacteria. Eradication of infected livestock has been the most effective way to prevent human infection. In 1917 the United States began the Bovine Tuberculosis Eradication program and reduced the reactor rate from 5% in 1917 to .015% in 1990 through herd eradication, along with disinfecting areas from which infected cattle were removed. Currently the program uses skin testing for interstate movement of cattle and herd accreditation and a nationwide surveillance program in slaughter plants, where State and Federal inspectors check organs for signs of TB in the organs and glands. If lesions are found, then tissue samples are sent to APHIS National Veterinary Services Laboratories for further testing. If testing for TB is positive then the carcass is destroyed and the animal is tracked back to the originating herd, which has to be tuberculin tested. If the originating herd is test positive for TB, then there are two options. The first option is to depopulate the herd, which is preferred by APHIS. If this cannot occur, the herd will be placed under quarantine and tested until all evidence of TB is gone. Veterinary epidemiologists try to determine the date the herd was infected and then an attempt to trace all cattle that have moved in and out of the herd is made to trace where the disease came from and where it has gone. The skin test does not detect minimal sensitivity cases. On October 17, 2000, Secretary of Agriculture Dan Glickman authorized the transfer of $44,196,876 from the emergency contingency funds to APHIS for the expansion of the United States' TB eradication program (USDA-APHIS 2002b).

Faries and Adams suggest adopting a total health management program to minimize the possibility of infection including annual herd tests, replacement animal tests, tests of emaciated and chronic coughing cattle, postmortem examinations, and individual animal identification and record keeping.

APHIS gives a list of ways to prevent the spread of TB. They suggest to test livestock by an accredited veterinarian, keep a closed herd and if that is not possible obtain historical health information about the herd of origin from the seller, and maintain fences to prevent a herd from coming in contact with a neighboring herd. Buying from an accredited herd is the best way to prevent TB if a herd cannot be kept closed. If health records are not available, it is important that the cattle be tested before purchase, and then retested and isolated for 60 days.

Herd Accreditation

APHIS released a set of minimum standards established to maintain TB-free accredited cattle herds that were effective January 22, 1999. For a herd to be accredited all animals 24 months or older and animals under 24 months, which did not originate from the herd must be tested for TB by a veterinarian employed in a full-time capacity by the State or Federal Government. Each animal is tagged for identification reasons. The herd must pass two consecutive annual tuberculin tests to become accredited and must pass an annual tuberculin test every 10 to 14 months to maintain the accreditation (USDA-APHIS 1999).

U.S. Import Laws for Mexican Cattle Regarding TB

The following summery of Mexican cattle import regulations are taken from the Code of Federal Regulations (CFR). Imports regulations for Mexican cattle are found in the CFR under Section 93.427 (USDA-Aphis 2004a). TB and brucellosis diagnostic tests requirements are defined in the CFR under Section 93.406 (USDA-APHIS 2004b). Under this regulation a certificate issued either by a salaried veterinary officer of the Mexican government from the region of origin or by a veterinarian accredited by the national Government of Mexico and endorsed by a full-time salaried veterinary officer of the National Government of Mexico must accompany all cattle, except those intended for immediate slaughter, imported from Mexico. The certificate states that the importation requirements for brucellosis and TB have been passed. Table II-1 gives the general requirements for the import of cattle from Mexico according to the Code of Federal Regulations.

To import cattle from Mexico, the importer should first apply for and obtain an import permit from APHIS found in section 93.404 of the CFR. This application is delivered to the veterinary inspector at the port of entry for inspection. The veterinary inspector at the port of entry will provide a written statement with a date when the animals may be received for inspection to the importer. The importer must provide two copies of the declaration spelled out in the CFR section 93.407. All cattle will be inspected at the port of entry (CFR).

Table II-1. Tuberculosis Requirements to Import Cattle from Mexico

Animal	Requirements
Steers	• Must originate for herd of origin that the whole herd tested negative for TB within 1 yr prior to exportation • Each animal received a negative test to an additional official TB test within 60 days prior to exportation • Each animal added to the herd tested negative for TB to any test required by the Administrator • Must be branded with a "M" between 2 and 3 inches tall on the right hip before arrival to the port of entry, except if it is imported for slaughter under section 93.429
Spayed Heifers	• Must originate for herd of origin that the whole herd tested negative for TB within 1 yr prior to exportation • Each animal received a negative test to an additional official TB test within 60 days prior to exportation • Each animal added to the herd tested negative for TB to any test required by the Administrator • Must be branded with a "M_x" between 2 and 3 on the right hip inches tall before arrival to the port of entry, unless it is imported for slaughter under section 93.429
Sexually Intact Cattle From an Accredited Herd	• The herd must be certified within 1 yr of exportation
Sexually Intact Cattle not Accredited	• Must be from a herd of origin that tested negative to a whole herd test for TB within 1 year prior to exportation • Each animal tested negative to an additional TB test between 60 days and 6 months before exportation • Any cattle added must be test negative to any TB test required by the Administrator, unless the animals are exported within six months of when the herd of origin tested negative to a whole herd test

(CFR Sections 93.406 and 93.427)

Cattle, which have been affected with or exposed to a communicable disease will be refused and will be handled, quarantined, or disposed of according to the

Administrator. All cattle, except for those in bond for immediate return to Mexico or for immediate slaughter, may be detained at the port of entry and are subject to disinfections, blood tests, other tests, and dipping to determine that they are free from any communicable diseases or infections. All cattle from a herd with one or more reactors to the tuberculin test will not be allowed to be imported until the herd is accredited. All Holstein and Holstein cross steers and spayed heifers from Mexico are prohibited from being imported into the U.S. The importer is responsible for the care, feed, and handling of the cattle during the period of detention (CFR).

TB Status Zones within Mexico

The U.S. recognizes four statuses regarding the prevalence of TB in cattle in Mexico. Specific application of the importing requirements with respect to TB as presented in the previous section depend on the TB status of different regions as assigned by the USDA. The first is the Modified Accredited Advanced (MAA) status, which only northern Sonora has obtained. The requirements for cattle from areas with a MAA status are listed in table II-2.

Table II-2. Import Requirements for Cattle from Modified Accredited Advanced (MAA) Zones

Type of Cattle	Import Requirements
Steers and Spayed Heifers	1. Certificate of Herd of Origin (CHO) endorsed by SAGARPA. 2. Official identification.
Sexually Intact Cattle	1. One negative individual TB test at the border. 2. CHO endorced by SAGARPA. 3. Official identification.

(USDA-APHIS 2006)

The second is the Modified Accredited (MA) status. Table II-3 lists the import requirements for cattle from regions designated with a MA status.

Table II-3. Import Requirements for Cattle from Modified Accredited (MA) Zones

Type of Cattle	Import Requirements
Steers and Spayed Heifers	1. One negative individual TB test. 2. CHO endorsed by SAGARPA. 3. Official identification.
Steers and Spayed Heifers from TB Accredited Free Herds	1. CHO endorsed by SAGARPA. 2. Official identification. 3. Proof of TB free herd status must be available to port veterinarian
Sexually Intact Cattle	1. Negative TB test within the past 12 months for the herd of origin. 2. One negative individual TB test at the border. 3. CHO endorsed by SAGARPA. 4. Official identification.
Sexually Intact Cattle from TB Accredited Free Herds	1. CHO endorsed by SAGARPA. 2. Official identification. 3. One negative individual TB test at the border. 4. Proof of TB free herd status must be available to port veterinarian.

(USDA-APHIS 2006)

The third TB status zone recognized by the USDA is the Accredited Preparatory (AP) status. Table II-4 lists the import requirements for cattle from regions designated with a MA status. The fourth TB status zone recognized by the USDA is the Non-Accredited (NA) status. Table II-5 lists the import requirements for cattle from regions designated with a NA status.

Table II-4. Import Requirements for Cattle From Accredited Preparatory (AP) Zones

Type of Cattle	Import Requirements
Steers and Spayed Heifers	1. Negative TB test on the herd of origin within the past 12 months. 2. One negative individual TB test. 3. CHO endorsed by SAGARPA 4. Official identification. 5. Import Permit Application endorsed by SAGARPA. 6. Lot of Origin Certificate (required by Mexico).
Steers and Spayed Heifers from TB Accredited Free Herds	1. One negative individual TB test. 2. CHO endorsed by SAGARPA 3. Official identification. 4. Import Permit Application endorsed by SAGARPA. 5. Proof of TB free herd status must be available to port veterinarian. 6. Lot of Origin Certificate (required by Mexico).
Sexually Intact Cattle	1. Negative TB test on the herd of origin within the past 12 months. 2. Two negative individual TB tests (with the second test conducted at the border). 3. CHO endorsed by SAGARPA. 4. Official identification. 5. Import Permit Application endorsed by SAGARPA. 6. Lot of Origin Certificate (required by Mexico).
Sexually Intact Cattle from TB Accredited Free Herds	1. One negative TB test at the border. 2. CHO endorsed by SAGARPA. 3. Official identification. 4. Import Permit Application endorsed by SAGARPA. 5. Lot of Origin Certificate (required by Mexico). 6. Proof of TB free herd status must be available to port veterinarian.

(USDA-APHIS 2006)

Table II-5. Import Requirements for Cattle From Non-Accredited (NA) Zones

Type of Cattle	Import Requirements
Only cattle direct to slaughter	1. One negative individual TB test (required by Mexico). 2. CHO endorsed by SAGARPA. 3. Official identification. 4. Import Permit Application endorsed by SAGARPA.

(USDA-APHIS 2006)

The guidelines and application process for U.S. recognition of animal health status of a region can be found in Section 92.2 of the CFR. It is important to consider the TB status of different regions in order to understand the impacts of improved animal health campaigns within Mexico. Figure II-1 is a map of Mexico and the TB zones as identified by the USDA. The maps of Mexico are not exact in the location and size of the TB zones within the states, they are on the map to show that there are areas within states that have a different status than the majority of the state.

Mexico and the U.S. have some differences with respect to the TB status of some regions. Durango is a particularly important point a state of disagreement between the two countries. Mexico considers it to be TB free and the U.S. declares it a Non-Accredited (NA) State. Figure II-2 is a map of Mexico with the current classifications of TB free and infected zones according to the Dirección General de Salud Animal in Mexico and the current check points as identified by the Secretaria de Comunicaciones y Transportes in Mexico.

Figure II-1. Map of TB Zones according to the USDA

(USDA-APHIS 2006, SAGARPA Direccion General de Salud Animal)

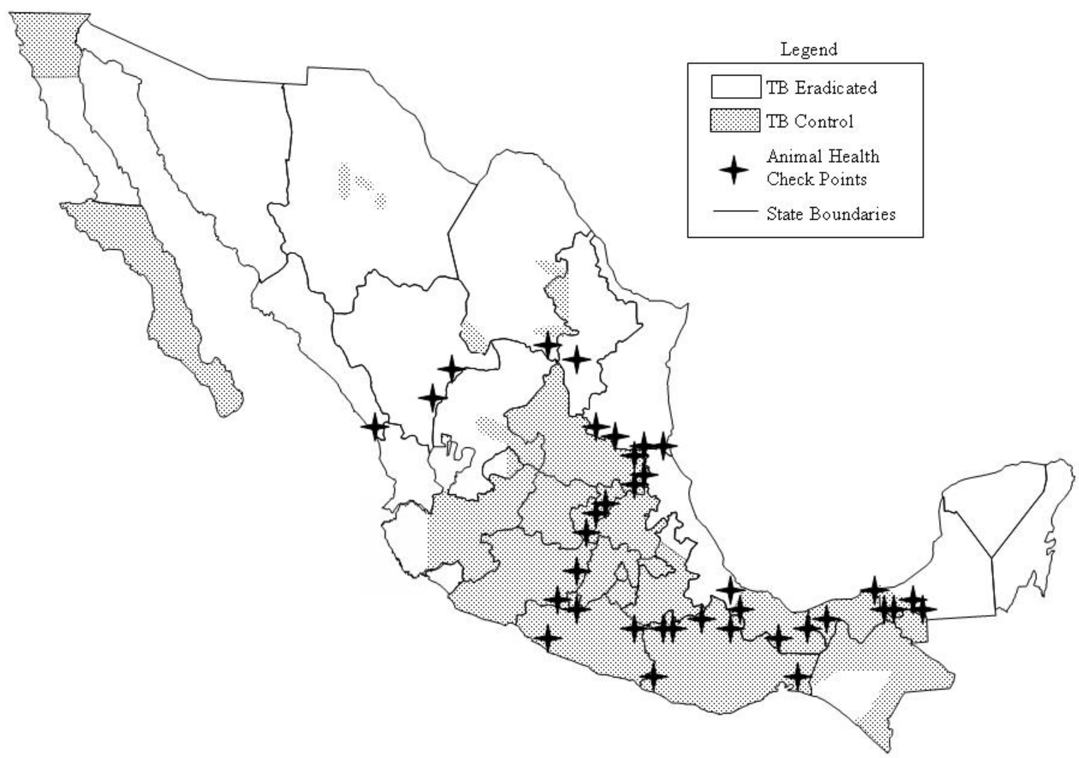
Climatic Zones

Mexico can be divided into three distinctive climatic zones: the arid and semiarid zone, the temperate zone, and the tropical zone. These zones can be further divided into sub zones. Production practices vary among the zone due to climatic variances. Disease prevalence is also dependent upon the climatic conditions.

<u>The Arid/Semiarid Zone</u>

The arid/semiarid zone is characterized by extreme conditions. Extreme temperatures, low precipitation with uneven distribution, and sometimes torrential rains and long periods of drought are characteristics of this zone. Very high temperatures with high evaporation and little environmental humidity characterize the spring and summer. The winter is characterized by low temperatures, intense freezes and snow cover (Villalobos 1994a).

Figure II-2. Map of TB Status in Mexico According to Dirección General de Salud Animal in Mexico.



(SAGARPA Direccion General de Salud Animal)

The arid/semiarid zone can be divided into two different zones: the arid zone and the semiarid zone. Table II-6 lists some of the characteristics of the arid/semiarid zone. The vegetation found in the semiarid and arid zones include bush type plants and grain producing plants found in the grass family. Pastures, thickets and forests make up the available vegetation in the arid/semiarid zone. The plants have adapted to the extreme conditions of this zone. Although cattle can forage on many of the plants available in this zone, many of the plants have little forage value (Villalobos 1994a).

Table II-6. Characteristics of the Arid/Semiarid Zone

	Arid Zone	Semiarid Zone
Normal Annual Precipitation	Less than 350 mm Irregular distribution	Ranges from 350 to 600 mm
Average Annual Temperature	Ranges from 15 to 25 °C	Ranges from 18 to 25 °C
Dry Months	No less than 7 months	6 to 8 months
Vegetation	Less than 70 percent vegetative coverage Dominant Species: Xerófitas	More than 70 percent vegetative coverage Mainly thickets and pasture

(Villalobos 1994a)

Temperate Zone

The temperate zone contains diverse climates. The climates vary depending on temperatures and rainfall distribution. The common amount of annual precipitation is from 500 to 2,500 mm, but can be as low as 200 mm in dry climates and as much as 4,000 mm in semi-warm climates. The average temperature is between 12 °C and 22 °C, but can reach lows of 6 °C and reach highs of 24 °C.

The temperate zone is comprised of forests, induced pastures, and tall thickets. The principal species being evergreens, pine trees, and oyamels (Villalobos 1994b).

Tropical Zone

The tropics are divided into two different zones: the dry tropics and the wet tropics. Table II-7 shows the characteristics of the tropical zone.

Table II-7. Characteristics of the Tropical Zone

	Wet Tropics	Dry Tropics
Precipitation	Greater than 1,300 mm	600 to 1,300 mm
Number of Days with Rain	200 to 365	115 to 175
Average Annual Temperature	Greater than 20 °C	Greater than 18 °C
Average Temperature in the Coldest Month	Greater than 17.7 °C	Greater than 16 °C
Average Temperature in the Warmest Month	Greater than 0.0 °C	Greater than -4.0 °C
Number of Freezes per Year?	Less than 1	0 – 25
Altitude	0 – 1,000 m	0 – 2,000 m

(Villalobos 1994c)

The Tropical zone is comprised of jungles, forests, and scrubs (Villalobos 1994c).

CHAPTER III

METHODS AND DATA

Linear Programming

GANAMEX is a linear programming model. A linear programming model was chosen for its ability to represent different productions systems in detail, to understand the impacts of resource limitations and how they are affected by changing market conditions, to represent regional differences, to analyze impacts of changes in isolation of specific factors, to analyze scenarios of hypothetical situations, and to overcome limitations in data availability or quality. Linear programming models contain two basic components (Hazel and Norton):

1. A feasible set of real numbers for the problem defined by the set of constraints and by the non-negativity conditions.
2. A single valued continuous objective function.

Every model has a set of activities, constraints, coefficients, and an objective function. The constraints are linear combinations of the activities that exactly exhaust the resource. The objective function is the first equation to be maximized (Hazel and Norton). The coefficients are assumed to be known constants and are the ratio of the quantity of resource is required to produce one unit of activity (Epplin, Hazel and Norton). The optimal solution must be feasible (Hazel and Norton).

There are eight basic assumptions regarding the nature of the production process, the resources, and activities are implicit in the in linear programming including (Hazel and Norton):

1. Optimization. An appropriate objective function is either maximized or minimized.
2. Fixedness. At least one constraint has a nonzero right hand side coefficient.
3. Finiteness. There are only a finite number of activities and constraints to be considered in order that a solution may be sought.
4. Determinism. All coefficients in the model are assumed to be known constants.
5. Continuity. Resources can be used and activities can be produced in fractional units.
6. Homogeneity. All units of the same resource or activity are identical.
7. Additivity. When two or more activities are used, their total product is the sum of their individual products; no interaction effects between activities are permitted.
8. Proportionality. Regardless of the level of activity used, the gross margin and resource requirements per unit of activity are constant. A constant gross margin per unit of activity assumes for a given activity perfectly elastic demand curve for the product, and a perfectly elastic supplies of any variable inputs that may be used.

Additivity and proportionality define the linear activities, linear isoquants in factor use between pairs of activities, and lead to an aggregate whole farm production function relating the value of the objective function and the fixed resources that have constant returns to scale. Although these assumptions must hold true for the model, they do not have to hold true for the farm production process. Linearity between inputs and outputs can be relaxed by incorporating several activities causing a piecewise linear approximation to observe nonlinear relations. To relax the additivity requirements and allow joint production and complementary or supplementary relationships activities can be defined to represent mixed enterprises. To relax the fixedness requirements mutliperiod specification may be applied (Hazell and Norton).

Optimization models not only show goals and constraints, but are often able to predict what farmers will do. When linear programming models are applied to the farm level, there is a single decision maker and the model is able to simulate the farmer's choices and their consequences. It becomes more difficult to apply the model to a decentralized economy where instead of a single decision maker there are two levels of decision makers, the farmers and the policy makers, whose interests differ at times. Since it is so difficult to build a two-level policy model, often times a model that explains the producers' reactions to external changes is developed, called a descriptive model (Hazell and Norton). The GANAMEX model is a descriptive model. TB restrictions are applied, the model is run, and then the results, which are the expected reactions of the cattle producers', are analyzed to provide insight of how TB restrictions would affect Mexican economics.

Linear programming models are chosen over econometric models mainly due to data difficulties and changes in underlying economic structure. Time series data normally does not contain enough degrees of freedom to estimate own and cross-supply elasticities. Linear programming models prove especially useful when modeling developing countries due to their lack of data and unreliable aggregate time series on production (Hazell and Norton). Not only is Mexico a developing country, but there is a lack of time-series data about the Mexican cattle industry currently available, which is one reason why a linear programming model was chosen for this research.

Linear programming has been used in the past to model various cattle and beef industries. Asuming-Grempong and Staatz used a mathematical programming model to model cattle and beef trade in the West African Central Corridor. They were researching the implications of creating a free-trade zone for cattle in West African countries, where cattle can be moved freely among the countries in the Economic Community of West African States (ECOWAS). Their model was developed to simulate the cattle industry of the ECOWAS, allowing for changes in government policies and some external shock. Although the current study is considering the effects of regional trade barriers and opening up regional barriers within a country, the Asuming-Grempong and Staatz study and this study have much in common. Both consider shifts in cattle production and beef consumption, who benefits and who loses from the policy change, and how the flow of trade is affected (Asuming-Grempong and Staatz).

Nelson modeled the U.S. beef industry using a linear programming model to develop a multistage, multiproduct, interregional competition model from beef production to beef distribution. He divided the U.S. into five production regions based on geographical, climatic and agricultural patterns, and six consumption regions based on groupings of primary markets (Nelson et al.).

Kalantar chose to use linear programming due to its ability to predict price alterations for all trading regions from specified production changes in one region. His research was interested in quantitatively estimating the influence of change in fed beef production for given regions upon prices of fed beef for all regions in the United States (Kalantar et al.).

The basis of the GANAMEX model came from a model developed by Hayes. The model was constructed to simulate the Mexican cattle industry and to evaluate the resource limitations, productivity of the herd, and changing demands of Mexican consumers. Mexico was divided into three production regions. Production, slaughter, transportation, import and export activities were included in the model (Hayes).

GANAMEX Model

The GANAMEX model was developed by Peel to simulate the Mexican cattle and beef industry (Peel 2001). For this research it was expanded to allow for more specific regional impacts. It is a cost minimization model, which allows for the allocation of scarce resources to competing activities.

The objective function minimizes the cost of providing a specified quantity of beef consumption in the Mexican market. It sums of all activities and multiplies them by the cost per unit associated with the activity, then chooses the level of the activities that minimizes the cost from the possible alternatives. When the objective function is minimized the activities contain the solution for the model given a set of circumstances. Activities included in the model are production, processing, transportation, and trade (Cunningham and Peel).

The general form of the objective function is given in equation (1).

$$(1) Cost = \sum_{a=1}^{p} \sum_{b-1}^{f} PF_{pf} F_{pf} + \sum_{a=1}^{p} \sum_{c=1}^{v} CC_{pv} C_{pv} + \sum_{a=1}^{p} \sum_{c=1}^{v} \sum_{d=1}^{r} CR_{pvr} R_{pvr}$$
$$+ \sum_{c=1}^{v} \sum_{d=1}^{r} \sum_{e=1}^{s} \sum_{g=1}^{m} CS_{vrsm} S_{vrsm} + \sum_{a=1}^{p} \sum_{a=1}^{p} \sum_{c=1}^{v} CT_{ppv} SC_{pv} + \sum_{p=1}^{p} \sum_{c=1}^{r} \sum_{e=1}^{s} RT_{prs} SR_{prs}$$
$$- \sum_{a=1}^{p} \sum_{c=1}^{v} EC_{p} CX_{pv} - \sum_{a=1}^{p} \sum_{c=1}^{v} \sum_{d=1}^{r} ER_{pvr} RX_{pvr} + \sum_{e=1}^{s} \sum_{g=1}^{m} \sum_{h=1}^{y} MT_{smy} M_{smy}$$
$$+ \sum_{g=1}^{m} \sum_{h=1}^{y} IM_{my} MI_{my}$$

Where

a=1...p, production regions
b=1...f, forage types
c=1…v, cattle types
d=1…r, stocker systems
e=1…s, finishing regions
g=1…m, meat types
h=1…y, consumption regions

PF is the forage price; F is forage used; CC is non-forage calf production cost; C is calves produced; CR is a non-forage cost of stocker production; R is stockers produced; CS is finishing cost; S is animals finished; CT is cost of shipping calves to other regions; SC is calves shipped; RT is cost of shipping stockers; SR is stockers shipped; EC is value of calves exported; CX is calves exported; ER is value of stocker exported; RX is stockers exported; MT is cost of shipping meat; M is meat shipped for slaughter to consumption; IM is the cost of imported meat; MI is meat imports.

The constraints represent the capacity or availability of resources and how the market activities are linked. There are two types of constraints in the GANAMEX model: inequality constraints and equality constraints. Inequality constraints' right-hand-side values represent resource capacity and availability, and in the case of meat demand, minimum consumption requirements. Equality constraints are balance equations whose right-hand-side values equal zero. These constraints enforce linkages in related production and processing activities, and track flows of product between regions. The constraints that represent resource capacity are for forage availability and feedlot capacity (Cunningham and Peel). Examples of the three basic types of constraints used in the model are given in equations 2-4.

$$\text{Forage Limit } (2) \sum_{a=1}^{p} \sum_{b=1}^{f} F_{pf} \leq \sum_{a=1}^{p} \sum_{b=1}^{f} PL_{pf}$$

$$\text{Calf Balance } (3) \sum_{a=1}^{p} \sum_{c=1}^{v} \sum_{d=1}^{r} R_{pvr} + \sum_{a=1}^{p} \sum_{c=1}^{v} CS_{pv} + \sum_{a=1}^{p} \sum_{c=1}^{v} CX_{pv} - \sum_{a=1}^{p} \sum_{c=1}^{v} C_{pv} = 0$$

$$\text{Meat Required } (4) \sum_{e=1}^{s} \sum_{g=1}^{m} \sum_{h=1}^{y} M_{smy} + \sum_{g=1}^{m} \sum_{h=1}^{y} MI_{my} \geq \sum_{g=1}^{m} \sum_{h=1}^{y} MC_{my}$$

PL is the hectares of forage available; MC is meat consumption requirements.

Activities and constraints are linked by technical coefficients that represent the productivity and input requirements of the production activities (Cunningham and Peel). A complete list of activities, constraints, and parameters included in the GANAMEX model follows.

The endogenous variables, also known as the activities, of the GANAMEX model include:

- Forage use by region (up to maximum) (F)
- Quantity type and location of
  - Cow-calf production (calves/stockers)
  - Stocker production (feeders)
  - Slaughter animal production
    - Finishing in feedlots
    - Finishing in pasture
- Domestic shipments of cattle by type

- Calves between production regions (SR)
- Stockers between production regions
- Feeders from production regions to feedlots

- Production of meat by type and location
- Quantity, type and location of Slaughter
- Domestic shipments of meat by type
    - From production regions to consumption regions
    - From feedlot regions to consumption regions
- Exports of calves by production region
    - Male and female
- Export of feeders by production region
    - Male and female
- Export of rodeo calves (constrained)
- Imports of meat by consumption region
- Imports of slaughter cows by production region
- Exports of meat by production region
- Imports of Central American calves and feeders (constrained).

The exogenous variables are the constraints of the model. The exogenous variables in the GANAMEX model include:

- Quantity of beef consumption by type and location
- Forage availability, productivity and cost
- Dairy sector contributions to cattle supplies and cull meat production by location
- Feedlot capacity by feedlot region

- Trade sector values
    - Value of export calves
    - Cost of meat imports
    - Cost of slaughter cow imports
    - Value of meat exports
    - Value of rodeo calf exports
    - Cost of Central American cattle imports
- Animal production and feed costs
    - Cow-calf by type and location
    - Stocker by type and location
    - Feedlot by type and location
        - Ration cost and conversion
        - Daily charge
        - Receiving cost
- Slaughter costs by type of slaughter
- Transportation costs for live animals and meat
    - Load sizes
    - Cost per loaded kilometer

The parameters reflect the input requirements and productivity of production activities. The parameters in the GANAMEX model include:

- Forage productivity by type and location
    - Stocking rates for native pasture
    - Forage yield of crop residues

    - Forage yield of irrigated pasture

- Cow-calf production by animal type and location
    - Male and female weaning weight
    - Birth (calving) percentage
    - Calf death loss (pre-weaning)
    - Cow culling rate
    - Cow death loss
    - Cow: Bull ratio
    - Cow mature and slaughter weight
    - Cow dressing percentage
- Stocker production by animal type, production system and location
    - Beginning weight (same as calf weaning weight)
    - Total stocker gain
    - Gain per day
    - Death loss
    - AU factor per animal
    - Ending weight
- Animal finishing systems by animal type and location
    - Beginning weight (same as stocker ending weight)
    - Days on feed
    - Gain per day
    - Death loss
    - Feed conversion rate (for feedlot and supplementation systems)

- AU factor per animal (for pasture systems)
- Ending weight
- Dressing percentage
- Carcass weight

The model is disaggregated into nine production regions, ten feedlot centers, and seven beef consumption regions. A complete listing of the programming code for the GANAMEX model is printed in Appendix I - VIII.

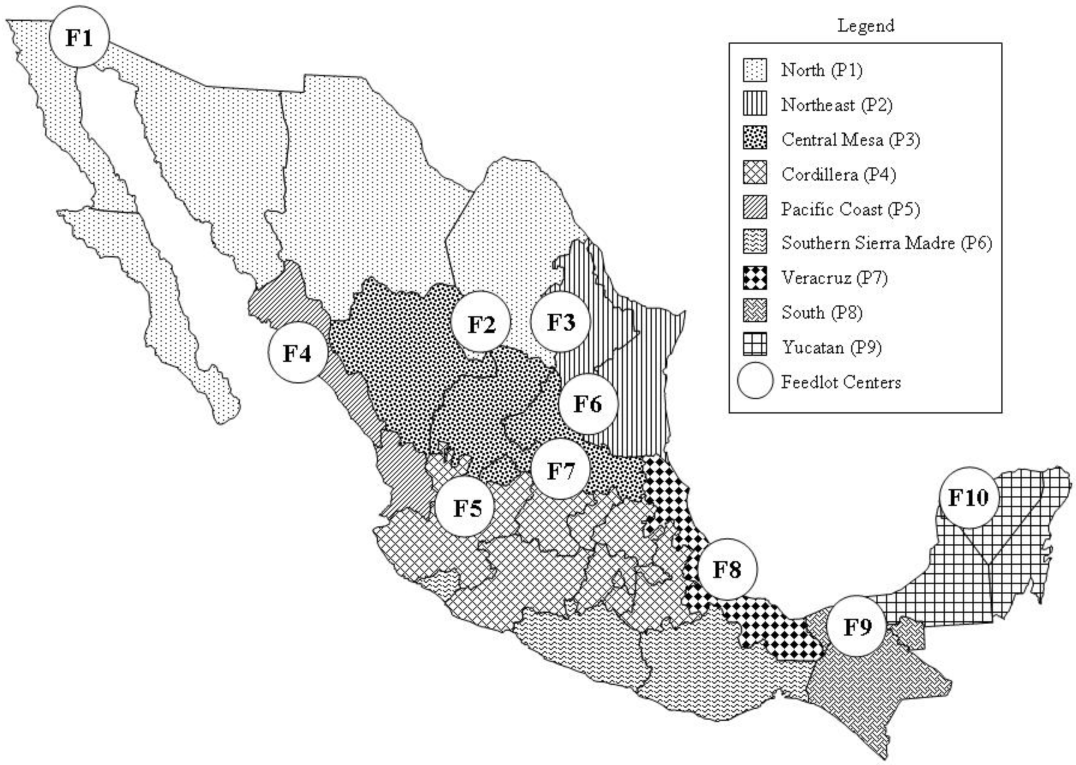
Production Regions

The production regions (P) refer to grazing regions used for cow-calf, stocker, and grass-finishing. The production regions are defined by geoclimatic characteristics, transportation considerations, and cultural differences in production practices. Figure III-1 is a map of Mexico and the nine production regions.

A representative city is specified for each of the production regions, from which transportation to and from the region is measured. Table III-1 lists the regions as designated in the model, the region names, the states included in each region, and the representative cities.

Information about the climatic composition of each production region are based on state level data from INEGI (2006). The North (P1) production region includes the states of Baja California, Baja California Sur, Sonora, Chihuahua, and Coahuila. It covers 37 percent of Mexico, and includes 72,738,200 square hectares. The region is comprised of several different climatic zones: 17.1 percent Temperate, 2 percent Dry Tropics, 66.1 percent Arid, and 14.8 percent Semiarid.

Figure III-1. Production Regions and Feedlot Centers in Mexico



The Northeast (P2) production region includes the states of Nuevo Leon and Tamaulipas. It possesses 7.4 percent of Mexico, covering 14,438,400 square hectares. The region is 11.6 percent Temperate, 14.5 percent Dry Tropics, 10.7 percent Arid, and 63.2 percent Semiarid.

The Central Mesa (P3) production region includes the states of Durango, Aguascalientes, San Luis Potosi, and Zacatecas. It spans over 26,312,500 square hectares, which is 27.8 percent of Mexico. The region is comprised of 27.8 percent Temperate, 1.4 percent Wet Tropics, 6.5 percent Dry Tropics, 18.9 percent Arid, and 45.7 percent Semiarid climates.

The Cordillera (P4) production region includes the states of Distrito Federal, Guanajuato, Hidalgo, Jalisco, Mexico, Michoacan, Morelos, Puebla, Queretero, and

Table III-1. Cattle Production Regions

Region	Region Name	States Included	Representative City
P1	North	Baja California, Baja California Sur, Sonora, Chihuahua, Coahuila	Chihuahua, Chih.
P2	Northeast	Nuevo Leon, Tamaulipas	Monterrey, N.L.
P3	Central Mesa	Durango, Zacatecas, San Luis Potosi, Aguascalientes	Zacatecas, Zac.
P4	Cordillera	Queretero, Hidalgo, Puebla, Tlaxcala, Mexico, Morelos, Guanajuato, Jalisco, Michoacan, DF	Guadalajara, Jal.
P5	Pacific Coast	Sinaloa, Nayarit	Culiacan, Sin.
P6	Southern Sierra Madre	Colima, Guerrero, Oaxaca	Oaxaca, Oax.
P7	Veracruz	Veracruz	Veracruz, Ver.
P8	South	Tabasco, Chiapas	Villahermosa, Tab.
P9	Yucatan	Yucatan, Campeche, Quintana Roo	Merida, Yuc.

Tlaxcala. It covers 44.2 percent of Mexico, spanning over 26,908,000 square hectares. The region is 44.2 percent Temperate, 3.9 percent Wet Tropics, 26.6 percent Dry Tropics, and 25.3 percent semiarid climates.

The Pacific Coast (P5) production region includes the states of Nayarit and Sinaloa. It covers 4.3 percent of Mexico, for a total of 8,571,300 square hectares. The region is comprised of 26.1 percent Temperate, 6.7 percent Wet Tropics, 53.2 percent Dry Tropics, 13.9 percent Arid, and .1 percent Semiarid Climates.

The Southern Sierra Madre (P6) production region includes the states of Colima, Guerrero, and Oaxaca. It covers 8.3 percent of Mexico, with 16,461,300 square hectares.

The region is comprised of 45.5 percent Temperate, 12.0 percent Wet Tropics, 39.5 percent Dry Tropics, and 3.0 percent Semiarid Climates.

The Veracruz (P7) production region includes the state of Veracruz. It covers 3.7 percent of Mexico, and includes 7,281,500 square hectares. The region is comprised of 11.5 percent Temperate, 70.5 percent Wet Tropics, 17.8 percent Dry Tropics, and .2 percent Semiarid climates.

The South (P8) production region includes the states of Chiapas and Tabasco. It covers 5.1 percent of Mexico, covering 9,854,800 square hectares. The region is comprised of 22.0 percent Temperate, 63.0 percent Wet Tropics, and 15.0 percent Dry Tropics climates.

The Yucatan (P9) production region includes the states of Campeche, Quintana Roo, and Yucatan. The Yucatan region covers 7.1 percent of Mexico, with a total of 14,152,300 square hectares. The region is comprised of 64.6 percent Wet Tropic and 35.4 percent Dry Tropic climates.

Feedlot Centers

The GANAMEX model contains ten feedlot regions with a representative city to measure transportation. Figure III-1 shows approximately where each feedlot center is located on a map of Mexico. Feedlot centers are less affected by geoclimatic considerations and more affected by the location of the infrastructure, than production regions. Feedlot centers are defined by regional centers of concentration of feeding facilities, by transportation considerations, and by the differences in feedlot production and management practices. Table III-2 lists the feedlot center, its name, and its representative city.

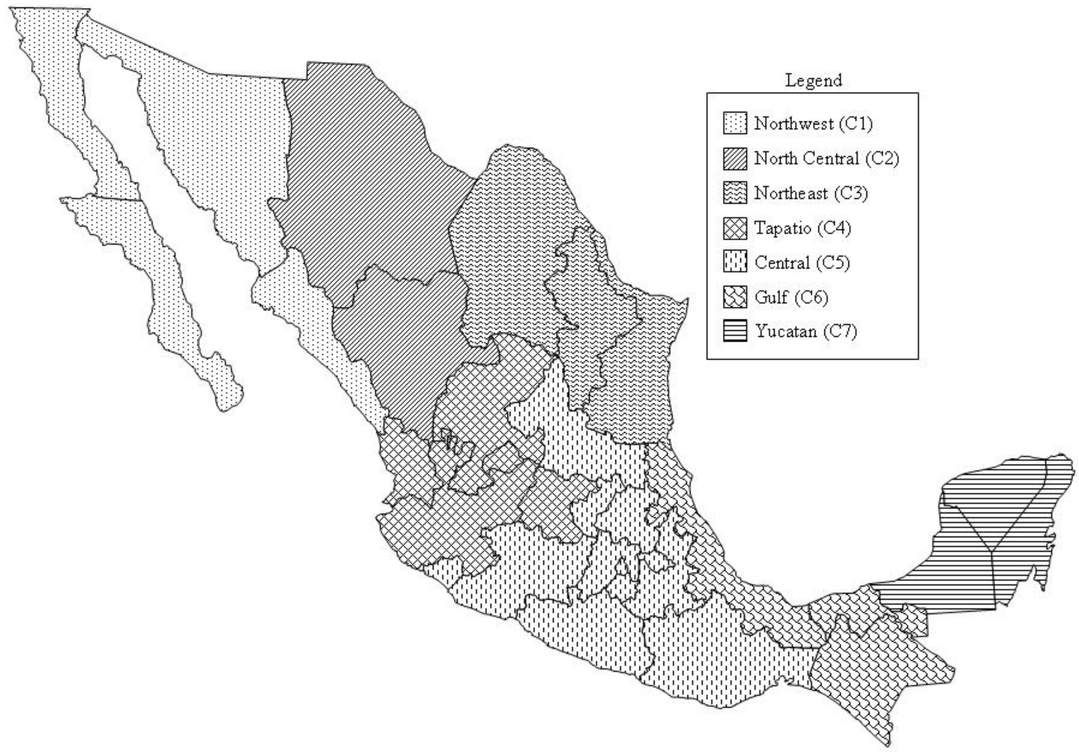
Table III-2. Feedlot Centers

Region	Region Name	Representative City
F01	Northwest	Mexicali, B.C.
F02	La Laguna	Torreon, Coah.
F03	Northeast	Monterrey, N.L.
F04	Pacific Coast	Culiacan, Sin.
F05	Cordillera	Guadalajara, Jal.
F06	Huasteca	Tampico, Tamp.
F07	Central Mesa	San Luis Potosi, S.L.P.
F08	Veracruz	Veracruz, Ver.
F09	Tabasco	Villahermosa, Tab.
F10	Yucatan	Merida, Yuc.

Consumption Region

The GANAMEX model contains seven consumption regions. Figure III-2 shows the consumption regions on a map of Mexico. Each region includes a representative city, from which transportation costs are calculated. The regions are defined by a combination of population characteristics and previous research found in Beardsley, including population and regional differences in beef demand. Consumption regions are specified to separate urban areas and to account for major transportation impacts of the rural and small urban centers. Table III-3 lists the consumption region, its name, the states, which make up the region, and its representative city.

Figure III-2. Consumption Regions in Mexico



Forages

There are three types of forages used to produce beef in Mexico; they are classified as irrigated pasture, native pasture, and crop residue.

Irrigated pastures produce the highest yield per hectare of the three forages at 3.0 animal units per hectare per year. They are the most costly to produce per hectare because of the labor and resources involved. The cost to produce irrigated pastures is 11,750 pesos per hectare per year. Because irrigation is involved, there is a high level of technology used to get the water to the pasture.

Native pastures are not managed as intensively as irrigated pastures and therefore do not have as high of yield on average as irrigated pastures. Native pastures are the

Table III-3. Consumption Regions

Region	Region Name	States Included	Representative City
C1	Northwest	Baja California, Baja California Sur, Sonora, Sinaloa	Hermosillo, Son.
C2	North Central	Chihuahua, Durango, Comarca Lagunera	Chihuahua, Chih.
C3	Northeast	Coahuila (without Torreon), Nuevo Leon, Tamaulipas	Monterrey, N.L.
C4	Tapatio	Nayarit, Jalisco, Aguascalientes, Colima, Guanajuato, Zacatecas	Guadalajara, Jal.
C5	Central	San Luis Potosi, Queretero, Hidalgo, Puebla, Mexico, Michoacan, Tlaxcala, Guerrero, Oaxaca, D.F.	Mexico City, D.F.
C6	Gulf	Veracruz, Tabasco, Chiapas	Veracruz, Ver.
C7	Yucatan	Campeche, Yucatan, Quintana Roo	Merida, Yuc.

most common of the three forage types. The cost of native pasture is set at 300 pesos per animal unit per year. Native pasture costs begin in pesos per animal unit because stocking rates for native pasture forages vary among regions. The per animal unit cost is divided by the stocking rate in each region to determine the cost of native pasture per hectare in each region. Yield varies depending on the production region because every region has a different climate, soil fertility, and amount of rainfall. Table III-4 shows the stocking rate and cost of production in pesos per hectare per year for native pastures in each production region. The stocking rates are based on official stocking rates for each state and are the weighted average of the stocking rates of the states in each region (COTECOCA-SARH).

The third type of forage used in cattle production is crop residue. Crop residue is what is left after a crop is harvested. Often times in Mexico, crops, like corn, are harvested and then the stalks are fed to the livestock. It is the least costly produce, having an almost zero cost per hectare. The cost specified in the GANAMEX model for crop residue is 10 pesos per hectare. It yields .09 animal units per hectare.

The cost index and the yield index for each type of forage in every region is 1.0. The cost index is used to make adjustments in the cost of each type of forage used in each region. The yield index is used to adjust production yields of each type of forage for each region. They are all one for this model so they do not make an impact in the model, but they were built into the model in the case that there was a need for adjustments in the yield or cost in certain regions.

Table III-4. Native Pasture Production

Production Region		Stocking Rate (Ha/AU)	Production Cost (Pesos/Ha/Yr)
North	(P1)	23.93	12.54
Northeast	(P2)	15.01	19.99
Central Mesa	(P3)	12.95	23.17
Cordillera	(P4)	8.24	36.41
Pacific Coast	(P5)	8.62	34.80
Southern Sierra Madre	(P6)	4.88	61.48
Veracruz	(P7)	1.81	165.75
South	(P8)	1.85	162.16
Yucatan	(P9)	3.94	76.14

(Stocking Rate is from COTECOCA-SARH)

Table III-5 specifies the available hectares for the production of each type of forage in each production region. The data on the number of hectares of irrigated pasture in each region comes from the SIACON database (SAGARPA 2005). The number of native pasture hectares available is based on data from COTECOCA. The number of hectares of crop residue available is based on the maximum total cropped hectares in each state, in any given year, based on data from the SIACON database (SAGARPA 2005).

Table III-5. Available Forage in Each Production Region (Ha)

Production Region		Irrigated Pasture	Native Pasture	Crop Residue
North	(P1)	27,730	53,105,000	2,571,700
Northeast	(P2)	49,662	9,170,000	2,085,584
Central Mesa	(P3)	11,781	15,380,000	3,174,187
Cordillera	(P4)	36,518	11,086,300	6,844,708
Pacific Coast	(P5)	14,248	3,300,000	1,745,767
Southern Sierra Madre	(P6)	12,347	5,124,000	2,058,244
Veracruz	(P7)	7,640	3,600,000	1,664,157
South	(P8)	0	4,117,000	1,836,982
Yucatan	(P9)	3,014	4,900,000	1,180,867

Total animal units for irrigated pasture and crop residue forages is calculated by multiply the appropriate yield for the forage type by the available forage for each region. Total animal units for native pasture is calculated by dividing the available forage for native pasture for each region by the stocking rate for each region. Total forage available in the GANAMEX model is 14,827,435 animal units. The break down forage is 3.30 percent irrigated pasture, 82.64 percent native pasture, and 14.06 percent crop residue.

Cattle Types

There are four types of cow-calf production systems represented in the GANAMEX model: northern-style, semi-intensive, traditional, and criollo. Figure III-3 is a flow chart of the various production systems each calf type can go through to consumption. They are defined by their differences in production characteristics, including genetics and biological productivity, and by management practices. Table III-6 describes these differences in more detail.

Northern-style cattle, referred to as V1NORT in the model, are predominantly European breed genetics and have a medium to large frame with above average milking ability. They produce number 1 to number 1 ½ calves. Their nutritional and managerial requirements are relatively high, as result these cattle are more costly to produce. Although, they are the most costly to produce of the four types of cow-calf systems, they also have the highest average productivity rate per cow. They tend to be produced mainly in the northern semi-arid and arid regions of Mexico, although production of northern-style cattle is not restricted to those regions.

Semi-Intensive cattle, referred to asV2SEMI in the model, are composed of European breed, dairy, and Zebu genetics. They have a medium to large frame size. They are smaller than the Northern cattle and have a lower productivity rate due to their smaller animal size, lighter muscling, and lower reproductive rate. Semi-Intensive cows primarily produce number 2 calves. They are used in a meat only system or dual-purpose production of beef and milk. In general, improved genetics and a relatively high level of management practices characterize the group, making them larger than the traditional cattle with improved reproductive performance.

Traditional cattle, referred to as V3TRAD in the model, are characterized by the same production practices as the semi-intensive cattle, but have less use of improved genetics and less intensive management practices. Health and nutritional management is at a lower level than that of the semi-intensive cattle. Due to the lower level of management practices, productivity is lower as well as production cost compared to the semi-intensive cattle.

Figure III-3. Beef Production Systems in the GANAMEX Model

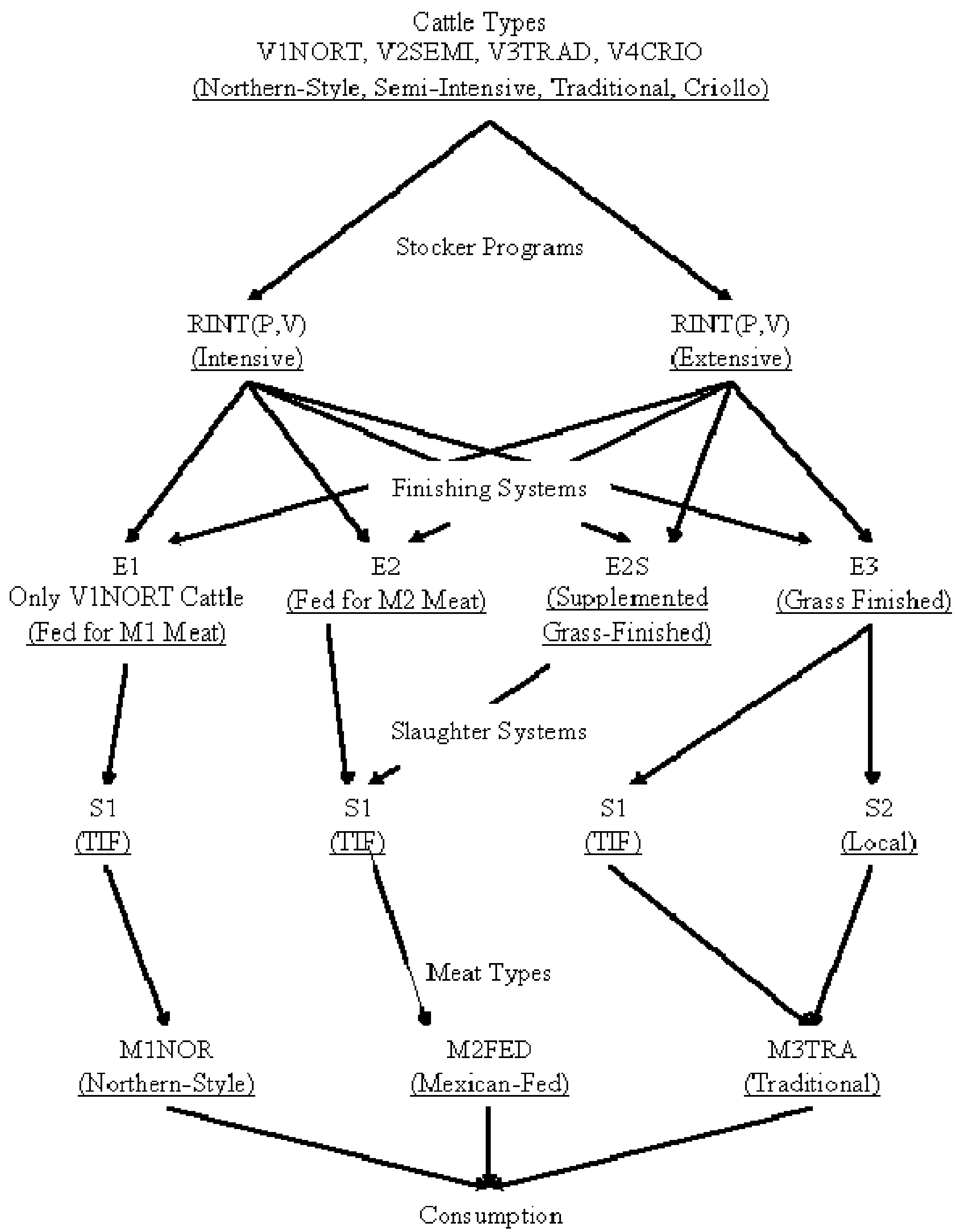


Table III-6. **Production Parameters by Cow Type**

	Northern-Style	Semi-Intensive	Traditional	Criollo
Cow Mature Weight (kg)	450	435	415	400
Milking Ability	Medium/ High	Medium	Medium /Low	Low
Male Weaning Weight (kg)	180	160	140	120
Heifer Weaning Weight (kg)	162	144	126	108
Average Calf Weaning Weight (kg)	171	152	133	114
Calving Rate (%)	74	64	56	45
Calf Death Loss (%)	4	5	8	10
Weaning %	70	59	48	35
Ranch AU factor/cow*	1.25	1.18	1.12	1.05
Relative Cow AU	1.0	0.96	0.91	0.85
Cull Cow Weight (kg)	405	391.5	373.5	360
Cull Cow Carcass Weight (kg)	226.8	219.24	209.16	201.6
Cow Culling %	10.0	10.0	8.0	7.0
Cow Death Loss (%)	2.0	2.0	4.0	5.0
Replacement Rate	.12	.12	.12	.12
Cull Cow Meat Per Cow (kg)	22.68	21.92	16.73	14.11
Bull Weight (kg)	562.5	543.75	518.75	500
Cull Bull Meat Per Cow (kg)	3.15	3.05	2.91	2.8
Per Cow Cull Meat (kg)	25.83	24.97	19.64	16.91

* The ranch AU factor is the animal units of forage required per cow. The value represents the relative biological size of the different cow types plus an allowance for replacement heifers and bulls that are required per cow.

Criollo cattle, referred to as V4CRIO in the model, are the least expensive to produce. They are usually found in subsistence farming situations. A wide variety of production practices are used ranging from meat and milk production for home consumption to animals used for traction to rodeo cattle. They are characterized generally by low productivity, unimproved genetics, and low management level. They have less value than other types of cattle except when sold as rodeo cattle.

To determine the heifer weaning weight, the model uses a male/female weight factor of 0.9 and multiplies it by the steer weaning weight for each cow type. The cull cow dressing percentage is 56. It is divided by 100 and then multiplied by the cull cow weight to determine the cull cow carcass weight in kilograms. The cow to bull ratio is 20 cows to every bull. The bull culling percent is 20 percent.

Stocker Programs

There are two types of stocker or grazing programs: intensive and extensive. All calves used for domestic meat production must go through one of these two stocker programs before finishing. Table III-7 describes the stocker production system for each of the cattle types. The intensive stocker system is more costly than the extensive stocker

Table III-7. Stocker Production

		Northern-Style	Semi-Intensive	Traditional	Criollo
Stockers	Weight Gain (kg)	100	100	120	120
	Ending Weight	271	252	253	234
Intensive Stockers	Intensive Stocker adg (kg)	1.1	1.0	0.85	0.8
	Days in Intensive Stocker	91	100	141	150
	Base Animal Unit Factor	0.60	0.55	0.55	0.50
	Death Loss %	2.0	2.0	2.0	2.0
	Adjusted End Weight (kg)	265.58	246.96	247.94	229.32
Extensive Stockers	Extensive Stocker adg (kg)	0.31	0.30	0.29	0.285
	Days in Extensive Stocker	323	333	414	421
	Base Animal Unit Factor	0.70	0.65	0.65	0.60
	Extensive Stocker Death Loss %	4.0	4.0	4.0	4.0
	Adjusted End Weight (kg)	260.16	241.92	242.88	224.64

system due to managerial practices. In the intensive stocker program the cattle are grazed on irrigated pasture, which leads to fewer days on pasture. Better management practices are used in the intensive stocker program, leading to a lower death rate of two percent. In the extensive stocker program the cattle are grazed on a lesser quality pasture for a longer period of time. A lower level of management is assumed, causing the death loss to be four percent.

The base animal unit factor (based on the size of the animals) is multiplied by the days of grazing and divided by 365 to determine the stocker animal units of forage required per head for stockers.

Finishing Systems

There are four types of finishing systems: fed for Northern-style (M1) meat, fed for Mexican Fed (M2) meat, supplemented grass finished for Mexican Fed (M2) meat, and grass finished for Traditional (M3) meat. Each type of finishing system is defined by differing management practices producing differing qualities of meat.

The cattle fed for Northern-style (M1) meat are managed much like the cattle in U.S. feedlots, and it is the most expensive finishing program of the four. Only Northern-style (V1) cattle can be fed for M1 meat. The cattle are on feed for 132 days. Average daily gain is the same as for Mexican Fed (M2) fed cattle and is shown in table III-8. Their ending weight is 459.76 kilograms. They have a 63 percent dressing weight resulting in a carcass weight to of 289.65 kilograms and the adjusted carcass weight to be half of that.

The cattle used for Mexican Fed (M2) meat production are fed in feedlots, like the cattle used for Northern-style (M1) production, but for fewer days. All types of cattle are available for feeding for M2 meat production. Cattle fed for M2 meat are assumed to gain at the same rate as cattle fed for M1 meat production, but the dressing percentage is lower due to the difference in genetics and because of less days on feed. Table III-8 describes the management practices and carcass results for cattle fed for M2 meat production.

Table III-8. Mexican Fed (M2) Meat Production From Fed Cattle

	Northern-Style	Semi-Intensive	Traditional	Criollo
Days on Feed	111.00	120.00	113.00	113.00
Adg (kg/day)	1.43	1.35	1.30	1.20
Feedlot Death Loss	0.50	0.50	0.50	0.50
Ending Wt (kg/hd)	429.73	414.00	399.90	369.60
Dressing %	61.00	60.00	59.00	58.00
Carcass Wt (kg)	262.14	248.40	235.94	214.37

The supplemented grass finishing program is less costly than the program for finishing cattle for M2 meat production in feedlots. The cattle are finished on grass with feed supplementation. The cattle are intended for M2 meat production. Table III-9 further describes the semi-intensive finishing program.

Table III-9. Supplemented Grass Finishing Program for M2 Meat Production

	Northern-Style	Semi-Intensive	Traditional	Criollo
Days on Feed	100.00	105.00	113.00	120.00
Adg (kg/day)	0.90	0.85	0.80	0.75
Death Loss %	3.00	3.00	3.00	3.00
Ending Wt (kg/hd)	361.00	341.25	343.40	324.00
Dressing %	59.00	58.50	58.00	57.50
Carcass Wt (kg)	104.69	199.63	199.17	186.30
Potrero Base AU Factor	0.75	0.70	0.70	0.70

The grass-finishing program is the least costly and least intensive of the four finishing systems. The cattle are finished on grass and are intended for the production of Traditional (M3) meat. This system requires very little resources and management. Table III-10 further describes the grass-finishing program.

Table III-10. Grass Finishing for M3 Meat Production

	Northern-Style	Semi-Intensive	Traditional	Criollo
Days on Feed	516.00	512.00	428.000	464.00
Adg (kg/day)	0.27	0.26	0.255	0.25
Potrero Death Loss %	4.00	4.00	4.000	4.00
Ending Weight (kg/hd)	410.32	385.12	362.140	350.00
Dressing %	58.50	57.50	56.500	56.00
Carcass Wt (kg)	240.04	221.44	204.610	196.00
Potrero Base AU Factor	0.80	0.75	0.750	0.75

Production Costs

The base annual non-forage variable cost per cow is 2000 pesos. To calculate the adjusted annual variable cost per cow, the annual variable cost per cow base is multiplied by the production cost index for each type of cow in each different region.

The cow types vary in cost among regions and by cow type. The Northern-style (V1) cattle are not only more costly animals because of their superior genetics but they are more costly to produce than the other cow types. They require more intensive management practices than the other three types. Production of these types of cattle is more expensive in the southern and coastal regions because these cows are more susceptible to disease and pests prevalent in the tropics. The Semi-Intensive (V2) and Traditional (V2) cattle have the same basic genetics, which are a lower quality than the Northern-style (V1) cattle, which make them slightly less expensive to produce. The difference between the two are managerial practices, the Semi-Intensive (V2) cattle are managed better than the Traditional (V3) cattle. These two types of cattle are less expensive (compared to Northern (V1) type cows) to produce in the southern and coastal regions because their genetics make them less susceptible to disease and pests, which means they have lower veterinary and medicine costs, and there is plenty of forage in these areas, which means they do not need feed supplementation. The Criollo (V4) cattle have very low quality of genetics, which makes them less costly than the other three type of cattle and they require very little management. Because they utilize whatever forage is available and scavenge the land, they have a very low cost of production and their production cost does not change among regions. Table III-11 gives the production cost index for each region and cow type.

Table III-12 outlines the stocker non-forage variable production costs specified in the GANAMEX model.

Intensive stockers are assumed to use the Northern (V1) cow cost index for all cattle types therefore the intensive stocker cost per region is calculated by multiplying the

Table III-11. Production Cost Index by Region and Cow Type

Production Region		Northern-Style Cow	Semi-Intensive Cow	Traditional Cow	Criollo Cow
North	(P1)	1.00	0.71	0.35	0.15
Northeast	(P2)	1.00	0.69	0.35	0.15
Central Mesa	(P3)	1.00	0.68	0.35	0.15
Cordillera	(P4)	1.02	0.67	0.28	0.15
Pacific Coast	(P5)	1.10	0.64	0.28	0.15
Southern Sierra Madre	(P6)	1.10	0.64	0.28	0.15
Veracruz	(P7)	1.10	0.64	0.28	0.15
South	(P8)	1.10	0.64	0.28	0.15
Yucatan	(P9)	1.10	0.64	0.28	0.15

Table III-12. Stocker Costs

	Unit	Cost	Source
Intensive Stocker Base	Pesos/hd	150	
Extensive Stocker Base	Pesos/hd	50	

intensive stocker base cost by the Northern cow production cost index for each region. Extensive stockers are assumed to use the cost index for each cattle type and region as specified in table III-11. Table III-13 outlines the general finishing costs in the GANAMEX model. Table III-14 outlines the feedlot finishing costs and table III-15 outlines the grass finishing costs specified in the GANAMEX model.

Table III-13. Finishing Costs

	Unit	Cost	Source
Grass Fed Finishing Base	Pesos/hd	150.00	
Ration Base	Pesos/kg	1.25	
Feedlot Conversion Base	Feed/gain	7.45	
Daily Feedlot Base	Pesos/day	2.00	
Feedlot Receiving Base	Pesos/hd	80.00	

Slaughter and Slaughter Costs

After finishing, cattle are either slaughtered in a TIF plant or locally. Slaughter capacity is assumed to not be limiting, regional constraints could be added if this is determined to be a limiting factor. All cattle can be slaughtered in the TIF plant. Only grass-finished cattle (M3) and cull cattle (M4) can be slaughtered locally. However, all meat that is shipped to a different consumption region away from the production region must be slaughtered in a TIF facility. TIF slaughter is more expensive than slaughtering locally because of the regulations, equipment, and labor required. TIF slaughter cost is 1.3 pesos per kilogram and local slaughter cost is 0.7 pesos per kilogram.

Table III-14. Feedlot Finishing

Region Name		Feedlot Ration Cost Index	Feedlot Conversion Index	Feedlot Capacity 1 Time (hd)	Feedlot Turnover Rate	Annual Production Capacity (Hd.)
Northwest	(F1)	1.00	0.93	175,000	2.5	437,500
La Laguna	(F2)	1.00	0.93	60,000	2.5	150,000
Northeast	(F3)	0.98	0.93	125,000	2.5	312,500
Pacific Coast	(F4)	1.02	0.94	130,000	2.5	325,000
Cordillera	(F5)	1.02	1.00	120,000	2.5	300,000
Huasteca	(F6)	1.00	1.04	35,000	2.5	87,500
Central Mesa	(F7)	1.01	1.00	5,500	2.5	13,750
Veracruz	(F8)	0.90	1.00	10,000	2.5	25,000
Tabasco	(F9)	1.05	1.10	10,000	2.5	25,000
Yucatan	(F10)	1.05	1.10	5,000	2.5	12,500

Table III-15. Grass Finishing with Supplementation for M2 Meat

Production Region		Production Limit (hd)	Cost Index	Conversion Index
North	(P1)	100	1.5	0.55
Northeast	(P2)	100	1.5	0.55
Central Mesa	(P3)	100	1.5	0.55
Cordillera	(P4)	100	1.5	0.55
Pacific Coast	(P5)	100	1.5	0.55
Southern Sierra Madre	(P6)	100	1.5	0.55
Veracruz	(P7)	5,000	1.5	0.55
South	(P8)	15,000	1.5	0.55
Yucatan	(P9)	100	1.5	0.55

Meat Types

Meat production has been generalized into four types: northern-style meat, Mexican-fed meat, traditional meat, and cull meat. Meat types are determined by a combination of cattle type used and cattle management practices.

Northern-style meat, referred to as M1NOR in the model, is produced only by cattle fed in a feedlot and is harvested only in TIF plants. It is a high quality beef and is the most expensive to produce of the four types. This type of beef is most like American-style beef.

Mexican-fed meat, referred to as M2FED in the model, is increasingly becoming the preferred beef type in Mexico. It can either be produced by finishing cattle in feedlots or by grass finishing with supplementation to produce the M2 type of meat rather than M3 meat. The cattle are then harvested in TIF plants only. This type of beef is not as high of quality as the northern-style beef.

Traditional meat, referred to as M3TRA in the model, was traditionally the preferred type of beef in Mexico. The cattle are finished on pasture and then harvested in either a TIF plant or though local slaughter.

Cull meat, referred to as M4DES in the model, demand is decreasing in Mexico. It is produced by cull cows and bulls. Cull meat is the lowest quality of beef available in the GANAMEX model and is the least expensive. Dairy meat production makes up 38 percent of the total M4 meat production and it is assumed that all available dairy meat production will be used because of the low cost of production.

Consumption

Table III-16 gives the population in 2005 in each of the consumption regions and their total consumption. The population has been indexed up three percent from INEGI Census for the year of 2000 to account for the population growth (INEGI 2006).

The consumption index is relative to the national average beef consumption of 16.75 kilograms per capita per year. The consumption index is included in the model to account for the differences in the quantity of beef consumed among the regions

(Beardsley). The Central consumption region is calculated within the model and may vary slightly in order to maintain the 16.75 kilogram per capita average beef consumption. The total beef consumption in Mexico is 1,679,851,218 kilograms per year. Table III-17 breaks down regional beef consumption into types of beef consumed as a percentage of total beef consumption in each region.

Table III-16. Consumption

Consumption Region		Population in 2005	Consumption Quantity Index	Total Consumption (kg)
Northwest	(C1)	7,889,204	1.200	158,572,993.00
North Central	(C2)	5,210,029	1.150	100,358,191.90
Northeast	(C3)	8,553,810	1.250	179,095,399.00
Tapatio	(C4)	15,175,165	1.050	266,893,216.20
Central	(C5)	47,046,289	0.986	776,992,990.40
Gulf	(C6)	13,092,323	0.700	153,507,484.70
Yucatan	(C7)	3,315,742	0.800	44,430,942.93

The percentages for the meat types by region are included in the model to account for the differences in the quantity of each type of beef consumed among the regions (Beardsley).

Table III-17. Regional Meat Consumption by Meat Type (%)

Consumption Region		Northern-Style Beef	Mexican-Fed Beef	Traditional Beef	Cull Beef
Northwest	(C1)	18.00	50.00	13.00	19.00
North Central	(C2)	27.00	48.00	10.00	15.00
Northeast	(C3)	25.00	53.00	10.00	12.00
Tapatio	(C4)	5.00	27.00	47.00	21.00
Central	(C5)	10.00	28.00	41.00	21.00
Gulf	(C6)	5.00	19.00	53.00	23.00
Yucatan	(C7)	10.00	18.00	50.00	22.00
Total		**12.12**	**32.69**	**35.49**	**19.70**

Table III-18 provides an example of the break down of consumption of the differing qualities of beef in the northeast and Yucatan regions. Comparing the northeast consumption region to the Yucatan consumption region shows differences in the quantity and quality of beef consumed between regions in Mexico. The Northeast consumption region consumes 21.0 kilograms per capita compared to the Yucatan consumption region, which consumes 13.4 kilograms per capita.

Table III-18. Breakdown of quantity of meat consumed

Consumption Region	Northern-Style Beef	Mexican-Fed Beef	Traditional Beef	Cull Beef
Northeast	5.23	11.10	2.09	2.51
Yucatan	1.34	2.41	6.70	2.95

Trade

The principal trade components of the GANAMEX model relate to exports of calves and feeder cattle, imports of M1 and M2 meat, and imports of cull cows. These trade sector values are specified in U.S. dollars and converted internally in the model into values in pesos and weights in kilograms. The model uses a single specified base price for calves to set the values for all calf and feeder cattle exports. To represent values for animals of different weights and for heifers, the model makes several adjustments. The specified base price for steer calves at 300 pounds is $159.00/cwt in U.S currency. Base heifer calf prices are calculated as 84 percent of the steer calf prices. For all calves a price slide of $14.00/cwt. is used for additional weight. Thus, a 400 pound steer calf would be valued at the base steer price minus $14.00/cwt. The base price for feeder steers is calculated as 0.755 times the base steer calf price. The base feeder heifer price for export is also calculated as 84 percent of the base feeder steer price. For feeder cattle the price slide for additional pounds is $10.50/cwt. All U.S. prices are converted to pesos at the specified exchange rate of 10.9 pesos to the dollar.

Northern style (M1) meat can be imported at a base price of $138 per hundred weight and Mexican-Fed (M2) meat price is calculated as 86 percent of the M1 price (Table III-20). Cull cows can be imported at a price of $54 per hundred weight, with a 900 live weight plus $10 per head import cost.

Cattle Exports

A constraint prevents export of heifer calves for the purpose of this research, as heifer exports are not currently allowed. Steer calf and feeder exports are unrestricted from the North (P1) and the Northeast (P2) production regions in the Benchmark. A limited amount of exports were allowed from the production regions in TB restricted zone. The Central Mesa (P3) production regions is allowed 30,000 head, the Cordillera (P4) production region is allowed 15,000 head, the Pacific Coast (P5) production region is allowed 20,000 head, the Southern Sierra Madre (P6) producitoin region is allowed 10,000 head, the Veracruz (P7) production region is allowed 100,000 head and Yucatan (P9) production region is allowed 35,000 head. These are based on 2005 cattle exports by state from the Sistema Nacional de Informacion y Integracion de Marcados (SNIIM). Table III-19 shows the costs to export calves to the U.S. Exports from TB restricted

Table III-19. Export Budget

	Basis	Unit	Price
U.S. steer calf price at the border	300 lb.	$/cwt	159.00
Calf Price Slide		$/cwt	14.00
Steer Export Cost		$/hd	35.00
Heifer to Steer Price Difference	U.S. basis	$	0.84
U.S. Heifer Calf Price at the Border	300 lb.	$/cwt	133.56
Feeder to Calf Price Difference		$	0.755
Feeder Price Slide		$	10.50

regions are subject to additional costs consistent with costs of whole herd testing required for regions with AP status. Whole herd TB tests in the Benchmark model are equal to $7.50 per head.

Table III-20. Meat Import Values

	Unit	Value
Import Price M1 meat	$/cwt	138.00
Import Price difference between M1 and M2 meat	%	86.00
Import Price M2 Meat	$/cwt	118.68

Table III-21. Live Import Values

	Unit	Value
Slaughter Cow Live Weight	Lbs.	900.00
Slaughter Cow Price	$/cwt	54.00
Slaughter Cow Import Cost	$	10.00
Maximum Slaughter Cow Import	Hd	0.00

Rodeo Calves

Only criollo cattle produce rodeo calves. They can only come from the Northern and Central Mesa regions. Exported rodeo calves are valued at $625/head. The maximum number of rodeo cattle allowed to be exported is 15,000 head from the Northern production (P1) region. Rodeo cattle cannot be exported from the Central Mesa (P3) production region in the Benchmark because P3 is TB restricted in the Benchmark, but in the case that the Central Mesa (P3) production region is included in the TB free status zone a maximum of 10,000 head of rodeo cattle are allowed to be exported (Wallace).

Central American Cattle Imports

Although currently a minor consideration, the GANAMEX model allows for limited imports of Central American calves and feeder cattle. All Central American cattle are assumed to be Semi-Intensive (V3) type cattle. Central American calves can be imported to the Southern Sierra Madre (P6) and Southern (P8) production regions. Central American feeder cattle imports can only be imported to the Northwestern, Pacific Coast, Huasteca, and Veracruz regions. Central American feeder imports are assumed to arrive by boat to these coastal feeding regions. Boat transportation costs are not highly correlated to distance and therefore no shipping cost differentials are applied to imports to each of these feeding regions. Central American calf and feeder calf prices are both 13.5 pesos per kilogram. They are identified by two different scalars in the GANAMEX model so that the two can have different prices. The maximum head of Central American calves that can be imported are 30,000. The maximum head of Central American feeder cattle allowed to be imported into Mexico is 20,000 head.

Transportation

Transportation is measured to and from the representative city of each production, feedlot or consumption region. Table III-22 outlines the costs and load size of

Table III-22. Transportation Budget

	Unit	Value
Cost of Hauling Live Animals	Pesos/loaded km	15.0
Cost of Hauling Meat	Pesos/loaded km	16.0
Live Animal Load Size	Kg	20,000.0
Meat Load Size	Kg	20,000.0

transporting live animals and meat. The cost of hauling meat is more expensive because of the need to use refrigerated trucks. Tables III-23 through III-28 gives the shipping distances used to calculate the various transportation costs in the GANAMEX model.

Table III-23. Shipping Distance Between Production Regions (km)

Production Region	North	Northeast	Central Mesa	Cordillera	Pacific Coast	Southern Sierra Madre	Veracruz	South	Yucatan
North	100	783	882	1,177	1,200	1,922	1,896	2,241	2,800
Northeast	783	100	469	786	1,096	1,359	1,023	1,504	2,063
Central Mesa	882	469	100	320	839	1,075	1,007	1,373	1,937
Cordillera	1,177	786	320	100	715	1,000	964	1,319	1,878
Pacific Coast	1,200	1,096	839	715	100	1,715	1,679	2,034	2,599
Southern Sierra Madre	1,922	1,359	1,075	1,000	1,715	100	382	620	1,179
Veracruz	1,896	1,023	1,007	964	1,679	382	100	481	1,040
South	2,241	1,504	1,373	1,319	2,034	620	481	100	559
Yucatan	2,800	2,063	1,937	1,878	2,599	1,179	1,040	559	100

<u>Dairy</u>

The dairy sector in the GANAMEX model is assumed to cover the specialized dairy sector that is largely in confinement and would not use native pasture. Thus, the size of the dairy sector is treated as exogenous to the model. However, the use of the calves and cull meat from the dairy sector are decided endogenously in the model. The model includes an exogenously specified total dairy herd size of 1,950,000 head. The herd is allocated among the production regions according to the current distribution of dairy cows (SARGARPA). Table III-29 shows how the herd is distributed among the production regions. From the regional dairy herd the model makes available a given

Table III-24. Shipping Distance From Production Region to Feedlot Region (km)

Feedlot Region		Production Regions								
		North	Northeast	Central Mesa	Cordillera	Pacific Coast	Southern Sierra Madre	Veracruz	South	Yucatan
	Northwest	1,385	2,168	2,278	2,098	1,391	3,098	3,062	3,417	3,976
	La Laguna	467	316	407	714	780	1,450	1,414	1,769	2,328
	Northeast	783	100	469	786	1,096	1,359	1,023	1,504	2,063
	Pacific Coast	1,200	1,096	839	715	100	1,715	1,679	2,034	2,599
	Cordillera	1,177	786	320	100	715	1,000	964	1,319	1,878
	Huasteca	1,313	530	591	742	1,438	829	493	974	1,533
	Central Mesa	1,045	517	190	336	1,032	877	841	1,196	1,755
	Veracruz	1,896	1,023	1,007	964	1,679	382	100	481	1,040
	South	2,241	1,504	1,373	1,319	2,034	620	481	100	559
	Yucatan	2,800	2,063	1,937	1,878	2,599	1,179	1,040	559	100

Table III-25. Shipping Distance From Production Region to Consumption Region (km)

Production Region		Consumption Region						
		Northwest	North Central	Northeast	Tapatio	Central	Gulf	Yucatan
	North	690	100	783	1,177	1,468	1,896	2,800
	Northeast	1,473	783	100	786	925	1,023	2,063
	Central Mesa	1,576	882	469	320	605	1,007	1,937
	Cordillera	1,403	1,177	786	100	546	964	1,878
	Pacific Coast	696	1,200	1,096	715	1,261	1,679	2,599
	Southern Sierra Madre	2,403	1,922	1,359	1,000	454	382	1,179
	Veracruz	2,367	1,896	1,023	964	418	100	1,040
	South	2,722	2,241	1,504	1,319	773	481	559
	Yucatan	3,281	2,800	2,063	1,878	1,332	1,040	100

number of dairy calves after accounting for dairy herd replacements, calf death loss and veal slaughter. The dairy calves are assumed to be traditional (V3) quality and are available at a specified value per head. Cull meat from dairy cows directly enter the

Table III-26. Shipping Distance From Feedlot Region to Consumption Region (km)

		Consumption Region						
		Northwest	North Central	Northeast	Tapatio	Central	Gulf	Yucatan
Feedlot Region	Northwest	170	1,385	2,168	2,098	2,644	3,062	3,976
	La Laguna	1,157	467	316	714	996	1,414	2,328
	Northeast	1,473	783	100	786	925	1,023	2,063
	Pacific Coast	696	1,200	1,096	715	1,261	1,679	2,599
	Cordillera	1,403	1,177	786	100	546	964	1,878
	Huasteca	2,003	1,313	530	742	488	493	1,533
	Central Mesa	1,720	1,045	517	336	423	841	1,755
	Veracruz	2,367	1,896	1,023	964	418	100	1,040
	South	2,722	2,241	1,504	1,319	773	481	559
	Yucatan	3,281	2,800	2,063	1,878	1,332	1,040	100

Table III-27. Distance to Export Cattle from Production Regions to the U.S. (km)

Production Region	Distance to U.S. Border
North	373
Northeast	224
Central Mesa	741
Cordillera	1,010
Pacific Coast	1,320
Southern Sierra Madre	1,583
Veracruz	1,247
South	1,726
Yucatan	2,287

Table III-28. Distance to Import Meat from the U.S. border to Consumption Regions (km)

Consumption Region	Distance from U.S. Border
Northwest	769
North Central	373
Northeast	224
Tapatio	1,010
Central	1,149
Gulf	1,247
Yucatan	2,287

supply of M4 meat in the region where the dairy cows are located. Table III-30 describes the dairy parameters specified in the GANAMEX model.

Table III-29. Share of Dairy Herd in each Production Region

Production Region		Share
North	(P1)	0.335
Northeast	(P2)	0.005
Central Mesa	(P3)	0.068
Cordillera	(P4)	0.439
Pacific Coast	(P5)	0.015
Southern Sierra Madre	(P6)	0.040
Veracruz	(P7)	0.058
South	(P8)	0.023
Yucatan	(P9)	0.016

Table III-30. Dairy Parameters

	Value
Total Inventory (hd)	1,950,000
Net Weaning %	65
Culling Rate	20
Cull Cow Carcass Weight (kg)	325
Calf Value (pesos/hd)	1,875
Calf Weight (kg/hd)	125

<u>Tracking Male and Female Animals in the GANAMEX Model</u>

Cattle production flows in the GANAMEX model are tracked through balance equations based on weight rather than head. This is done to most easily capture the production differences associated with the different cattle types. In essence, this means that for purposes of calculating domestic meat production of a given type from a given cattle type, the model does not distinguish between meat from male and female animals. However, there are some aspects of the model where the distinction between male and female animals is important. Most importantly, is the different weight of male and female animals beginning with cow calf production. Kilograms of calf produced per cow (of any given type) is calculated generally assuming that fifty percent of the calf crop is each male and female. Thus, kilograms of calf weaned per cow is a weighted average of male animal weight plus female animal weight adjusted for the weight of female animals that must be retained for replacement breeding animals. Balance equations based on weight also facilitate handling of death loss as the weight contribution of a production activity can be adjusted by the appropriate death loss to reflect the loss in production available to the subsequent stage of production.

Stocker and finishing production activities simply utilize available weight of animals from previous production stages as inputs for stocker and finishing production. These are tracked separately for each animal type but not for male and female animals. Therefore, production parameters, such as rates of gain and conversions for stocker, grass finishing and feedlot finishing, should be viewed as average values across male and female animals. This slight loss of production reality is viewed as an acceptable tradeoff given that tracking male and female animals separately through the entire model would roughly double the number of production activities.

The other circumstance where treating male and female animals separately is important is for calf and feeder exports. This is because there are often different costs and regulations for exporting steers versus heifers. Therefore separate steer and heifer calf and feeder export activities are specified in the model. For the exports the model maintains a redundant set of balance equations that do track pounds of male and female animals separately. This is necessary to prevent the model from, for example, exporting all calf weight as steer exports. This would have the unrealistic effect of converting heifers into steers for purposes of exports and is thus be prevented by the additional constraints.

CHAPTER IV

Benchmark Results

The scenarios of changes in TB status for various regions compared to the Benchmark model are in subsequent sections. For the Benchmark, the GANAMEX model was configured to represent the situation of the Mexican cattle and beef industry in 2005. The Benchmark model provides a realistic representation of the production and trade values for the Mexican beef and cattle industry in 2005. To configure the GANAMEX model for the benchmark cost, trade, population and consumption figures were adjusted to 2005 values. Most of these values were reported in detail in the previous chapter.

Central to this research is the current TB status of Mexican production regions. In the Benchmark model, the TB unrestricted regions include the North and Northeast production regions (P1 and P2), based on the predominance of MA status (USDA) in these regions. All other regions are TB restricted, meaning that exports are restricted and stocker and feeder cattle shipments from these regions to the unrestricted regions are not allowed. The model allows for shipments of feeder cattle to all feedlot areas from any production region. In most of the restricted regions the USDA recognizes small areas of MA status or AP status zones, enabling limited exports from these regions. Cattle exports from the restricted regions are limited by constraints to current levels (SNIM). Although most exports are the Northern type (V1) cattle, exports of the Semi-Intensive type (V2) cattle are permitted. The model includes a constraint limiting the number of V2 calf exports to no more than 10 percent of total exports to account for the limited demand for V2 type of cattle in the U.S.

The following section includes a complete documentation of the national and regional details of the values associated with the optimal activities set for the Benchmark model. All of the scenarios in the following chapter are compared to the values presented in this section.

Objective Function

The objective function minimizes the cost of producing beef in Mexico. To capture industry incentives realistically, the objective function treats cattle or meat exports as negative costs, i.e., as reducing the cost of producing meat in Mexico. Thus, the correct domestic cost of meat as calculated by the model is the value of the objective function plus the value of cattle exports. In the Benchmark model, this total value is 39,448,224,000 pesos. This implies a domestic meat cost of 23.49 pesos per kilogram of beef consumed in Mexico. This value is similar to wholesale values of beef in Mexico in late 2004 and early 2005 (USDA-FAS). The total value of exports is 6,635,924,000 pesos.

Forage Use

In the Benchmark model, 100 percent of all available pasture and crop residue are used and 94.40 percent of the available irrigated pasture is used. The only region, which is not completely using all of its forages, is the Northeast production region (P2), which is only using 81.6 percent of its available irrigated pasture. Irrigated pasture is the most expensive to produce and therefore the last to be utilized. The Northeast (P2) production region is not utilizing all of its available irrigated pasture because the model has found a less costly way to provide the necessary nutritional requirements for the cattle produced in this region than irrigated pasture.

Cow Production

Northern-style, semi-intensive, and traditional cows are optimally produced; the criollos are the only cattle not in the optimal solution. Table IV-1 describes the cattle production in Mexico, as found by the Benchmark model.

Table IV-1. Cow Production in 2005 (Hd.)

Production Region		Northern-Style Cows	Semi-Intensive Cows	Traditional Cows	Totals
North	(P1)	1,924,560	0	0	1,924,560
Northeast	(P2)	638,903	0	0	638,903
Central Mesa	(P3)	162.942	94,361	0	257,303
Cordillera	(P4)	42,857	0	986,263	1,029,120
Pacific Coast	(P5)	57,143	310,596	0	367,739
Southern Sierra Madre	(P6)	28,571	206,808	0	235,380
Veracruz	(P7)	285,714	1,434,704	0	1,720,418
South	(P8)	0	309,273	1,182,496	1,491,769
Yucatan	(P9)	58,538	131,492	865,377	1,055,407
Totals		**3,199,229**	**2,487,234**	**3,034,137**	**8,720,599**

Stocker Production

Extensive Stocker Production

The Benchmark model includes 1,665,721 head of cattle in the extensive stocker program. All of the cattle used in this program are traditional type cattle. Table IV-2 shows where the cattle are being used in the extensive program.

Table IV-2. Extensive Stocker Production (Hd.)

Production Region		Traditional Cattle
North	(P1)	0
Northeast	(P2)	0
Central Mesa	(P3)	465,214
Cordillera	(P4)	257,136
Pacific Coast	(P5)	0
Southern Sierra Madre	(P6)	420,381
Veracruz	(P7)	0
South	(P8)	457,499
Yucatan	(P9)	65,491
Totals		**1,665,721**

Intensive Stocker Production

There are a total of 2,796,165 head of cattle in the intensive stocker program. The cattle in the intensive stocker program are comprised of northern-style, semi-intensive, and traditional cattle. Table IV-3 describes the current intensive stocker situation regarding the distribution of cattle among production regions within the intensive stocker system.

Table IV-3. Intensive Stocker Production (Hd.)

Production Region		Northern-Style Cattle	Semi-Intensive Cattle	Traditional Cattle	Totals
North	(P1)	241,670	0	221,288	462,958
Northeast	(P2)	552,280	0	183,741	736,021
Central Mesa	(P3)	14,031	220,634	0	234,665
Cordillera	(P4)	97,593	385,480	173,381	656,455
Pacific Coast	(P5)	12,451	147,942	87,390	247,783
Southern Sierra Madre	(P6)	0	245,818	0	245,818
Veracruz	(P7)	30,152	122,202	0	152,355
South	(P8)	0	0	0	0
Yucatan	(P9)	12,755	47,356	0	60,111
Totals		**960,933**	**1,169,433**	**665,799**	**2,796,165**

Finishing Systems

Grass Finished Cattle Production

Semi-Intensive (V2) and Traditional (V3) cattle are used in the grass finishing system in the Benchmark. The Northeast production (P2) region is not producing grass-finished cattle. Table IV-4 describes the current number of cattle used for grass finishing in each region.

Table IV-4. Grass Finishing Production (Hd.)

Production Region		Semi-Intensive Cattle	Traditional Cattle	Totals
North	(P1)	0	51,092	51,092
Northeast	(P2)	0	0	0
Central Mesa	(P3)	216,222	668,609	884,830
Cordillera	(P4)	377,771	246,000	623,771
Pacific Coast	(P5)	96,970	0	96,970
Southern Sierra Madre	(P6)	276,414	403,565	679,979
Veracruz	(P7)	84,246	0	84,246
South	(P8)	0	414,199	414,199
Yucatan	(P9)	46,409	62,872	109,281
Totals		**1,098,032**	**1,846,337**	**2,944,369**

Supplemented Grass Finishing Production

Supplemented grass finishing production is not occurring in the Benchmark model.

Meat Production

Northern-Style (M1) and Mexican Fed (M2) Meat Production

Northern-style (M1) meat is only produced from Northern (V1) type cattle in the GANAMEX model. A total of 706,328 head of cattle are fed for M1 meat production in the Benchmark (Table IV-5).

M2 type of beef is coming from northern-style, semi-intensive, and traditional cattle finished in feedlots. Table IV-5 shows the number of head of cattle in the feedlot used for the production of Northern-style (M1) and Mexican Fed (M2) meat.

Table IV-5. Northern-Style (M1) and Mexican Fed (M2) Meat Production in Feedlots

Feedlot Region		Northern-Style (Hd.)*	Semi-Intensive (Hd.)	Traditional (Hd.)	Total (Hd.)	Percent of Capacity
Northwest	(F01)	86,837	0	137,181	224,018	51.20
La Laguna	(F02)	150,000	0	0	150,000	100.00
Northeast	(F03)	305,849	0	6,651	312,500	100.00
Pacific Coast	(F04)	12,202	48,013	85,643	145,858	44.88
Cordillera	(F05)	95,642	0	170,764	226,406	88.80
Huasteca	(F06)	4,549	0	0	4,549	5.20
Central Mesa	(F07)	13,750	0	0	13,750	100.00
Veracruz	(F08)	25,000	0	0	25,000	100.00
Tabasco	(F09)	0	0	25,000	25,000	100.00
Yucatan	(F10)	12,500	0	12,500	12,500	100.00
Total		**706,329**	**48,013**	**425,238**	**1,179,580**	**69.85**

*All Northern-style (V1) cattle are being used for M1 meat. All the remaining cattle are being used for M2 meat.

The Northwest (F1) feedlot center is not operating at full capacity possibly because there are not a lot of cattle around this particular center and its location causes it to compete with live exports. The Pacific Coast (F5) and Cordillera (F6) feedlot center's geography is a cause of the low utilization rate; the mountains on the east side of these centers make it difficult to ship cattle to the two feedlot centers.

Traditional (M3) Meat Production

Table IV-6 shows the Traditional (M3) meat produced in TIF plants and in local slaughter plants. Only the Veracruz region is slaughtering cattle to produce Traditional (M3) meat in TIF plants and not utilizing the local slaughter system.

Table IV-6. Traditional M3 Meat Production (Kg.)

Production Region		TIF Production	Local Slaughter Production	Total Slaughter Production
North	(P1)	0	10,035,820	10,035,820
Northeast	(P2)	0	0	0
Central Mesa	(P3)	0	177,297,000	177,297,000
Cordillera	(P4)	0	128,629,300	128,629,300
Pacific Coast	(P5)	0	20,614,490	20,614,490
Southern Sierra Madre	(P6)	0	139,342,700	138,032,000
Veracruz	(P7)	17,909,540	0	17,909,540
South	(P8)	0	81,358,970	81,358,970
Yucatan	(P9)	0	22,215,470	22,215,470
Totals		**17,909,540**	**578,183,200**	**596,092,700**

Cull (M4) Meat Production

Table 4-7 shows the amount of Cull (M4) meat produced in TIF plants and local slaughter in kilograms.

Table IV-8 shows the Cull (M4) beef produced from Dairy cattle. Since this meat is the least expensive to produce, the model restricts the quantity allowed to be produced and the constraint is binding at the optimum.

Table IV-7. Cull (M4) Meat Production (Kg.)

Production Region		TIF Production	Local Slaughter Production	Total Slaughter Production
North	(P1)	46,990,050	45,182,600	92,172,650
Northeast	(P2)	0	17,136,610	17,136,610
Central Mesa	(P3)	0	15,183,880	15,183,880
Cordillera	(P4)	0	76,118,290	76,118,290
Pacific Coast	(P5)	0	11,132,520	11,132,520
Southern Sierra Madre	(P6)	0	10,971,790	10,971,790
Veracruz	(P7)	49,107,000	1,447,607	50,554,610
South	(P8)	0	33,859,110	33,859,110
Yucatan	(P9)	14,042,560	9,774,807	23,817,360
Totals		**110,139,600**	**220,807,200**	**330,946,800**

Table IV-8. M4 Dairy Meat Production (Kg.)

Production Region		Dairy Meat
North	(P1)	42,461,250
Northeast	(P2)	633,750
Central Mesa	(P3)	8,169,000
Cordillera	(P4)	55,643,250
Pacific Coast	(P5)	1,901,250
Southern Sierra Madre	(P6)	5,070,000
Veracruz	(P7)	7,351,500
South	(P8)	2,915,250
Yucatan	(P9)	2,028,000
Totals		**126,623,300**

Domestic Shipping

Live Shipments

Northern-Style (V1) Calves

A total of 265,936 head of Northern-style (V1) cattle are shipped among the production regions. The Cordillera (P4) production region is receiving 88,255 head from other production regions. Table IV-9 shows the source and destination of Semi-Intensive (V2) calf shipments.

Table IV-9. Shipments of Northern-Style (V1) Calves

Source Production Region		Destination Production Region		Head
North	(P1)	Northeast	(P2)	177,681
Central Mesa	(P3)	Cordillera	(P4)	49,926
Southern Sierra Madre	(P6)	Cordillera	(P4)	6,226
Veracruz	(P7)	Cordillera	(P4)	32,104
Total				**265,936**

<u>Semi-Intensive (V2) Calves</u>

A total of 708,481 head of Semi-Intensive (V2) cattle are shipped among the production regions. The Veracruz (P7) production region is shipping 561,169 head and the South (P8) production region is shipping 147,312 head to other regions. Table IV-10 shows the source and destination of Semi-Intensive (V2) calf shipments.

Table IV-10. Shipments of Semi-Intensive Calves

Source Production Region		Destination Production Region		Head
Veracruz	(P7)	Central Mesa	(P3)	175,687
Veracruz	(P7)	Cordillera	(P4)	385,480
South	(P8)	Southern Sierra Madre	(P6)	147,312
Total				**708,481**

<u>Traditional (V3) Calf Shipments</u>

A total of 1,244,814 head of Traditional (V3) calves are are shipped among the production regions in Mexico. The Cordillera (P4) production region is shipping a total of 453,729 head. The Southern Sierra Madre (P6) production region received a total of 342,730 head of Traditional (V3) calves. The South (P8) is shipping Traditional (V3) calves to the Southern Sierra Madre region and receiving Traditional (V3) calves from the Yucatan (P9) production region. Table IV-11 shows the source and destination of Traditional (V3) calf shipments among production regions within Mexico.

Table IV-11. Shipments of Traditional Calves

Source Production Region		Destination Production Region		Head
North	(P1)	Northeast	(P2)	177,784
Cordillera	(P4)	Central Mesa	(P3)	384,208
Cordillera	(P4)	Pacific Coast	(P5)	69,522
Veracruz	(P7)	Southern Sierra Madre	(P6)	69,093
South	(P8)	Southern Sierra Madre	(P6)	273,637
Yucatan	(P9)	South	(P8)	270,570
Total Traditional Calves				**1,244,814**

Total Calf Shipments

A total of 2,219,231 calves are shipped among the production regions within Mexico. A total of 453,729 calves are shipped from the Cordillera (P4) production region and 662,366 calves are shipped from the Veracruz (P7) production region. The Central Mesa (P3) production region is receiving a total of 559,897 head of calves and the Southern Sierra Madre (P6) production region is receiving a total of 490,042 head of calves. Table IV-12 shows the source and destination production regions of the calves shipped.

Table IV-12. Total Calf Shipments

Source Production Region		Destination Production Region		Head
North	(P1)	Northeast	(P2)	355,466
Central Mesa	(P3)	Cordillera	(P4)	49,926
Cordillera	(P4)	Central Mesa	(P3)	384,208
Cordillera	(P4)	Pacific Coast	(P5)	69,522
Southern Sierra Madre	(P6)	Cordillera	(P4)	6,226
Veracruz	(P7)	Central Mesa	(P3)	175,689
Veracruz	(P7)	Cordillera	(P4)	417,584
Veracruz	(P7)	Southern Sierra Madre	(P6)	69,093
South	(P8)	Southern Sierra Madre	(P6)	420,949
Yucatan	(P9)	South	(P8)	270,570
Total Calves				**2,219,231**

Stockers Shipped

Very few stockers are shipped in the Benchmark model. Stocker shipments are cattle shipped from one production region to another production region for grass finishing. A total of 257,517 head of stockers are shipped. Northern (V1) type and Criollo (V4) stockers are not shipped. Semi-Intensive (V2) cattle are only shipped from the Veracruz production (P7) region to the Southern Sierra Madre production (P6) region. There are 35,513 head of these cattle shipped. Traditional (V3) stockers are shipped from the North (P1) and Northeast (P2) production regions to the Central Mesa (P3) production region. There are 48,589 head of Traditional stockers shipped from the North production region and 173,415 head of Traditional stockers shipped from the Northeast production region.

Northern-Style (V1) Feeder Shipments

A total of 706,329 head are shipped from production regions to feedlot centers within Mexico. The North (P1) production region is shipping a total of 236,837 feeders to feedlot centers. The Veracruz (P7) production region is shipping 29,549 feeders to feedlot centers. Table IV-13 shows shipments of Northern-style (V1) feeders from production regions feedlot centers.

Semi-Intensive (V2) Feeder Shipments

There are 48,013 Semi-Intensive feeders being shipped in the Benchmark model. All are from the Pacific Coast production (P5) region to the Pacific Coast feedlot (F04).

Table IV-13. Northern-Style (V1) Feeders Shipped From Production Region to Feedlot Center

Source Production Region		Destination Feedlot Center		Head
North	(P1)	Northwest	(F01)	86,837
North	(P1)	La Laguna	(F02)	150,000
Northeast	(P2)	Northeast	(F03)	305,849
Central Mesa	(P3)	Central Mesa	(F07)	13,750
Cordillera	(P4)	Cordillera	(F05)	95,642
Pacific Coast	(P5)	Pacific Coast	(F04)	12,202
Veracruz	(P7)	Huasteca	(F06)	4,549
Veracruz	(P7)	Veracruz	(F08)	25,000
Yucatan	(P9)	Yucatan	(F10)	12,500
Total				**706,329**

Traditional (V3) Feeder Shipments

There is a total of 405,238 head of Traditional (V3) feeders being shipped within Mexico. Table IV-14 shows Traditional (V3) feeder shipments from production regions to feedlot centers within Mexico.

Table IV-14. Traditional (V3) Feeders Shipped

Source Production Region		Destination Feedlot Center		Head
North	(P1)	Northwest	(F01)	117,181
Northeast	(P2)	Northeast	(F03)	6,651
Cordillera	(P4)	Cordillera	(F05)	170,764
Pacific Coast	(P5)	Pacific Coast	(F04)	85,643
South	(P8)	Tabasco	(F09)	25,000
Total				**405,238**

Total Feeder Shipments

There is a total of 1,159,580 head of feeders being shipped within Mexico. A total of 354,018 head of feeders are being shipped from the North (P1) production region to feedlot centers in Mexico. Table IV-15 shows total feeder shipments from production regions to feedlot centers within Mexico.

Table IV-15. Total Feeders Shipped

Source Production Region		Destination Feedlot Center		Head
North	(P1)	Northwest	(F01)	204,018
North	(P1)	La Laguna	(F02)	150,000
Northeast	(P2)	Northeast	(F03)	312,500
Central Mesa	(P3)	Central Mesa	(F07)	13,750
Cordillera	(P4)	Cordillera	(F05)	266,406
Pacific Coast	(P5)	Pacific Coast	(F04)	145,858
Veracruz	(P7)	Veracruz	(F08)	25,000
South	(P8)	Tabasco	(F09)	25,000
Yucatan	(P9)	Yucatan	(F10)	12,500
Total				**1,159,580**

Meat Shipments

Northern-Style (M1) Meat Shipments

A total of 203,564,300 kilograms of Northern-style (M1) meat is being shipped from feedlot centers to consumption regions within Mexico. The La Laguna (F02) feedlot region is shipping 43,230,080 kilograms of Northern-style (M1) meat. The Northeast (F03) feedlot region is shipping 88,145,890 kilograms of Northern-style (M1) meat. A total of 27,563,960 kilograms are shipped from the Cordillera (F05) feedlot region and 7,205,014 kilograms are shipped from the Veracruz (F08) feedlot region. The Northwest (C1) consumption region is receiving 28,543,140 kilograms of M1 meat and the Central (C5) consumption region is receiving 77,687,470 kilograms. The Gulf (C6) consumption region is receiving 7,675,374 kilograms and the Yucatan (C7) consumption region is receiving 4,443,094 kilograms of M1 meat. Table IV-16 shows shipments of Northern-style (M1) meat from feedlot regions to consumption regions within Mexico.

Table IV-16. Northern-Style (M1) Meat Shipments

Source Feedlot Center		Destination Consumption Region		Kilograms
Northwest	(F01)	Northwest	(C1)	25,026,490
La Laguna	(F02)	North Central	(C2)	27,096,710
La Laguna	(F02)	Central	(C5)	16,133,370
Northeast	(F03)	Northeast	(C3)	44,773,850
Northeast	(F03)	Central	(C5)	43,372,040
Pacific Coast	(F04)	Northwest	(C1)	3,516,654
Cordillera	(F05)	Tapatio	(C4)	13,344,660
Cordillera	(F05)	Central	(C5)	14,219,300
Huasteca	(F06)	Gulf	(C6)	1,310,948
Central Mesa	(F07)	Central	(C5)	3,962,758
Veracruz	(F08)	Gulf	(C6)	6,364,427
Veracruz	(F08)	Yucatan	(C7)	840,587
Yucatan	(F10)	Yucatan	(C7)	3,602,507
Total				**203,564,300**

<u>Mexican Fed (M2) Meat Shipments</u>

A total of 111,696,300 kilograms of Mexican Fed (M2) meat is being shipped from feedlot centers to consumption regions within Mexico. A total of 72,061,170 kilograms of Mexican Fed (M2) meat is being shipped to the Tapatio (C4) consumption region. The Yucatan (C7) consumption region is receiving a total of 7,430,402 kilograms of Mexican Fed (M2) beef. Table IV-17 shows shipments of Mexican Fed (M2) meat from feedlot centers to consumption regions within Mexico.

Table IV-17. Mexican Fed (M2) Meat Shipments

Source Feedlot Center		Destination Consumption Region		Kilograms
Northwest	(F01)	Northwest	(C1)	3,220,469
Northeast	(F03)	Yucatan	(C7)	1,561,370
Pacific Coast	(F04)	Tapatio	(C4)	31,872,360
Cordillera	(F05)	Tapatio	(C4)	40,088,810
Tabasco	(F09)	Yucatan	(C7)	5,869,032
Total				**111,696,300**

Traditional (M3) Meat Shipments

In the Benchmark model, 17,909,540 kilograms of Traditional style (M3) meat is being shipped from the Veracruz production (P7) region to the Northeast consumption (C3) region.

Cull (M4) Meat Shipments

A total of 110,139,600 kilograms of Cull (M4) meat is being shipped from production regions to consumption regions. The North (P1) production region is shipping 46,990,050 kilograms of Cull (M4) meat to consumption regions within Mexico. The Central (C5) consumption region is receiving 63,149,560 kilograms of Cull (M4) meat. Table IV-18 shows the shipments of Cull (M4) meat from production regions to consumption regions within Mexico.

Table IV-18. Cull (M4) Meat Shipments

Source Production Region		Destination Consumption Region		Kilograms
North	(P1)	Northeast	(C3)	4,354,836
North	(P1)	Tapatio	(C4)	42,635,210
Veracruz	(P7)	Central	(C5)	49,107,000
Yucatan	(P9)	Central	(C5)	14,042,560
Total				**110,139,600**

Consumption

Table IV-19 shows meat consumption by consumption region and meat type. Consumption is constant and will not change in the scenarios.

Table IV-19. Consumption (1,000 Kg.)

Consumption Region		M1 Meat	M2 Meat	M3 Meat	M4 Meat	Total
Northwest	(C1)	28,543	79,287	20,614	30,129	158,573
North Central	(C2)	27,097	48,172	10,036	15,054	100,358
Northeast	(C3)	44,774	94,921	17,910	21,491	179,095
Tapatio	(C4)	13,345	72,061	125,440	56,048	266,893
Central	(C5)	77,687	217,525	318,519	163,144	776,875
Gulf	(C6)	7,675	29,166	81,359	35,307	153,508
Yucatan	(C7)	4,443	7,998	22,215	9,775	44,431
Total		**203,564**	**549,129**	**596,093**	**330,947**	**1,679,733**

Imports

Slaughter cows were not imported. 30,000 head of calves were imported from Central America into production region six, also referred to as the Southern Sierra Madre region. Currently 20,000 head of feeder cattle are being imported from Central America into the Northwest (F01) feedlot region. Table IV-20 shows the type of meat each consumption region imported.

Table IV-20. Meat Imports

Consumption Region		M2 Meat
Northwest	(C1)	47,081,810
North Central	(C2)	48,171,930
Northeast	(C3)	94,920,560
Tapatio	(C4)	0
Central	(C5)	217,524,900
Gulf	(C6)	29,166,420
Yucatan	(C7)	567,168
Total		**437,432,800**

Exports

Northern style heifer calf, Northern style feeder heifer, and semi-intensive heifer are not permitted in the Benchmark model. Rodeo calf exports, though permitted from the North(P1) production region, are not included in the Benchmark model. A total of

1,107,212 head of calves are being exported. The actual number of cattle exported from Mexico to the U.S. in 2005 was 1.25 million head (USDA). Table IV-21 describes the distribution of cattle types exported from Mexico.

Table IV-21. Live Exports (Hd.)

Production Region		Northern Style Steer Calf	Northern Style Feeder Steer	Semi-Intensive Steer Calf	Total
North	(P1)	673,596	0	0	673,596
Northeast	(P2)	0	223,616	0	223,616
Central Mesa	(P3)	30,000	0	0	30,000
Cordillera	(P4)	15,000	0	0	15,000
Pacific Coast	(P5)	20,000	0	0	20,000
Southern Sierra Madre	(P6)	10,000	0	0	10,000
Veracruz	(P7)	100,000	0	0	100,000
South	(P8)	0	0	0	
Yucatan	(P9)	20,488	0	14,512	35,000
Totals		**1,092,700**	**223,616**	**14,512**	**1,107,212**

Cull (M4) meat is not being exported in the Benchmark model.

CHAPTER V

RESULTS: ANALYSIS OF SCENARIOS

The restriction of trade due to tuberculosis is a regional issue, therefore a spatial model was used for this study. In the Benchmark model the North (P1) and Northeast (P2) production regions made up the TB free zone while the rest of the regions were considered to be in the TB restricted zone. Four scenarios were included in this study. The North (P1) and Northeast (P2) production regions were never included in the TB restricted zone in any of the scenarios. The first scenario included the Pacific Coast (P5) in the TB free zone. The second scenario included the Central Mesa (P3) production region in the TB free zone. The third scenario included the Veracruz (P7) production region in the TB free zone. The fourth scenario included the Pacific Coast (P5), Central Mesa (P3), and Veracruz (P7) production regions in the TB free zone.

The scenarios were chosen because the regions moved from the TB restricted zone to the TB free zone were just south of the designated TB free zone in the Benchmark model. Each region was included in the TB free zone separately in order determine which region made the biggest impact on trade and what the various impacts would be. The fourth scenario was included to determine how big of an impact the three regions being included in the TB free zone would make on trade.

Scenario 1

In scenario one, the Pacific Coast production region (P5) was moved to the TB free status zone. Thus, the TB free zone includes the North, Northeast, and Pacific Coast production regions (P1, P2, P5). The TB restricted zone includes the remaining production regions. The objective function was reduced by less than one percent to 32,800,000,000 pesos. The value of exports increased by approximately 8.62 percent to 7,207,675,000 pesos. The total value of the domestic cost of meat is 40,007,675,000 pesos in scenario one. This was a 1.42 percent increase from the total value of the domestic cost of meat in the Benchmark model. The domestic cost increased by .333 pesos per kilogram.

Forage Use

All available forage is being used except for in the Northeast and Pacific Coast production (P2 and P5) regions. The Northeast (P2) production region reduced the use of irrigated pasture from 81.6 percent to 66.6 percent of available irrigated pasture used. The Pacific Coast (P5) production region is using 1,616 hectares of irrigated pasture, a reduction from 100 percent of available irrigated pasture used to 88.7 percent used. All available native pasture and crop residue is being used in Mexico. The total use of irrigated pasture was reduced by 9,094 hectares, a 5.91 percent decrease from the Benchmark model.

Cow Production

Total cow production in Mexico decreased to 8,674,555. head. Northern-style (V1) cattle increased to 3,351,949 head. Semi-Intensive (V2) cow production decreased to 183,598 head and Traditional (V3) cow production decreased to 857,520 head. Table V-1 shows the percent changes in cow production from the Benchmark model to Scenario 1. Because Northern-style (V1) cattle are bigger and produce more meat than the other types of cattle, meat consumption requirements can be met with less cattle when using Northern-style (V1) cattle than when Semi-Intensive (V2) and Traditional (V3) cattle are used. The Central Mesa (P3) production region increased the production of Semi-Intensive (V2) cattle by 228,611 head and decreased the production of Northern-style (V1) cattle by 77,227 head. The Pacific Coast (P5) production region decreased total cow produciton by 9,617 head. The Yucatan (P9) production region increased the production of Semi-Intensive (V2) cow and decreased the production of Northern-style

Table V-1. Percent Changes in Cow Production

Production Region		Northern-Style Cattle	Semi-Intensive Cattle	Traditional Cattle	Total Percent Change
North	(P1)	0.00	0.00	0.00	0.00
Northeast	(P2)	0.00	0.00	0.00	0.00
Central Mesa	(P3)	-47.40	+242.27	0.00	+58.83
Cordillera	(P4)	0.00	0.00	-20.30	-20.42
Pacific Coast	(P5)	+526.71	-100.00	0.00	-2.62
Southern Sierra Madre	(P6)	-100.00	+23.09	0.00	+8.15
Veracruz	(P7)	0.00	0.00	0.00	0.00
South	(P8)	0.00	-8.28	+2.29	+0.09
Yucatan	(P9)	-72.53	+39.63	-0.91	+0.16
Totals		**+4.77**	**-0.31**	**-6.29**	**-0.53**

(V1) and Traditional (V3) cows, causing the region's total cow production to increase by 1,788 head.

Stocker Systems

Intensive Stocker Production

Total intensive stockers decreased in Mexico by approximately 135,522 head. Northern-style cattle used in the intensive stocker system increased by approximately 4,800 head, while semi-intensive and traditional cattle decreased by approximately 140,000 head. The decrease in Northern-style (V1) cattle in the intensive stocker system in the North (P1) production region is the same as the increased number in the Northeast (P2) production region. The Central Mesa (P3) production region reduced the use of Semi-Intensive (V2) cattle by approximately the same number of Northern-style (V1) cattle. The Pacific Coast is no longer using Semi-Intensive (V2) cattle in the intensive stocker system and increased the use of Northern-style (V1) cattle by 65,582 head and Traditional (V3) cattle by 35,937 head. The Veracruz (P7) production region decreased the use of Semi-Intensive (V2) cattle by approximately the same number of head as it increased the use of Northern-style (V1) cattle. The Yucatan (P9) production region decreased the use of Northern-style (V1) cattle by approximately the same number as it increased the use of Semi-Intensive (V2) cattle. Table V-2 shows the percent changes in the number of cattle in the intensive stocker system from the Benchmark model to Scenario one.

Table V-2. Percent Changes in Intensive Stockers

Production Region		Northern-Style Cattle	Semi-Intensive Cattle	Traditional Cattle	Total Percent Change
North	(P1)	-2.81	0.00	+2.15	-0.44
Northeast	(P2)	+1.23	0.00	-59.99	-14.05
Central Mesa	(P3)	+33.11	-2.09	0.00	+0.02
Cordillera	(P4)	-90.43	+37.70	-23.62	+2.46
Pacific Coast	(P5)	+526.27	-100.00	+41.12	-18.74
Southern Sierra Madre	(P6)	0.00	0.00	0.00	0.00
Veracruz	(P7)	+106.47	-26.05	0.00	+0.17
South	(P8)	0.00	0.00	0.00	0.00
Yucatan	(P9)	-72.54	+19.38	0.00	-0.13
Totals		**+0.50**	**-2.55**	**-16.59**	**-4.85**

Extensive Stocker Production

Overall, Mexico experienced a slight increase in extensive stockers of 40,511 head. The only type of cattle being used in the extensive stocker program are traditional cattle type. The largest changes occurred in the Central Mesa (P3) production region, which decreased in extensive stocker production by approximately 109,700 head, and the Cordillera (P4) production region, which increased in extensive stocker production by more than 143,000 head. Table V-3 shows the percent change in extensive stocker production.

Table V-3. Percent Changes in Extensive Stockers

Production Region		Traditional Cattle
North	(P1)	0.00
Northeast	(P2)	0.00
Central Mesa	(P3)	-23.58
Cordillera	(P4)	+55.69
Pacific Coast	(P5)	0.00
Southern Sierra Madre	(P6)	+1.38
Veracruz	(P7)	0.00
South	(P8)	0.00
Yucatan	(P9)	-1.06
Totals		**+2.43**

Grass-Finishing Program

The total number of cattle being grass finished decreased by 135,522 head. There are 4,553 head of Northern-style cattle are being grass-finished in Mexico, these cattle are in the Central Mesa (P3) production region and are a small portion of total cattle finished on grass. There was an increase of 18,735 head of Semi-intensive (V2) cattle and a decrease of 25,618 head of Traditional (V3) cattle grass-finished. The Pacific Coast (P5) production region shifted from grass-finishing Semi-Intensive cattle to grass-finishing 104,949 head of Traditional (V3) cattle. Table V-4 shows the percentage change in the number of cattle grass finished from the Benchmark model to Scenario one.

Table V-4. Percentage Changes in Grass Finishing Production

Production Region		Northern-Style Cattle	Semi-Intensive Cattle	Traditional Cattle	Total Percent Change
North	(P1)	0	0.00	0.00	0.00
Northeast	(P2)	0	0.00	0.00	0.00
Central Mesa	(P3)	+	-2.09	-15.78	-11.92
Cordillera	(P4)	0	+37.70	-9.24	+19.19
Pacific Coast	(P5)	0	-100.00	+	+8.23
Southern Sierra Madre	(P6)	0	-11.29	+1.83	-3.50
Veracruz	(P7)	0	0.00	0.00	0.00
South	(P8)	0	0.00	0.00	0.00
Yucatan	(P9)	0	+19.38	-15.48	-0.68
Totals		**+**	**+1.71**	**-1.39**	**-0.08**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

The use of the supplemented grass finishing system has remained unchanged from the Benchmark and is not being utilized in Scenario one.

Meat Production

Production of Cattle for Northern-style (M1) and Mexican Fed (M2) Meat

Only Northern-style (V1) cattle are used in Northern-style (M1) meat production. The La Laguna (F2), Northeast (F3), and Veracruz (F7) feedlot centers are at capacity and are only feeding cattle for Northern-style (M1) meat. The reduction in the number of head being fed in the Northwest (F01) feedlot center is the same as the increase in the number of head being fed in the Northeast (F03) feedlot center. The Pacific Coast (F04) feedlot center experienced the largest increase in the number of cattle fed for M1 meat, increasing numbers by 64,095 head. The Cordillera (F05) experienced the largest decrease in numbers, with a decrease of 86,490 head being fed. Although the percentage decrease in the Yucatan (F10) feedlot center is high, the feedlot only decreased in number by just over 9,000 head. Table V-5 shows the percent change in cattle fed for Northern-style (M1) meat production.

Table V-5. Percent Changes in Cattle Fed for Northern-Style (M1) Meat Production

Feedlot Region		Northern-Style (V1) Cattle
Northwest	(F01)	-7.66
La Laguna	(F02)	0.00*
Northeast	(F03)	+2.17*
Pacific Coast	(F04)	+525.28
Cordillera	(F05)	-90.43
Huasteca	(F06)	+691.62
Central Mesa	(F07)	0.00
Veracruz	(F08)	0.00*
South	(F09)	0.00
Yucatan	(F10)	-72.54
Total		**0.00**

* Indicates scenario level equals maximum regional feedlot capacity.

Total production of Mexican fed beef decreased overall by 91,591 head of cattle. There are 175 head of Northern-style (V1) cattle being fed for the production of Mexican Fed (M2) meat. There are no Semi-Intensive cattle being used for M2 meat production. The use of Traditional (V3) cattle for Mexican Fed (M2) meat decreased from the Benchmark by 43,753 head. The Yucatan (F10) feedlot center is feeding at their maximum feedlot capacity by feeding Traditional (V3) cattle for Mexican Fed (M2) meat. The largest increase in the number of Traditional (V3) cattle used was in the Cordillera (F5) feedlot center, which experienced an increase of approximately 120,000 head. The feedlot center, which experienced the largest decrease in the number of Traditional (V3) cattle, was the Northwest (F01) feedlot center, which decreased its numbers by 96,523 head. Table V-6 shows the percent change in cattle used for M2 meat production from the Benchmark model.

Table V-6. Percent Changes in Cattle Used For M2 Meat Production from Feedlots

Feedlot Region		Northern-Style Cattle	Semi-Intensive Cattle	Traditional Cattle	M2 Meat Production
Northwest	(F01)	0	0.00	-70.36	-70.36
La Laguna	(F02)	0	0.00	0.00	0.00
Northeast	(F03)	0	0.00	-100.00	-100.00
Pacific Coast	(F04)	+	-100.00	-81.42	-87.96
Cordillera	(F05)	0	0.00	+70.32	+70.32
Huasteca	(F06)	0	0.00	0.00	0.00
Central Mesa	(F07)	0	0.00	0.00	0.00
Veracruz	(F08)	0	0.00	0.00	0.00
South	(F09)	0	0.00	0.00	0.00
Yucatan	(F10)	0	0.00	+*	+*
Total		**+**	**-100.00**	**-10.29**	**-19.35**

* Indicates scenario level equals maximum regional feedlot capacity.
+ Indicates a positive level in the scenario compared to zero in the Benchmark.

All feedlot centers are at operating at full capacity except for the Northwest (F01), Pacific Coast (F04), and Hausteca (F06) feedlot centers. The number of cattle in feedlots decreased from the Benchmark model by approximately 91,600 head. Table V-7 shows changes in feedlot production and capacity.

Table V-7. Changes in Feedlot Produciton and Capacity

Feedlot Region		Percent Change in Cattle Fed	Change in Percent Feedlot Capacity
Northwest	(F01)	-46.06	-23.58
La Laguna	(F02)	0.00	0.00*
Northeast	(F03)	0.00	0.00*
Pacific Coast	(F04)	-36.66	-16.45
Cordillera	(F05)	+12.61	+11.20*
Huasteca	(F06)	+691.62	+35.95
Central Mesa	(F07)	0.00	0.00*
Veracruz	(F08)	0.00	0.00*
South	(F09)	0.00	0.00*
Yucatan	(F10)	0.00	0.00*
Total		**-7.76**	**-5.42**

* Indicates scenario level equals maximum regional feedlot capacity.

Traditional (M3) Meat Production

TIF Traditional (M3) meat production did not change from the Benchmark model. Total local Traditional (M3) meat production did not change, although production among production regions did. The Central Mesa (P3) and the Southern Sierra Madre (P6) production regions decreased local Traditional meat production, while the Cordillera (P4) production region increased. The Central Mesa (P3) production region decreased M3 production by 20,633,100 kilograms and the Southern Sierra Madre (P6) decreased M3 production by 5,178,500 kilograms from the Benchmark. Table V-8 shows the percent change in Traditional (M3) Meat production from the Benchmark to Scenario one.

Table V-8. Percent Changes in Traditional (M3) Meat Production

Production Region		M3 Local Production	Total M3 Production
North	(P1)	0.00	0.00
Northeast	(P2)	0.00	0.00
Central Mesa	(P3)	-11.64	-11.64
Cordillera	(P4)	+20.07	+20.07
Pacific Coast	(P5)	0.00	0.00
Southern Sierra Madre	(P6)	-3.79	-3.79
Veracruz	(P7)	0.00	0.00
South	(P8)	0.00	0.00
Yucatan	(P9)	0.00	0.00
Totals		**0.00**	**0.00**

<u>Cull (M4) Meat Production</u>

Production of Cull (M4) meat by dairy cattle did not change from the production of Cull (M4) meat by dairy cattle in the Benchmark model. Total Cull beef (M4) production did not change, although the amount of Cull beef (M4) in TIF and local slaughter altered slightly. Table V-9 shows the percent change in Cull meat production from the Benchmark model. The largest increase in local M4 meat production occurred

Table V-9. Percent Changes in M4 Meat Production

Production Region		M4 TIF Production	M4 Local Production	Total M4 Production
North	(P1)	0.00	0.00	0.00
Northeast	(P2)	0.00	0.00	0.00
Central Mesa	(P3)	0.00	+24.46	+24.46
Cordillera	(P4)	0.00	-5.42	-5.42
Pacific Coast	(P5)	0.00	+0.17	+0.17
Southern Sierra Madre	(P6)	0.00	+4.14	+4.14
Veracruz	(P7)	-0.22	+7.58	0.00
South	(P8)	0.00	-0.32	-0.32
Yucatan	(P9)	+0.36	0.00	+0.21
Totals		**-0.05**	**+0.03**	**0.00**

in the Central Mesa (P3) production region, which had an increase of 3,713,420 kilograms. The largest decrease of local M4 production was in the Cordillera (P4) production region, which experienced a decrease of 4,126,890 kilograms from the Benchmark. The Veracruz (P7) production region reduced M4 TIF production by 109,750 kilograms and increased local production by the same amount of Cull (M4) beef.

Domestic Live Shipments

Northern-Style (V1) Calves

Northern-Style (V1) calf shipments decreased by 81,468 head from the Benchmark. The North (P1) production increased shipments to the Northeast (P2) production region by 6,787 head. Table V-10 shows the percent change in Northern-Style (V1) calf shipments.

Table V-10. Percent Change in Northern-Style (V1) Calf Shipments

Source Production Region		Destination Production Region		% Change in Number of Cattle
North	(P1)	Northeast	(P2)	+3.82
Central Mesa	(P3)	Cordillera	(P4)	-100.00
Southern Sierra Madre	(P6)	Cordillera	(P4)	-100.00
Veracruz	(P7)	Cordillera	(P4)	-100.00
Total				**-30.63**

Semi-Intensive (V2) Calf Shipments

There is a total of 728,101 head of Semi-Intensive calves being shipped throughout Mexico in Scenario 1. The Veracruz (P7) production region increased total shipments by 31,839 head. Tables V-11 shows the percent change in shipments of Semi-Intensive (V2) calves from the Benchmark model.

Table V-11. Percent Changes in Semi-Intensive (V2) Calf Shipments

Source Production Region		Destination Production Region		% Change in Number of Cattle
Veracruz	(P7)	Central Mesa	(P3)	-64.60
Veracruz	(P7)	Cordillera	(P4)	+37.70
South	(P8)	Southern Sierra Madre	(P6)	-8.29
Total				**+2.77**

Traditional (V3) Calf Shipments

A total of 797,957 head of Traditional (V3) calves are being shipped throughout Mexico. The North (P1) production region is shipping 4,767 head of Traditional (V3) calves less than in the Benchmark, with a total of 105,458 head shipped to the Pacific Coast (P5) production region. The Cordillera (P4) production region reduced shipments by 179,232 head, and the Yucatan (P9) production region reduced shipments by 2,185 head from the Benchmark. The Pacific Coast (P5) production region is receiving 35,936 more head of V3 calves. The Southern Sierra Madre (P6) production region is receiving 7,714 more head of Traditional (V3) cattle, with the increase coming from the 268,385 head being shipped from the Yucatan (P9) production region. Table V-12 shows the percent change in shipments of Traditional (V3) calves from the Benchmark model.

Table V-12. Percent Changes in Traditional (V3) Calf Shipments

Source Production Region		Destination Production Region		% Change in Number of Cattle
North	(P1)	Northeast	(P2)	-62.00
North	(P1)	Pacific Coast	(P5)	+
Cordillera	(P4)	Central Mesa	(P3)	-28.56
Cordillera	(P4)	Pacific Coast	(P5)	-100.00
Veracruz	(P7)	Southern Sierra Madre	(P6)	0.00
South	(P8)	Southern Sierra Madre	(P6)	-95.26
Yucatan	(P9)	Southern Sierra Madre	(P6)	+
Yucatan	(P9)	South	(P8)	-100.00
Total				**-35.90**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Total Calf Shipments

A total of 1,710,527 calves are being shipped between production regions in Scenario 1. The North (P1) production region is shipping 105,458 head to the Pacific Coast (P5) production region. The Yucatan is shipping 268,385 head to the Southern Sierra Madre (P6) production region. The North (P1) production region increased calf shipments by 2,019 head and the Veracruz (P7) production region decreased calf shipments by 265 head. The Northeast (P2) production region reduced the number of calves received by 103,440 head and the Central Mesa (P3) production region reduced calves received by 223,210 head. The Southern Sierra Madre (P6) production region increased calves received by approximately 4,500 head. Table V-13 shows the percent change in total calf shipments among regions from the Benchmark model.

Table V-13. Percent Changes in Total Calf Shipments

Source Production Region		Destination Production Region		% Change in Number of Cattle
North	(P1)	Northeast	(P2)	-29.10
North	(P1)	Pacific Coast	(P5)	+
Central Mesa	(P3)	Cordillera	(P4)	-100.00
Cordillera	(P4)	Central Mesa	(P3)	-28.56
Cordillera	(P4)	Pacific Coast	(P5)	-100.00
Southern Sierra Madre	(P6)	Cordillera	(P4)	-100.00
Veracruz	(P7)	Central Mesa	(P3)	-64.60
Veracruz	(P7)	Cordillera	(P4)	+27.12
Veracruz	(P7)	Southern Sierra Madre	(P6)	0
South	(P8)	Southern Sierra Madre	(P6)	-64.83
Yucatan	(P9)	Southern Sierra Madre	(P6)	+
Yucatan	(P9)	South	(P8)	-100.00
Total				**-22.92**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Stocker Shipments

A total of 226,139 head of stockers, a 12.18 percent decrease from the Benchmark model, are being shipped between production regions. There are no Northern-style (V1) stockers shipped in Scenario 1. Semi-Intensive (V2) stocker shipments reduced by 87.86 percent. The Veracruz (P7) production region is shipping 4,311 V2 stockers to the Southern Sierra Madre (P6) production region. Traditional (V3) stockers shipped reduced by 0.08 percent. The Central Mesa (P3) production region is receiving 149,784 V3 cattle from the North (P1) production region, a 208.27 percent increase from the Benchmark model, and 72,045 V3 cattle from the Northeast (P2) production region, a 58.46 percent decrease from the Benchmark model.

Northern-Style (V1) Feeder Shipments

Northern-Style (V1) feeder shipments increased from the Benchmark by 175 head. The North (P1) production region decreased shipments by 6,651 head and the Veracruz (P7) production region increased shipments by 581,462 head. Table V-14 shows the percent change in Northern-style (V1) feeder shipments.

Semi-Intensive (V2) Feeder Shipments

There are no shipments of Semi-Intensive (V2) calves in scenario one.

Traditional (V3) Feeder Shipments

Traditional (V3) feeder shipments declined by 43,753 head from the Benchmark. The Yucatan (P9) production region is shipping 9,067 head of V3 cattle to the Yucatan

(F10) feedlot region. Table V-15 shows the percent change in shipments of Traditional (V3) feeders.

Table V-14. Percent Changes in Northern-Style (V1) Feeder Shipments

Source Production Region		Destination Feedlot Center		% Change in Number of Cattle
North	(P1)	Northwest	(F01)	-7.66
North	(P1)	La Laguna	(F02)	0.00
Northeast	(P2)	Northeast	(F03)	+2.17
Central Mesa	(P3)	Central Mesa	(F07)	0.00
Cordillera	(P4)	Cordillera	(F05)	-90.43
Pacific Coast	(P5)	Pacific Coast	(F04)	+526.72
Veracruz	(P7)	Hausteca	(F06)	+691.62
Veracruz	(P7)	Veracruz	(F08)	0.00
Yucatan	(P9)	Yucatan	(F10)	-72.54
Total				**+0.02**

Table V-15. Percent Changes in Traditional (V3) Feeder Shipments

Source Production Region		Destination Feedlot Center		% Change in Number of Cattle
North	(P1)	Northwest	(F01)	-82.37
Northeast	(P2)	Northeast	(F03)	-100.00
Cordillera	(P4)	Cordillera	(F05)	+70.32
Pacific Coast	(P5)	Pacific Coast	(F04)	-81.42
South	(P8)	Tabasco	(F09)	0.00
Yucatan	(P9)	Yucatan	(F10)	+
Total				**-10.80**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Total Feeder Shipments

Total feeder shipments were reduced from the Benchmark by 91,591 head. Table V-16 show the percent change in total feeder shipments.

Table V-16. Percent Changes in Total Feeder Shipments

Source Production Region		Destination Feedlot Center		% Change in Number of Cattle
North	(P1)	Northwest	(F01)	-50.57
North	(P1)	La Laguna	(F02)	0.00
Northeast	(P2)	Northeast	(F03)	0.00
Central Mesa	(P3)	Central Mesa	(F07)	0.00
Cordillera	(P4)	Cordillera	(F05)	+12.61
Pacific Coast	(P5)	Pacific Coast	(F04)	-36.66
Veracruz	(P7)	Hausteca	(F06)	+691.62
Veracruz	(P7)	Veracruz	(F08)	0.00
South	(P8)	Tabasco	(F09)	0.00
Yucatan	(P9)	Yucatan	(F10)	0.00
Total				**-7.90**

Domestic Meat Shipments

Northern-Style (M1) Meat Shipments

Total Northern-style (M1) meat shipments did not change. The Pacific Coast (F04) feedlot center increased M1 shipments from the Benchmark by 18,472,226 kilograms and shipping 13,344,660 kilograms to the Tapatio (C4) consumption region and 3,210,781 kilograms to the Central (C5) consumption region in scenario 1. The Cordillera (F05) feedlot center reduced shipment of M1 meat by 24,926,470 kilograms. The Hausteca (F06) feedlot center is shipping 6,454,245 kilograms of Northern-style (M1) meat to the Central (C5) consumption region and increased total shipments by 9,067,302 kilograms. Although where the Veracruz (F08) feedlot center altered where M1 meat shipments were going, total shipments remained unchanged from the Benchmark. The amount of Northern-style (M1) meat each consumption region received did not change from the Benchmark. Table V-17 shows the percent change in shipments of Northern-style (M1) meat.

Table V-17. Percent Changes in Northern-Style (M1) Meat Shipments

Source Feedlot Region		Destination Consumption Region		% Change in Number of Cattle
Northwest	(F01)	Northwest	(C1)	-7.66
La Laguna	(F02)	North Central	(C2)	0.00
La Laguna	(F02)	Central	(C5)	0.00
Northeast	(F03)	Northeast	(C3)	0.00
Northeast	(F03)	Central	(C5)	+4.42
Pacific Coast	(F04)	Northwest	(C1)	+54.51
Pacific Coast	(F04)	Tapatio	(C4)	+
Pacific Coast	(F04)	Central	(C5)	+
Cordillera	(F05)	Tapatio	(C4)	-100.00
Cordillera	(F05)	Central	(C5)	-81.45
Hausteca	(F06)	Central	(C5)	+
Hausteca	(F06)	Gulf	(C6)	+199.33
Central Mesa	(F07)	Central	(C5)	0.00
Veracruz	(F08)	Gulf	(C6)	-41.06
Veracruz	(F08)	Yucatan	(C7)	+310.86
Yucatan	(F10)	Yucatan	(C7)	-72.53
Total				**0.00**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Mexican Fed (M2) Meat Shipments

Mexican Fed (M2) meat shipments declined by 22,092,720 kilograms from the Benchmark. The amount of M2 meat the Tapatio (C4) consumption region remained unchanged from the Benchmark. The Northwest (C1) consumption is receiving 22,659,845 kilograms of M2 meat. The Yucatan (F10) feedlot center is shipping 2,128,537 kilograms of Mexican Fed (M2) meat to the Yucatan (C7) consumption region. The Yucatan (C7) consumption region is receiving 567,168 kilograms more of Mexican Fed (M2) meat than in the Benchmark. Table V-18 shows the percent change in shipments of Mexican Fed (M2) meat.

Table V-18. Change in Mexican Fed (M2) Meat Shipments

Source Feedlot Region		Destination Consumption Region		% Change in Number of Cattle
Northwest	(F01)	Northwest	(C1)	-70.36
Northeast	(F03)	Yucatan	(C7)	-100.00
Pacific Coast	(F04)	Tapatio	(C4)	-88.17
Cordillera	(F05)	Tapatio	(C4)	+70.32
Tabasco	(F09)	Yucatan	(C7)	0.00
Yucatan	(F10)	Yucatan	(C7)	+
Total				**-19.78**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Traditional (M3) Meat Shipments

Traditional (M3) meat shipments remained unchanged from the Benchmark model.

Cull (M4) Meat Shipments

Cull (M4) meat shipments were reduced by 59,800 kilograms from the Benchmark. The Central (C5) consumption region is receiving 59,780 kilograms of M4 meat less than in the Benchmark. Table V-19 shows the percent change in Cull (M4) meat shipments.

Table V-19. Percent Changes in Cull (M4) Meat Shipments

Source Production Region		Destination Consumption Region		% Change in Number of Cattle
North	(P1)	Northeast	(C3)	0.00
North	(P1)	Tapatio	(C4)	0.00
Veracruz	(P7)	Central	(C5)	-0.22
Yucatan	(P9)	Central	(C5)	+0.36
Total				**-0.05**

Imports

Live imports did not change from the Benchmark model. Meat imports increased by over 22 million kilograms of beef from the Benchmark. Northern-style (M1) meat imports were unaffected by the Pacific Coast (P5) production region becoming a TB free region. The Northwest (C1) consumption region increased meat imports by 22,659,840 kilograms of Mexican Fed (M2) meat. Table V-20 shows the percent change in meat imports from the Benchmark model.

Table V-20. Percent Change in Meat Imports

Consumption Region		M2 Meat Imports
Northwest	(C1)	+48.13
North Central	(C2)	0.00
Northeast	(C3)	0.00
Central	(C5)	0.00
Gulf	(C6)	0.00
Yucatan	(C7)	-100.00
Total		+5.05

Exports

Total live exports increased by 105,343 head from the Benchmark. The Pacific Coast (P5) increased Northern-style (V1) steer calf exports by 105,343 head. The Southern Sierra Madre (P6) production region decreased the number of Northern –style steer calves and increased the number of Semi-Intensive steer calf exports by 10,000 head. Table V-21 shows the percent change in live exports from the Benchmark model to Scenario one.

Table V-21. Percent Change in Live Exports From Production Region to the U.S.

Production Region		Northern-Style Steer Calves	Northern Style Feeders	Semi-Intensive Steer Calves	Total
North	(P1)	0.00	0.00	0.00	0.00
Northeast	(P2)	0.00	0.00	0.00	0.00
Central Mesa	(P3)	0.00	0.00	0.00	0.00
Cordillera	(P4)	0.00	0.00	0.00	0.00
Pacific Coast	(P5)	+526.72	0.00	0.00	+526.72
Southern Sierra Madre	(P6)	-100.00	0.00	+	0.00
Veracruz	(P7)	0.00	0.00	0.00	0.00
South	(P8)	0.00	0.00	0.00	0.00
Yucatan	(P9)	-72.54	0.00	+102.40	0.00
Totals		**+9.26**	**0.00**	**+171.31**	**+9.51**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Scenario 2

In scenario two, the Central Mesa production region (P3) was moved to the TB free status zone. Thus, the TB free zone includes the North (P1), Northeast (P2), and Central Mesa (P3) production regions. Because the Central Mesa (P3) production region is included in the TB free status zone, a constrained number of rodeo cattle are allowed to be exported from this region. The maximum number of rodeo cattle allowed to be exported from the Central Mesa (P3) production region is 10,000 head. The TB restricted zone includes the rest of the production regions. The objective function was reduced by 1.00 percent to 32,483,600,000 pesos. The value of exports increased by approximately 28.24 percent to 8,510,217,000 pesos from the Benchmark. The total value of the domestic cost of meat is 40,993,817,000 pesos in scenario one. This was a 3.92 percent increase from the total value of the domestic cost of meat in the Benchmark model. The domestic cost increased by 0.92 pesos per kilogram to 24.405 pesos per kilogram.

Forage Use

All forage use remained the same, except for in the North (P1) and the Northeast (P2) production regions. The North (P1) production region reduced its use of irrigated pasture from 100 percent of available forage used to 98.9 percent of available forage used, a reduction of 299 hectare. The Northeast (P2) production region decreased its use of irrigated pasture from 81.6 percent to 66.9 percent of available forage, a reduction of 7,295 hectares from the Benchmark. Total irrigated pasture usage decreased by less than 0.01 percent.

Cow Production

Mexico experienced an overall increase in cow production by approximately 57,000 head. Northern-style (V1) cattle increased by 849,157 head and Traditional (V3) cattle increased by 355,369 head while the Semi-Intensive (V2) cattle decreased by 1,157,933 head. The Central Mesa (P3) production region increased production of Northern-style (V1) cows by one million head, but total cow production was only increased by 921,354 head. The Southern Sierra Madre (P6) production reduced total cow production by 235,168 head. The Veracruz (P7) production region is producing 373,218 head of Traditional (V3) cattle. The South (P8) production region reduced production or Semi-Intensive (V2) cattle by 248,740 head and increased the production of 262,066 head. The Yucatan (P9) production region decreased the production of Semi-Intensive (V2) cattle by 99,422 head and increased the production of Traditional (V3) cattle by 97,008 head. Table V-22 shows the percent change in cow production from the Benchmark model to Scenario two.

Table V-22. Percent Change in Cow Production

Production Region		Norte-Style Cattle	Semi-Intensive Cattle	Traditional Cattle	Total Percent Change
North	(P1)	-3.84	0.00	0.00	-3.84
Northeast	(P2)	-10.04	0.00	0.00	-10.04
Central Mesa	(P3)	+623.36	-100.00	0.00	+358.08
Cordillera	(P4)	0.00	0.00	-38.22	-36.63
Pacific Coast	(P5)	0.00	-32.57	0.00	-27.51
Southern Sierra Madre	(P6)	-100.00	-99.90	0.00	-99.91
Veracruz	(P7)	0.00	-28.41	+	-2.00
South	(P8)	0.00	-80.43	+22.16	+0.89
Yucatan	(P9)	0.00	-75.61	+11.21	-0.23
Totals		**+26.54**	**-46.56**	**+11.71**	**+0.53**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark..

Stocker Systems

Intensive Stocker System

Overall, Mexico decreased in the number of intensive stockers by 231,462 head of cattle. Northern-style (V1) cattle used in intensive stocker production were increased by 132,940 head and Traditional (V3) cattle were increased by 197,665 head, while Semi-Intensive (V2) cattle were reduced by 562,068 head. The North (P1) production region increased the use of Northern-style (V1) cattle by 12,452 head and decreased the use of Traditional (V3) cattle by 12,950 head in intensive stocker production. The Central Mesa (P3) production region increased the use of Northern-style (V1) cattle by 175,537 head and Traditional cattle by 32,971 head, while it decreased the use of Semi-Intensive (V2) cattle by 220,634 head. The Cordillera (P4) production region decreased the use of Northern-style (V1) cattle by 37,718 head and Semi-Intensive (V2) cattle by 245,893 head. It increased the use of Traditional (V3) cattle by 200,671 head. The Yucatan (P9) production region is using 33,544 Traditional (V3) cattle. Table V-23 shows the percent changes in the number of intensive stockers from the Benchmark model to Scenario two.

Table V-23. Percent Changes in Number of Intensive Stockers

Production Region		Northern-Style Cattle	Semi-Intensive Cattle	Traditional Cattle	Total Percent Change
North	(P1)	+5.15	0.00	-5.85	-0.11
Northeast	(P2)	-3.14	0.00	-49.36	-14.68
Central Mesa	(P3)	+1251.07	-100.00	+	-5.17
Cordillera	(P4)	-38.65	-63.79	+115.74	-12.63
Pacific Coast	(P5)	0.00	-32.57	+39.06	-5.67
Southern Sierra Madre	(P6)	0.00	0.00	0.00	0.00
Veracruz	(P7)	0.00	0.00	0.00	0.00
South	(P8)	0.00	0.00	0.00	0.00
Yucatan	(P9)	0.00	-100.00	+	-22.98
Totals		**+13.83**	**-48.06**	**+29.69**	**-8.28**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Extensive Stocker System

The only type of cattle being used in the extensive stocker program is the Traditional (V3) cattle. Table V-24 shows the percent change in the number of extensive stockers from the Benchmark model to Scenario two. Extensive stocker production

Table V-24. Percent Changes in Number of Extensive Stockers

Production Region		Traditional Cattle
North	(P1)	0.00
Northeast	(P2)	0.00
Central Mesa	(P3)	-100.00
Cordillera	(P4)	+63.40
Pacific Coast	(P5)	0.00
Southern Sierra Madre	(P6)	+2.57
Veracruz	(P7)	+
South	(P8)	0.00
Yucatan	(P9)	+27.60
Totals		**-4.05**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

declined by 67,487 head from the Benchmark. The Veracruz (P7) production region is using 205,809 head in its intensive stocker program.

Grass-Finishing Systems

Overall, Mexico experienced a slight increase of 29,098 head of grass finished cattle. Mexico is grass-finishing 70,880 head of Northern-style (V1) cattle in Scenario 2. Grass-finished Semi-Intensive (V2) cattle decreased by 502,814 head and grass-finished Traditional (V3) cattle increased by 34,131 head from the Benchmark model. The North (P1) production region increased grass-finishing by 104,949 head. The Northeast (P2) production region is grass-finishing 91,178 head. The Cordillera (P4) production region is grass-finishing 58,678 head of Northern-style (V1) cattle in Scenario 2. It increased the grass-finishing Semi-Intensive (V2) cattle by 99,024 and Traditional (V3) cattle by 556,233 head from the Benchmark. The Pacific Coast increased grass-finished Semi-Intensive cattle by 793 head and is grass-finishing 12,202 head of Semi-Intensive (V2) cattle and 119,090 head of Traditional (V3) cattle. The Southern Sierra Madre (P6) increased grass-finished Semi-Intensive (V2) cattle by the same number of head the Veracruz (P7) production region decreased grass-finished Semi-Intensive (V2) cattle. Table V-25 shows the percent change in the production of grass-finished cattle from the Benchmark model to Scenario two.

The use of the supplemented grass finishing system has remained unchanged and is not being practiced in Scenario two.

Table V-25. Percent Change in Grass-Finished Cattle

Production Region		Northern-Style Cattle	Semi-Intensive Cattle	Traditional Cattle	Total Percent Change
North	(P1)	0.00	0.00	+205.41	+205.41
Northeast	(P2)	0.00	0.00	+	+
Central Mesa	(P3)	0.00	-100.00	-100.00	-100.00
Cordillera	(P4)	+	-63.79	+216.11	+59.95
Pacific Coast	(P5)	+	+0.82	+	+136.21
Southern Sierra Madre	(P6)	0.00	+30.48	+51.53	+42.98
Veracruz	(P7)	0.00	-100.00	0.00	-100.00
South	(P8)	0.00	0.00	0.00	0.00
Yucatan	(P9)	0.00	-100.00	+79.89	+3.49
Totals		+	-45.79	+24.97	+0.99

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Meat Production

Production of Cattle for Northern-style (M1) and Mexican Fed (M2) Meat

Total Northern-style (M1) meat production did not change from the Benchmark, however there were some alterations of which feedlot center are producing M1 meat. The Northwest (F01) feedlot center increased M1 production by the same number of cattle the Pacific Coast (F04) feedlot center. The Central Mesa (F03) feedlot center increased M1 production by the same number of cattle as the Cordillera (F05) feedlot center. The La Laguna (F02), Northeast (F03), Central Mesa (F07), Veracruz (F08), South (F09), and Yucatan (F10) feedlot centers have met the maximum feedlot capacity producing Northern-style (M1) meat. Table V-26 shows the percent changes in cattle fed for the Northern-style (M1) meat production.

Mexican Fed (M2) meat production decreased by 297,084 head from the Benchmark. There are 83,036 Northern-style (V1) cattle used to produce Mexican Fed

Table V-26. Percent Changes in Cattle Fed for Northern-Style (M1) Meat Production

Feedlot Center		Northern-Style (V1) Cattle
Northwest	(F01)	+14.05
La Laguna	(F02)	0.00*
Northeast	(F03)	+2.17*
Pacific Coast	(F04)	-100.00
Cordillera	(F05)	-6.95
Huasteca	(F06)	0.00
Central Mesa	(F07)	0.00*
Veracruz	(F08)	0.00*
South	(F09)	0.00*
Yucatan	(F10)	0.00*
Total		**0.00**

* Indicates scenario level equals maximum regional feedlot capacity.

(M2) Meat. The use of Semi-Intensive (V2) cattle decreased by 48,013 head and Traditional (V3) cattle decreased by 332,108 head for M2 meat. The Cordillera (F05) feedlot center is producing 83,036 Northern-style (V1) cattle and decreased Traditional (V3) cattle used for the production of M2 meat. The South (F09) feedlot center is operating at full capacity by producing Traditional (V3) cattle for Mexican Fed (M2) meat. Table V-27 shows the percent change in the production of Mexican Fed (M2) meat production from the Benchmark model.

The La Laguna (F02), Northeast (F03), Central Mesa (F07), Veracruz (F08), South (F09), and Yucatan (F10) feedlot centers are all operating at maximum capacity in Scenario 2. Feedlot production decreased by 297,085 head from the Benchmark model. The Northwest (F01) feedlot center decreased feedlot production by 56,849 head and the Pacific Coast (F04) feedlot center decreased production by 145,858 head. The Cordillera (F04) feedlot center increased feedlot production by 94,379 head from the Benchmark. Table V-28 shows the percent change in feedlot production and capacity from the Benchmark model.

Table V-27. Percent Change in Mexican Fed (M2) Fed Meat Production

Feedlot Region		Northern-Style Cattle	Semi-Intensive Cattle	Traditional Cattle	M2 Meat Production
Northwest	(F01)	0.00	0.00	-50.34	-50.34
La Laguna	(F02)	0.00	0.00	0.00	0
Northeast	(F03)	0.00	0.00	-100.00	-100.00
Pacific Coast	(F04)	0.00	-100.00	-100.00	-100.00
Cordillera	(F05)	+	0.00	-100.00	-51.37
Huasteca	(F06)	0.00	0.00	0.00	0.00
Central Mesa	(F07)	0.00	0.00	0.00	0.00
Veracruz	(F08)	0.00	0.00	0.00	0.00
South	(F09)	0.00	0.00	0.00*	0.00*
Yucatan	(F10)	0.00	0.00	0.00	0.00
Total		+	**-100.00**	**-78.10**	**-62.78**

* Indicates scenario level equals maximum regional feedlot capacity.
\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Table V-28. Percent Changes in Feedlot Produciton and Capacity

Feedlot Region		Percent Change in Cattle Fed	Change in Percent Feedlot Capacity
Northwest	(F01)	-25.38	-12.99
La Laguna	(F02)	0.00	0.00*
Northeast	(F03)	0.00	0.00*
Pacific Coast	(F04)	-100.00	-44.88
Cordillera	(F05)	-35.43	-31.46
Huasteca	(F06)	0.00	0.00
Central Mesa	(F07)	0.00	0.00*
Veracruz	(F08)	0.00	0.00*
South	(F09)	0.00	0.00*
Yucatan	(F10)	0.00	0.00*
Total		**-25.19**	**-17.59**

* Indicates scenario level equals maximum regional feedlot capacity.

Traditional (M3) Meat Production

Total Traditional (M3) meat produced did not change from the Benchmark, but where it was produced and how it was harvested did. There is no TIF production of Traditional (V3) meat in Scenario 2. Local production of Traditional (M3) meat increased by 17,909,500 kilograms. The Northeast (P2) production region is producing

17,909,540 kilograms of M3 meat locally. The only decrease in local production occurs in the Central Mesa (P3) production region, which decreased local production by 177,297,000 kilograms, stopping the production of M3 meat in this region. Table V-29 shows the percent change in Traditional (M3) meat production by production region from the Benchmark model.

Table V-29. Percent Change in Mexican Fed (M3) Meat Production

Production Region		TIF Production	Local Production	Total Production
North	(P1)	0.00	+205.41	+205.41
Northeast	(P2)	0.00	+	+
Central Mesa	(P3)	0.00	-100.00	-100.00
Cordillera	(P4)	0.00	+55.63	+55.63
Pacific Coast	(P5)	0.00	+127.93	+127.93
Southern Sierra Madre	(P6)	0.00	+42.57	+42.57
Veracruz	(P7)	-100.00	0.00	-100.00
South	(P8)	0.00	0.00	0.00
Yucatan	(P9)	0.00	0.00	0.00
Totals		**-100.00**	**+3.10**	**0.00**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Cull (M4) Meat Production

Cull Meat (M4) production by dairy cattle is the same as in the Benchmark model. Total Cull (M4) meat did not change, however the regions where it is produced and how it is harvested has changed from the Benchmark. The only production regions that increased Cull (M4) meat production were the Central Mesa (P3) and Veracruz (P7) production regions. The Central Mesa (P3) production region increased local production of M4 meat by 23,879,840 kilograms. The Veracruz (P7) production region decreased TIF production by 3,913,920 kilograms and increased local production by 1,064,400 kilograms. The South production region decreased local production of M4 meat by

1,064,400 kilograms. Table V-30 shows the percent change in Cull (M4) meat production from the Benchmark model.

Table V-30. Percent Change in Cull (M4) Meat Production

Production Region		TIF Production	Local Production	Total Production
North	(P1)	-4.06	0.00	-2.07
Northeast	(P2)	0.00	-9.67	-9.67
Central Mesa	(P3)	0.00	+157.27	+157.27
Cordillera	(P4)	0.00	-9.72	-9.72
Pacific Coast	(P5)	0.00	-22.69	-22.69
Southern Sierra Madre	(P6)	0.00	-53.74	-53.74
Veracruz	(P7)	-7.97	+73.53	-5.64
South	(P8)	0.00	-3.14	-3.14
Yucatan	(P9)	-4.11	0.00	-2.42
Totals		**-5.81**	**+2.90**	**0.00**

Domestic Live Shipments

Northern-Style (V1) Calf Shipments

Shipments of Northern-style (V1) calves among production regions decreased by 17,436 head. The Central Mesa production region is shipping 48,822 head to the Northeast (P2) production region. The Central Mesa (P3) production region is shipping 17,329 more V1 calves than in the Benchmark. The Northeast (P2) production region is receiving 20,282 calves more than in the Benchmark. The Cordillera (P4) production region is receiving 37,718 head less than in the Benchmark. Table V-31 shows the percent change in Northern-style (V1) calf shipments.

Table V-31. Percent Change in Northern-Style (V1) Calf Shipments

Source Production Region		Destination Production Region		% Change in Number of Cattle
North	(P1)	Northeast	(P2)	-16.06
Central Mesa	(P3)	Northeast	(P2)	+
Central Mesa	(P3)	Cordillera	(P4)	-63.08
Southern Sierra Madre	(P6)	Cordillera	(P4)	-100.00
Veracruz	(P7)	Cordillera	(P4)	0.00
Total				**-6.56**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Semi-Intensive (V2) Calf Shipments

Scenario 2 is shipping 312,651 more Semi-Intensive (V2) calves among the production regions than the Benchmark model. The Veracruz (P7) production region is shipping 227,410 Semi-Intensive (V2) calves to the Southern Sierra Madre (P6) production region in Scenario 2. The Veracruz (P7) production region is shipping 194,172 fewer Semi-Intensive (V2) calves than in the Benchmark model. The Southern Sierra Madre (P6) production region is receiving 108,931 more V2 calves than in the Benchmark. Table V-32 shows the percent change in Semi-Intensive (V2) calf shipments.

Table V-32. Percent Change in Semi-Intensive (V2) Calf Shipments

Source Production Region		Destination Production Region		% Change in Number of Cattle
Veracruz	(P7)	Central Mesa	(P3)	-100.00
Veracruz	(P7)	Cordillera	(P4)	-63.79
Veracruz	(P7)	Southern Sierra Madre	(P6)	+
South	(P8)	Southern Sierra Madre	(P6)	-80.43
Total				**-44.13**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Traditional (V3) Calf Shipments

Scenario 2 is shipping 398,011 fewer Traditional (V3) calves than the Benchmark model. The North (P1) production is shipping 103,652 Traditional (V3) calves to the Pacific Coast (P5) production region and the Central Mesa (P3) is shipping 48,035 V3 calves to the Cordillera (P4) production region in Scenario 2. The North (P1) production is shipping 12,950 more V3 cattle than in the Benchmark. The Cordillera is not shipping Traditional (V3) calves in Scenario 2. The Pacific Coast (P5) production region is receiving 34,130 more head of V3 calves and the Southern Sierra Madre (P6) production region is receiving 10,820 V3 calves than in the Benchmark. Table V-33 shows the percent change in domestic shipments of Traditional (V3) calves from the Benchmark model.

Table V-33 Percent Change in Traditional (V3) Calf Shipments

Source Production Region		Destination Production Region		% Change in Number of Cattle
North	(P1)	Northeast	(P2)	-51.02
North	(P1)	Pacific Coast	(P5)	+
Central Mesa	(P3)	Cordillera	(P4)	+
Cordillera	(P4)	Central Mesa	(P3)	-100.00
Cordillera	(P4)	Pacific Coast	(P5)	-100.00
Veracruz	(P7)	Southern Sierra Madre	(P6)	-100.00
South	(P8)	Southern Sierra Madre	(P6)	+29.20
Yucatan	(P9)	South	(P8)	-5.95
Total				**-31.97**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Total Calves Shipped

Total calf shipments were reduced by 728,099 head from the Benchmark. The North (P1) is shipping 103,652 calves to the Pacific Coast (P5) production region and the

Central Mesa (P3) is shipping 48,822 calves to the Northeast (P2) production region in Scenario 2. The North is shipping 15,591 fewer calves and the Veracruz (P7) production region is shipping 263,265 fewer calves than in the Benchmark. The Central Mesa (P6) is shipping 263,265 head more than in the Benchmark and is not receiving shipments of calves in Scenario 2. The Northeast (P2) production region is receiving 70,421 fewer calves and the Cordillera (P4) production region is receiving 235,578 fewer calves than in the Benchmark. The Pacific Coast (P5) production region is receiving 34,130 more head of calves. The Southern Sierra Madre (P6) production region is receiving 119,751 more head of calves than in the Benchmark. Table V-34 shows the percent change in total calf shipments from the Benchmark model.

Table V-34. Percent Change in Total Calf Shipments

Source Production Region		Destination Production Region		% Change in Number of Cattle
North	(P1)	Northeast	(P2)	-33.55
North	(P1)	Pacific Coast	(P5)	+
Central Mesa	(P3)	Northeast	(P2)	+
Central Mesa	(P3)	Cordillera	(P4)	+33.13
Cordillera	(P4)	Central Mesa	(P3)	-100.00
Cordillera	(P4)	Pacific Coast	(P5)	-100.00
Southern Sierra Madre	(P6)	Cordillera	(P4)	-100.00
Veracruz	(P7)	Central Mesa	(P3)	-100.00
Veracruz	(P7)	Cordillera	(P4)	-58.88
Veracruz	(P7)	Southern Sierra Madre	(P6)	+229.14
South	(P8)	Southern Sierra Madre	(P6)	-9.16
Yucatan	(P9)	South	(P8)	-5.95
Total				**-32.81**

+ Indicates a positive level in the scenario compared to zero in the Benchmark.

<u>Stocker Shipments</u>

There are a total of 349,647 stockers being shipped throughout Mexico, a 35.78 percent increase from the Benchmark model. Northern-style (V1) stockers are not being shipped amongst the production regions. Semi-Intensive (V2) stocker shipments increased by 237.23 percent from the Benchmark model. As in the Benchmark model V2 stockers are being shipped from the Veracruz (P7) production region to the Southern Sierra Madre (P6) production region. Total Traditional (V3) stocker shipments increased by 3.55 percent from the Benchmark. Traditional (V3) stockers are not being shipped to the Central Mesa (P3) production region in Scenario 1. The Central Mesa (P3) production region is shipping 32,312 head of V3 stockers to the Cordillera (P4) production region and the Veracruz (P7) production region is shipping 197,576 head of V3 stockers to the Southern Sierra Madre (P6) production region. Table V-35 shows the percent change in total domestic stockers shipped from the Benchmark model.

Table V-35. Percent Change in Total Stockers Shipped

Source Production Region		Destination Production Region		% Change in Number of Cattle
North	(P1)	Central Mesa	(P3)	-100.00
Northeast	(P2)	Central Mesa	(P3)	-100.00
Central Mesa	(P3)	Cordillera	(P4)	+
Veracruz	(P7)	Southern Sierra Madre	(P6)	+793.57
Total				**+35.77**

<u>Northern-Style (V1) Feeder Shipments</u>

Scenario 2 is shipping 83,036 more Northern (V1) feeders to feedlot centers than the Benchmark model. The Central Mesa (P3) production region is shipping 17,2027 V1 feeders to the Cordillera (F05) feedlot center. The North (P1) production region is shipping 12,202 more V1 feeders than in the Benchmark. The Cordillera (F05) feedlot center is receiving 76,385 more V1 feeders than in the Benchmark. Table V-36 shows the percent increased in domestic shipments of Northern-Style (V1) feeders from the Benchmark model.

Table V-36. Percent Change in Northern-Style (V1) Feeder Shipments

Source Production Region		Destination Feedlot Center		% Change in Number of Cattle
North	(P1)	Northwest	(F01)	+14.05
North	(P1)	La Laguna	(F02)	0.00
Northeast	(P2)	Northeast	(F03)	+2.17
Central Mesa	(P3)	Cordillera	(F05)	+
Central Mesa	(P3)	Central Mesa	(F07)	0.00
Cordillera	(P4)	Cordillera	(F05)	-100.00
Pacific Coast	(P5)	Cordillera	(F05)	-100.00
Veracruz	(P7)	Huasteca	(F06)	0.00
Veracruz	(P7)	Veracruz	(F08)	0.00
Yucatan	(P9)	Yucatan	(F10)	0.00
Total				**+11.76**

+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Semi-Intensive (V2) Feeder Shipments

The GANAMEX model is not shipping Semi-Intensive (V2) feeders from production regions to feedlot centers in Scenario 2.

Traditional (V3) Feeder Shipments

There are 332,108 less Traditional (V3) feeders being shipped in Scenario 2. The North (P1) production region is shipping 69,051 fewer V3 feeders to the Northwest feedlot center than in the Benchmark. Table V-37 shows the percent change in Traditional (V3) feeder shipments from production regions to feedlot centers within Mexico.

Table V-37 Percent Change in Traditional (V3) Feeder Shipments

Source Production Region		Destination Production Region		% Change in Number of Cattle
North	(P1)	Northwest	(F02)	-58.93
Northeast	(P2)	Northeast	(F03)	-100.00
Cordillera	(P4)	Cordillera	(F05)	-100.00
Pacific Coast	(P5)	Pacific Coast	(F04)	-100.00
South	(P8)	Tabasco	(F09)	0.00
Total				**-81.95**

Total Feeder Shipments

There are 297,085 fewer feeders being shipped from production regions to feedlot centers within Mexico in Scenario 2 than in the Benchmark. The Central Mesa (P3) production region is shipping 172,027 feeders to the Cordillera (F05) feedlot center in Scenario 2. The North (P1) production region is shipping 56,849 fewer feeders. The Cordillera (F05) feedlot center is receiving 94,379 fewer feeders than in the Benchmark model. Table V-38 shows the percent change in total feeder cattle shipments from the Benchmark model.

Table V-38. Percent Change in Total Feeders Shipped

Source Production Region		Destination Feedlot Center		% Change in Number of Cattle
North	(P1)	Northwest	(F01)	-27.86
North	(P1)	La Laguna	(F02)	0.00
Northeast	(P2)	Northeast	(F03)	0.00
Central Mesa	(P3)	Cordillera	(F05)	+
Central Mesa	(P3)	Central Mesa	(F07)	0.00
Cordillera	(P4)	Cordillera	(F05)	-100.00
Pacific Coast	(P5)	Pacific Coast	(F04)	-100.00
Veracruz	(P7)	Huasteca	(F06)	0.00
Veracruz	(P7)	Veracruz	(F08)	0.00
South	(P8)	Tabasco	(F09)	0.00
Yucatan	(P9)	Yucatan	(F10)	0.00
Total				**-25.62**

+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Domestic Meat Shipments

Northern-Style (M1) Meat Shipments

Total Northern-style (M1) meat shipments have not changed from the Benchmark. Each consumption region is receiving the same number of kilograms of M1 meat in Scenario 2 as in the Benchmark. Table V-39 shows the percent change in Northern-style (M1) meat shipments.

Table V-39 Percent Change in Northern-Style (M1) Meat Shipments

Source Feedlot Center		Destination Consumption Region		% Change in Kilograms
Northwest	(F01)	Northwest	(C1)	+14.05
La Laguna	(F02)	North Central	(C2)	0.00
La Laguna	(F02)	Central	(C5)	0.00
Northeast	(F03)	Northeast	(C3)	0.00
Northeast	(F03)	Central	(C5)	+4.42
Pacific Coast	(F04)	Northwest	(C1)	-100.00
Cordillera	(F05)	Tapatio	(C4)	0.00
Cordillera	(F05)	Central	(C5)	-13.48
Huasteca	(F06)	Gulf	(C6)	0.00
Central Mesa	(F07)	Central	(C5)	0.00
Veracruz	(F08)	Gulf	(C6)	0.00
Veracruz	(F08)	Yucatan	(C7)	0.00
Yucatan	(F10)	Yucatan	(C7)	0.00
Total				**0.00**

Mexican Fed (M2) Meat Shipments

Mexican Fed (M2) meat shipments were reduced by 68,175,020 kilograms. The Tapatio (C4) consumption region is receiving by 50,403,280 kilograms less than in the Benchmark and the Yucatan (C7) is receiving 1,561,370 kilograms less than in the Benchmark. Table V-40 shows the percent change in domestic shipments of Mexican Fed (M2) meat from the Benchmark model.

Table V-40. Percent Change in Northern-Style (M2) Meat Shipments

Source Feedlot Center		Destination Consumption Region		% Change in Kilograms
Northwest	(F01)	Northwest	(C1)	-50.34
Northeast	(F03)	Yucatan	(C7)	-100.00
Pacific Coast	(F04)	Tapatio	(C4)	-100.00
Cordillera	(F05)	Tapatio	(C4)	-45.98
Tabasco	(F09)	Yucatan	(C7)	0.00
Total				**-61.04**

Traditional (M3) Meat Shipments

The GANAMEX model is not shipping Traditional (M3) meat to consumption regions in Scenario 2.

Cull (M4) Meat Shipments

Cull (M4) meat shipments were reduced by 6,398,600 kilograms from the Benchmark. The North (P1) production region is shipping 1,907,230 fewer kilograms and the Central (C5) consumption region is receiving 4,491,370 kilograms than in the Benchmark model. Table V-41 shows the percent change in domestic shipments of Cull (M4) meat from the Benchmark model.

Table V-41. Percent Changes in Cull (M4) Meat Shipments

Source Region		Destination Region		% Change in Kilograms
North	(P1)	Northeast	(C3)	+38.05
North	(P1)	Tapatio	(C4)	-8.36
Veracruz	(P7)	Central	(C5)	-7.97
Yucatan	(P9)	Central	(C5)	-4.11
Total				**-5.81**

Imports

Live imports were unchanged from the Benchmark model. Mexico is not importing Northern-style (M1) meat in Scenario 2. Imports of Mexican Fed (M2) meat increased by 68,175,000 kilograms in Scenario 2. The Tapatio (C4) consumption region is importing 50,403,280 kilograms of M2 meat. The Northwest (C1) consumption region increased M2 meat imports by 16,210,330 kilograms and the Yucatan (C7) consumption region increased M2 meat imports by 1,561,369 kilograms from the Benchmark. Table V-42 shows the percent change in meat imports from the Benchmark model.

Table V-42. Percent Change in Meat Imports

Consumption Region		M2 Meat Imports
Northwest	(C1)	+34.43
North Central	(C2)	0.00
Northeast	(C3)	0.00
Tapatio	(C4)	+
Central	(C5)	0.00
Gulf	(C6)	0.00
Yucatan	(C7)	+275.29
Total		**+15.59**

+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Exports

Total live exports increased by 334,235 from the Benchmark model. The Southern Sierra Madre (P6) production region is exporting 10,000 head of Semi-Intensive (V2) steer calves rather than exporting Northern-style (V1) steer calves in Scenario 2. Table V-43 shows the percent change in live exports from the Benchmark model.

Table V-43. Percent Change in Live Exports

Production Region		Northern-Style Steer Calves	Northern-Style Feeder	Semi-Intensive Steer Calves	Total
North	(P1)	-3.84	0.00	0.00	-3.84
Northeast	(P2)	0.00	-10.04	0.00	-10.04
Central Mesa	(P3)	+1275.10	0.00	0.00	+1275.10
Cordillera	(P4)	0.00	0.00	0.00	0.00
Pacific Coast	(P5)	0.00	0.00	0.00	0.00
Southern Sierra Madre	(P6)	-100.00	0.00	+	0.00
Veracruz	(P7)	0.00	0.00	0.00	0.00
South	(P8)	0.00	0.00	0.00	0.00
Yucatan	(P9)	0.00	0.00	0.00	0.00
Totals		**+39.89**	**-10.04**	**+68.91**	**+30.19**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Scenario 3

In scenario three, the Veracruz production region (P7) was moved to the TB free status zone. Thus, the TB free zone includes production regions one, two, and seven. The TB restricted zone includes the rest of the production regions. The objective function was reduced by 0.25 percent to 32,729,700,000 pesos. The value of exports increased by 40.44 percent to 9,319,617,000 pesos. The total value of the domestic cost of meat is 42,049,317,000 pesos in scenario one. This was a 6.59 percent increase from the total value of the domestic cost of meat in the Benchmark model. The domestic cost increased by 1.548 pesos per kilogram to 25.033 pesos per kilogram.

Forage Use

All forage use remained the same except for irrigated pasture use in production regions one, two, and five. Production region one decreased irrigated pasture usage from

100 percent of the available irrigated pasture to 97.9 percent of the available irrigated pasture and decreased total forage usage from 100 percent to 99.999 percent. Production region two decreased irrigated pasture usage from 81.6 percent of available irrigated pasture to 66.9 percent of available irrigated pasture, decreasing total forage usage from percent 99.919 percent of available forage to 99.854 percent of available forage. Production region six decreased irrigated pasture usage from 100 percent of the available irrigated pasture to 58.8 percent of the available irrigated pasture, decreasing total forage usage from 100 percent of available forage to 99.884 percent of available forage. Total irrigated pasture usage in Mexico reduced from 94.402 percent of the available irrigated pasture to 85.942 percent of the available irrigated pasture.

Cow Production

Cow production increased by 55,329 head from the Benchmark. Production of Northern-style (V1) cows increased by 3,942,378 head and Traditional (V3) cows increased by 430,712 head from the Benchmark model. Semi-Intensive (V2) cow production decreased by 1,437,762 head. The Northeast (P2) production region is producing 2,514 cows and decreased Northern-style (V1) production by 66,522 cows. The Veracruz (P7) production region increased Northern-style (V1) cow production by 1,180,086 head and decreased Semi-Intensive (V2) head by 1,174,980 head. The Southern Sierra Madre (P6) production region increased Semi-Intensive (V2) cows by 9,224 and the South (P7) production region decreased Semi-Intensive (V2) cows by the same number of head. The South (P7) production region increased production of Traditional (V3) cows by 24,500 head. The Yucatan (P9) production region increased production of Northern-style (V1) cows by 41,462 head and Traditional (V3) cows by 80,259 head and is not producing Semi-Intensive (V2) cows in Scenario 3. Table V-44 shows the percent change in cow production from the Benchmark model.

Table V-44. Percent Change in Cow Production

Production Region		Northern-Style Cattle	Semi-Intensive Cattle	Traditional Cattle	Total Percent Change
North	(P1)	0.00	0.00	0.00	0.00
Northeast	(P2)	-10.41	+	0.00	-10.02
Central Mesa	(P3)	-39.32	-100.00	0.00	-61.58
Cordillera	(P4)	0.00	0	+33.05	+31.67
Pacific Coast	(P5)	0.00	-12.70	0.00	-8.22
Southern Sierra Madre	(P6)	-100.00	+4.46	0.00	+0.30
Veracruz	(P7)	+413.03	-81.90	0.00	+0.30
South	(P8)	0.00	-2.98	+2.07	+1.02
Yucatan	(P9)	+70.83	-100.00	+9.27	-0.93
Totals		**+33.21**	**-57.81**	**+14.20**	**+0.63**

+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Stocker Systems

Intensive Stocker System

Intensive stocker production decreased by 371,546 head from the Benchmark. Use of Northern-style (V1) cattle increased by 183,371 head and Traditional (V3) cattle by 239,544 head. Semi-Intensive (V2) cattle use for intensive stockers decreased by 794,461 head in Scenario 3. The Central Mesa (P3) production region is using 54,323 head of Traditional (V3) calves and the South (P8) production region is using 27,198 Traditional (V3) calves for intensive stocker production. The Central Mesa (P3) production region increased the use of Northern-style (V1) calves by 61,579 head and is not using Semi-Intensive (V2) calves as intensive stockers in Scenario 3. The Pacific

Coast (P4) production region increased the use of Traditional (V3) calves by 335,046 head and decreased the use of Northern-style (V1) calves by 88,255 calves in the intensive stocker program. The Veracruz (P7) production region shifted the use of Semi-Intensive (V2) calves to Northern-style (V1) calves as intensive stockers. Table V-45 shows the percent changes in the number of intensive stockers from the Benchmark model.

Table V-45. Changes in Number of Intensive Stockers

Production Region		Northern-Style Cattle	Semi-Intensive Cattle	Traditional Cattle	Total Percent Change
North	(P1)	+5.15	0.00	+7.59	-0.94
Northeast	(P2)	-3.30	0.00	-49.36	-14.80
Central Mesa	(P3)	+1034.43	-100.00	+	-9.02
Cordillera	(P4)	-90.43	-100.00	+193.24	-21.13
Pacific Coast	(P5)	0.00	-12.70	-79.55	-35.64
Southern Sierra Madre	(P6)	0.00	0.00	0.00	0.00
Veracruz	(P7)	+408.67	-100.00	0.00	+0.67
South	(P8)	0.00	0.00	0.00	0.00
Yucatan	(P9)	+70.83	-100.00	+	-18.51
Totals		**+19.08**	**-67.94**	**+35.98**	**-13.29**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Extensive Stocker System

Only Traditional (V3) cattle are being used in the extensive stocker system. Extensive stockers decreased by 81,767 head. Table V-46 shows the percent change in extensive stocker production from the Benchmark model.

Grass-Finishing Systems

Grass finishing increased by 1,025,778 head in Scenario 3. Mexico is grass-finishing 198,275 Northern-style (V1) cattle in Scenario 3. The use of Semi-Intensive

Table V-46. Changes in Number of Extensive Stockers

Production Region		Traditional Cattle
North	(P1)	0.00
Northeast	(P2)	0.00
Central Mesa	(P3)	+35.29
Cordillera	(P4)	-100.00
Pacific Coast	(P5)	0.00
Southern Sierra Madre	(P6)	+2.16
Veracruz	(P7)	0.00
South	(P8)	-4.91
Yucatan	(P9)	+37.58
Totals		**-4.91**

(V2) cattle decreased by 730,559 head and Traditional (V3) cattle increased by 558,062 head in grass-finishing production. The Northeast (P1) production region is grass-finishing 91,178 Traditional (V3) cattle. The Central Mesa (P3) production region is grass-finishing 155,989 Northern-style (V1) cattle and increased the use of Traditional (V3) cattle by 138,163 head. The Pacific Coast (P5) production region is grass-finishing 17,512 Traditional (V3) cattle. The Southern Sierra Madre (P6) production region is finishing 42,286 Northern-style (V1) cattle. The Yucatan (P9) production region increased grass-finished Traditional (V3) cattle by 50,228 head. Table V-47 shows the percent change in grass-finished cattle from the Benchmark model.

The use of the supplemented grass finishing system has remained unchanged and is not being practiced in Scenario one.

Meat Production

Production of Northern-Style (M1) and Mexican Fed (M2) Meat

Only Northern-style (V1) cattle are fed for the production of Northern-style (M1) meat. Total production of M1 meat has not changed from the Benchmark. The Northeast

Table V-47. Percent Change in Grass-Finished Cattle

Production Region		Northern-Style Cattle	Semi-Intensive Cattle	Traditional Cattle	Total Percent Change
North	(P1)	0.00	0.00	0.00	0.00
Northeast	(P2)	0.00	0.00	+	+
Central Mesa	(P3)	+	-100.00	+20.66	+8.81
Cordillera	(P4)	0.00	-100.00	+102.54	-20.12
Pacific Coast	(P5)	0.00	+30.53	+	+48.58
Southern Sierra					
Madre	(P6)	+	-12.85	+2.16	+2.28
Veracruz	(P7)	0.00	-100.00	0.00	-100.00
South	(P8)	0.00	0.00	0.00	0.00
Yucatan	(P9)	0.00	-100.00	+79.89	+3.49
Totals		+	**-66.53**	**+30.23**	**+0.88**

+ Indicates a positive level in the scenario compared to zero in the Benchmark.

(F03) feedlot center is operating at full capacity by feeding for Northern-style (M1) meat. The largest increase in cattle fed for Northern-style (M1) meat is in the Huasteca (F06) feedlot center, which increased production by 78,470 head. The largest decrease in M1 production is found in the Cordillera (F04) feedlot center, which decreased production by 86,490 head. Table V-48 shows the percent change in cattle fed for Northern-style (M1) meat for Scenario 3.

Table V-48. Percent Change in Cattle Fed for Northern-Style (M1) Meat

Feedlot Center		Northern-Style (V1) Cattle
Northwest	(F01)	+14.05
La Laguna	(F02)	0.00
Northeast	(F03)	+2.17*
Pacific Coast	(F04)	0.00
Cordillera	(F05)	-90.43
Huasteca	(F06)	+1724.99
Central Mesa	(F07)	-100.00
Veracruz	(F08)	0.00
South	(F09)	+
Yucatan	(F10)	0.00
Total		**0.00**

* Indicates scenario level equals maximum regional feedlot capacity.
+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Total production of cattle fed for Mexican Fed (M2) meat has decreased by 443,881 head. No feedlot centers are operating at maximum capacity by feeding for Mexican Fed (M2) meat. In Scenario 3, 5,937 head of Northern-style (V1) cattle are being fed for M2 meat and they are all coming from the South (F09) feedlot center. There are no Semi-Intensive (V2) cattle being used for M2 meat. Traditional (V3) cattle fed for M2 meat declined by 401,805 head from the Benchmark. Traditional cattle fed for Mexican Fed (M2) meat decreased by 117,181 head in the Northwest (F01) feedlot center and by 21,567 head in the South (F09) feedlot center. Table V-49 shows the percent change in Mexican Fed (M2) meat production from the Benchmark model.

Table V-49. Change in M2 Fed Meat Production

Feedlot Center		Northern-Style Cattle	Semi-Intensive Cattle	Traditional Cattle	M2 Meat Production
Northwest	(F01)	0.00	0.00	-85.42	-85.42
La Laguna	(F02)	0.00	0.00	0.00	0.00
Northeast	(F03)	0.00	0.00	-100.00	-100.00
Pacific Coast	(F04)	0.00	-100.00	-100.00	-100.00
Cordillera	(F05)	0.00	0.00	-100.00	-100.00
Huasteca	(F06)	0.00	0.00	0.00	0.00
Central Mesa	(F07)	0.00	0.00	0.00	0.00
Veracruz	(F08)	0.00	0.00	0.00	0.00
South	(F09)	+	0.00	-86.27	-62.52
Yucatan	(F10)	0.00	0.00	0.00	0.00
Total		**+**	**-100.00**	**-94.49**	**-93.79**

+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Total cattle fed in feedlots decreased by 443,881 head from the Benchmark. The La Laguna (F02), Northeast (F03), Veracruz (F08), and Yucatan (F10) feedlot centers are all operating at maximum capacity. Table V-50 shows changes in feedlot production and capacity.

Table V-50. Changes in Feedlot Production and Capacity

Feedlot Region		Percent Change in Cattle Fed	Change in Percent Feedlot Capacity
Northwest	(F01)	-46.86	-28.56
La Laguna	(F02)	0.00	0.00*
Northeast	(F03)	0.00	0.00*
Pacific Coast	(F04)	-91.63	-41.13
Cordillera	(F05)	-96.56	-58.29
Huasteca	(F06)	+1724.99	+89.68
Central Mesa	(F07)	-100.00	-100.00
Veracruz	(F08)	0.00	0.00*
South	(F09)	-50.85	-88.33
Yucatan	(F10)	0.00	0.00*
Total		**-37.63**	**-26.29**

* Indicates scenario level equals maximum regional feedlot capacity.

<u>Traditional (M3) Meat Production</u>

Total Traditional (M3) meat production did not change from the Benchmark. TIF M3 meat production is not occurring in Scenario 3. Total local production of Traditional (M3) meat increased by 17,909,500 kilograms from the Benchmark. The 17.909,540 kilograms of TIF M3 meat produced in the Veracruz (P7) production region in the Benchmark model is being produced for local M3 meat in the Northeast (P2) production region in Scenario 3. Table V-51 shows the percent change in Traditional (M3) meat production from the Benchmark model.

<u>Cull (M4) Meat Production</u>

Total Cull (M4) meat production did not change from the Benchmark. Production of Cull (M4) meat from dairy cattle did not change from the Benchmark. Production of

Table V-51. Percent Change in Traditional (M3) Meat Production

Production Region		M3 Local Production	Total M3 Production
North	(P1)	0.00	0.00
Northeast	(P2)	+	+
Central Mesa	(P3)	+9.66	+9.66
Cordillera	(P4)	-23.91	-23.91
Pacific Coast	(P5)	+47.21	+47.21
Southern Sierra Madre	(P6)	+2.93	-2.93
Veracruz	(P7)	0.00	-100.00
South	(P8)	0.00	0.00
Yucatan	(P9)	0.00	0.00
Totals		**+3.10**	**0.00**

+ Indicates a positive level in the scenario compared to zero in the Benchmark.

758,200 kilograms of Local M4 meat was moved to TIF production. Table V-52 shows the percent change in Cull (M4) meat production from the Benchmark model. The

Table V-52. Percent Change in Cull (M4) Meat Production

Production Region		TIF Production	Local Production	Total Production
North	(P1)	0.00	0.00	0
Northeast	(P2)	0.00	-9.66	-9.66
Central Mesa	(P3)	0.00	-26.42	-26.42
Cordillera	(P4)	0.00	+8.41	+8.41
Pacific Coast	(P5)	0.00	-8.85	-8.85
Southern Sierra Madre	(P6)	0.00	-4.63	-4.63
Veracruz	(P7)	+2.84	-17.32	+2.26
South	(P8)	0.00	+0.74	+0.74
Yucatan	(P9)	-4.53	+137.15	-2.67
Totals		**+0.69**	**-0.34**	**0**

Veracruz (P7) production region reduced local M4 meat production by 250,790 kilograms and The South (P8) production region increased local M4 meat production by the same amount. The Veracruz (P7) production region increased production of M4 TIF by 1,394,350 kilograms.

Domestic Live Shipments

Northern Style (V1) Calf Shipments

Shipments of Northern-style (V1) cattle increased by 65,311 head from the Benchmark. The Veracruz (P7) production region is shipping 33,232 head to the Northeast (P2) production region and l132,785 head to the Central Mesa (P3) production region. The Northeast (P2) production region is receiving 20,781 head more than in the Benchmark. Table V-53 shows the percent change in shipments of Northern-style (V1) claves.

Table V-53. Percent Change in Northern-Style (V1) Calf Shipments

Source Production Region		Destination Production Region		% Change in Number of Cattle
North	(P1)	Northeast	(P2)	-7.01
Central Mesa	(P3)	Cordillera	(P4)	-100.00
Southern Sierra Madre	(P6)	Cordillera	(P4)	-100.00
Veracruz	(P7)	Northeast	(P2)	+
Veracruz	(P7)	Central Mesa	(P3)	+
Veracruz	(P7)	Cordillera	(P4)	-100.00
Total				**+24.56**

Semi-Intensive (V2) Calf Shipments

Semi-Intensive (V2) calf shipments were reduced by 441,853 head from the Benchmark. The Veracruz (P7) production region is shipping 123,711 head to the Northeast (P2) production region. Table V-54 shows the percent change in Semi-Intensive (V2) calves from the Benchmark model.

Table V-54. Percent Change in Semi-Intensive (V2) Calf Shipments

Source Production Region		Destination Production Region		% Change in Number of Cattle
Veracruz	(P7)	Northeast	(P2)	+
Veracruz	(P7)	Central Mesa	(P3)	-
Veracruz	(P7)	Cordillera	(P4)	-
South	(P8)	Southern Sierra Madre	(P6)	-2.98
Total				**-62.37**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark..

<u>Traditional (V3) Calf Shipments</u>

Traditional (V3) calf shipments increased by 45,025 head from the Benchmark. The North (P1) production region is shipping 107,502 Traditonal (V3) cattle to the Central Mesa (P3) production region, totaling shipments of V3 cattle from the North (P1) production region to be 16,800 head higher than in the Benchmark. The Cordillera (P4) production region is shipping 41,493 V3 calves more than in the Benchmark. The Central Mesa (P3) production region is receiving 218,516 head more and the Southern Sierra Madre (P6) production region is receiving 9,086 head more than in the Benchmark. Table V-55 shows the percent change in Traditional (V3) calf shipments from the Benchmark model.

Table V-55. Percent Change in Traditional (V3) Calf Shipments

Source Production Region		Destination Productioin Region		% Change in Number of Cattle
North	(P1)	Northeast	(P2)	-51.02
North	(P1)	Central Mesa	(P3)	+
Cordillera	(P4)	Central Mesa	(P3)	+28.89
Cordillera	(P4)	Pacific Coast	(P5)	-100.00
Veracruz	(P7)	Southern Sierra Madre	(P6)	0.00
South	(P8)	Southern Sierra Madre	(P6)	+3.32
Yucatan	(P9)	South	(P8)	-8.26
Total				**+3.62**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Total Calf Shipments

Total calf shipments among production regions were reduced by 331,516 head. The North (P1) production region is shipping 107,503 head to the Central Mesa (P3) production region and the Veracruz (P7) production region is shipping 156,943 head to the Northeast (P2) production region. The North increased shipments by 4,348. The Cordillera (P4) production region increased shipments by 41,493 head. The Veracruz (P7) production region decreased calf shipments by 303,545 head. The Northeast (P2) production region is receiving 53,789 more calves than in the Benchmark. The Central Mesa (P3) production region is receiving 175,612 more calves and the Southern Sierra Madre (P6) production region is receiving 4,692 more calves than in the Benchmark. Table V-56 shows the percent change in total calf shipments from the Benchmark model.

Table V-56. Percent Change in Total Calf Shipments

Source Production Region		Destination Production Region		% Change in Number of Cattle
North	(P1)	Northeast	(P2)	-29.02
North	(P1)	Central Mesa	(P3)	+
Central Mesa	(P3)	Cordillera	(P4)	-100.00
Cordillera	(P4)	Central Mesa	(P3)	+28.89
Cordillera	(P4)	Pacific Coast	(P5)	-100.00
Southern Sierra Madre	(P6)	Cordillera	(P4)	-100.00
Veracruz	(P7)	Northeast	(P2)	+
Veracruz	(P7)	Central Mesa	(P3)	-2.44
Veracruz	(P7)	Cordillera	(P4)	-100.00
Veracruz	(P7)	Southern Sierra Madre	(P6)	0.00
South	(P8)	Southern Sierra Madre	(P6)	+1.11
Yucatan	(P9)	South	(P8)	-8.26
Total				**-14.94**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Stocker Shipments

In Scenario 3, 42.286 Northern style (V1) stocker are shipped from the Veracruz (P7) production region to the Southern Sierra Madre (P6) production region. Semi-Intensive (V2) stockers are not being shipped in Scenario 3. There are 149,305 Traditional (V3) stockers being shipped from the North (P1) production region to the Central Mesa (P3) production region. Table V-57 shows the percent change in total stocker shipments.

Table V-57. Percent Change in Total Stocker Shipments

Source Production Region		Destination Production Region		% Change in Number of Cattle
North	(P1)	Central Mesa	(P3)	+207.28
Northeast	(P2)	Central Mesa	(P3)	-100.00
Veracruz	(P7)	Southern Sierra Madre	(P6)	+19.07
Total				**-25.60**

Northern-style (V1) Feeder Shipments

Northern-style (V1) feeder shipments increased by 5,937 head from the Benchmark. The Yucatan (P9) production is shipping 8,854 V1 feeders to the Tabasco (F09) feedlot center. The North (P1) production region increased Northern-style (V1) feeder shipments by 12,202 head. The Veracruz (P7) production region increased V1 feeder shipments by 78,470 head. Table V-58 shows the percent change in Northern-style feeder shipments from the Benchmark model.

Semi-Intensive (V2) Feeder Shipments

There are no shipments of Semi-Intensive (V2) feeders in Scenario 3.

Table V-58. Percent Change in Northern-style (V1) Feeder Shipments

Source Production Region		Destination Feedlot Center		% Change in Number of Cattle
North	(P1)	Northwest	(F01)	+14.05
North	(P1)	La Laguna	(F02)	0.00
Northeast	(P2)	Northeast	(F03)	+2.17
Central Mesa	(P3)	Central Mesa	(F07)	-100.00
Cordillera	(P4)	Cordillera	(F05)	-90.43
Pacific Coast	(P5)	Pacific Coast	(F04)	0.00
Veracruz	(P7)	Hausteca	(F06)	+1724.99
Veracruz	(P7)	Veracruz	(F08)	0.00
Yucatan	(P9)	Tabasco	(F09)	+
Yucatan	(P9)	Yucatan	(F10)	0.00
Total				**+0.84**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Traditional (V3) Feeder Shipments

In Scenario 3, 3,433 Traditional (V3) feeders being shipped from the South (P8) production region to the Tabasco (F09) feedlot center.

Total Feeder Shipments

Total feeder shipments decreased by 443,881 head from the Benchmark. The North (P1) production region reduced shipments by 104,979 head. The Veracruz (P7) production region increased feeder shipments by 78,470 and the Yucatan (P9) production region increased feeder shipments by 8,854 head. The Tabasco (F09) feedlot center is receiving 12,713 fewer feeders than in the Benchmark. Table V-59 shows the percent change in shipments of feeder cattle from the Benchmark model.

Table V-59. Percent Change in Total Feeder Shipments

Source Production Region		Destination Feedlot Center		% Change in Number of Cattle
North	(P1)	Northwest	(F01)	-51.46
North	(P1)	La Laguna	(F02)	0.00
Northeast	(P2)	Northeast	(F03)	0.00
Central Mesa	(P3)	Central Mesa	(F07)	-100.00
Cordillera	(P4)	Cordillera	(F05)	-96.56
Pacific Coast	(P5)	Pacific Coast	(F04)	-91.63
Veracruz	(P7)	Huasteca	(F06)	+1724.99
Veracruz	(P7)	Veracruz	(F08)	0.00
South	(P8)	Tabasco	(F09)	-86.27
Yucatan	(P9)	Tabasco	(F09)	+
Yucatan	(P9)	Yucatan	(F10)	0.00
Total				**-38.28**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Domestic Meat Shipments

Northern-Style (M1) Meat Shipments

Total Northern-style (M1) meat shipments did not change from the Benchmark nor did how much each consumption region received. The La Laguna (F02) feedlot center is shipping 7,190,517 kilograms of meat to the Tapatio (C4) consumption region. The total amount of M1 meat it is shipping has not changed from the Benchmark. The Northeast (F03) feedlot center 1,916,780 more kilograms of Northern-style (M1) meat to consumption regions than in the Benchmark. The Pacific Coast (F04) is shipping 3,516,654 kilograms of meat to the Tapatio (C4) consumption region. It is shipping the same amount of M1 meat to consumption regions as in the Benchmark. The Cordillera (F05) feedlot center decreased M1 meat shipments by 24,816,470 kilograms. The Huasteca (F06) feedlot center is shipping 23,455,790 kilograms of M1 meat to the Central (C5) consumption region and is shipping 22,615,203 more kilograms of M1 meat to consumption regions within Mexico. The Veracruz (F08) feedlot center increased M2 meat shipments by 3,242,256 kilograms. The Tabasco (F09) feedlot center is shipping 840,587 kilograms of M1 meat to the Yucatan (C7) feedlot center. Table V-60 shows the percent changes in shipments of Northern-style (M1) meat from the Benchmark model.

Table V-60. Percent Change in Northern-Style (M1) Meat Shipments

Source Feedlot Center		Destination Production Region		% Change Kilograms
Northwest	(F01)	Northwest	(C1)	+14.05
La Laguna	(F02)	North Central	(C2)	0.00
La Laguna	(F02)	Tapatio	(C4)	+
La Laguna	(F02)	Central	(C5)	-44.57
Northeast	(F03)	Northeast	(C3)	0.00
Northeast	(F03)	Central	(C5)	+4.42
Pacific Coast	(F04)	Northwest	(C1)	-100.00
Pacific Coast	(F04)	Tapatio	(C4)	+
Cordillera	(F05)	Tapatio	(C4)	-80.24
Cordillera	(F05)	Central	(C5)	-100.00
Huasteca	(F06)	Central	(C5)	+
Huasteca	(F06)	Gulf	(C6)	-64.12
Central Mesa	(F07)	Central	(C5)	-100.00
Veracruz	(F08)	Gulf	(C6)	+13.21
Veracruz	(F08)	Yucatan	(C7)	-100.00
Tabasco	(F09)	Yucatan	(C7)	+
Yucatan	(F10)	Yucatan	(C7)	0.00
Total				**0.00**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Mexican Fed (M2) Meat Shipments

Mexican Fed (M2) meat shipments were reduced by 104,646,555 kilograms. The Northeast (F01) feedlot center reduced shipments to consumption regions by 27,509,464 kilograms. The Yucatan (C7) consumption region is receiving 2,987,308 less kilograms of M2 meat than in the Benchmark. Table V-61 shows the percent change in shipments of Mexican Fed (M2) meat from the Benchmark.

Table V-61. Percent Change in Mexican Fed (M2) Meat Shipments

Source Feedlot Center		Destination Production Region		% Change Kilograms
Northwest	(F01)	Northwest	(C1)	-85.42
Northeast	(F03)	Yucatan	(C7)	-100.00
Pacific Coast	(F04)	Tapatio	(C4)	-100.00
Cordillera	(F05)	Tapatio	(C4)	-100.00
Tabasco	(F09)	Yucatan	(C7)	-59.88
Total				**-93.69**

<u>Traditional (M3) Meat Shipments</u>

There are no Traditional (M3) meat shipments in Scenario 3.

<u>Cull (M4) Meat Shipments</u>

Shipments of Cull (M4) meat increased by 758,200 kilograms from the Benchmark. The North (P1) production region total M4 meat shipments did not change from the Benchmark. The Central (C5) consumption region is receiving 1,655,500 less kilograms of Cull (M4) meat than in the Benchmark. Table V-62 shows the percent change in Cull (M4) meat shipments from the Benchmark model.

Table V-62. Percent Change in Cull (M4) Meat Shipments

Source Region		Destination Region		% Change Kilograms
North	(P1)	Northeast	(C3)	+38.02
North	(P1)	Tapatio	(C4)	-3.88
Veracruz	(P7)	Central	(C5)	+2.84
Yucatan	(P9)	Central	(C5)	-4.53
Total				**+0.69**

Imports

Live imports did not change from the Benchmark model. There are no Northern-style (M1) meat imports in Scenario 3. Mexican Fed (M2) meat imports increased by 104,646,500 kilograms from the Benchmark. The Tapatio (C4) consumption region is importing 72,061,170 kilograms of M2 meat in Scenario 3. Table V-63 shows the percent change in meat imports from the Benchmark model.

Table V-63. Change in Meat Imports

Consumption Region		M2 Meat Imports
Northwest	(C1)	+58.43
North Central	(C2)	0.00
Northeast	(C3)	0.00
Tapatio	(C4)	+
Central	(C5)	0.00
Gulf	(C6)	0.00
Yucatan	(C7)	+894.95
Total		**+23.92**

Exports

Total live exports increased by 498,410 head from the Benchmark. The Northeast is exporting 118,663 head in Scenario 3. Table V-64 shows the percent change in live exports from the Benchmark model.

Scenario 4

In scenario four, the Pacific Coast, Central Mesa, and Veracruz production regions (P5, P3, P7) were moved to the TB free status zone. Thus, the TB free zone includes production regions one, two, three, five, and seven. Because the Central Mesa

Table V-64. Percent Change in Live Exports

Production Region		Northern-Style Steer Calves	Northern-Style Feeder Steers	Semi-Intensive Steer Calves	Total
North	(P1)	0.00	0.00	0.00	0.00
Northeast	(P2)	0.00	-10.41	+	+42.65
Central Mesa	(P3)	0.00	0.00	0.00	0.00
Cordillera	(P4)	0.00	0.00	0.00	0.00
Pacific Coast	(P5)	0.00	0.00	0.00	0.00
Southern Sierra Madre	(P6)	-100.00	0.00	0.00	-100.00
Veracruz	(P7)	+413.03	0.00	0.00	+413.03
South	(P8)	0.00	0.00	0.00	0.00
Yucatan	(P9)	+70.83	0.00	-100.00	0.00
Totals		**+48.04**	**-10.41**	**+717.69**	**+45.01**

(P3) production region is included in the TB free status zone, a constrained number of rodeo cattle are allowed to be exported from this region. The maximum number of rodeo cattle allowed to be exported from the Central Mesa (P3) production region is 10,000 head. The TB restricted zone includes the remaining production regions. The objective function was reduced by 1.07 percent to 32,460,700,000 pesos. The value of exports increased by approximately 40.23 percent to 9,305,664,000 pesos. The total value of the domestic cost of meat is 41,766,364,000 pesos in scenario 4. This was a 5.88 percent increase from the total value of the domestic cost of meat in the Benchmark model. The domestic cost increased by 1.38 pesos per kilogram to 24.87 pesos per kilogram.

Forage Use

All forage use remained the same, except for use of irrigated pasture in th North (P1) and Northeast (P2) production regions. The North (P1) production region's usage of irrigated pasture decreased from using 100 percent of available irrigated pasture to using 86.4 percent of irrigated pasture causing total forage usage to decrease from 100 percent to 99.99 percent. The Northeast (P2) production region reduced usage of irrigated pasture from 81.6 percent to 66.8 percent of available irrigated pasture, causing total forage usage to decrease from 99.919 percent to 99.854 percent. Total irrigated pasture usage in Mexico reduced from 94.402 percent of the available irrigated pasture to 87.58 percent of the available irrigated pasture.

Cow Production

Total cow production has increased to 8,802,453 head in Mexico. Production of Northern-style (V1) cattle increased by 1,017,419 head; Semi-Intensive (V2) cattle decreased by 1,483,248 head; and Traditional (V3) cattle increased by 547,682 head. The Northeast (P2) production region is producing 2,617 Semi-Intensive (V2) cattle and the Veracruz (P7) production region is producing 711,794 Traditional (V3) cattle in Scenario 4. The production region affected the most by the three regions becoming TB free is the Central Mesa (P3) production region. Although it no longer produces Semi-Intensive cattle, it increased total cattle production by 921,354 million head by increasing Northern-style cow production by 1,015,715 head from the Benchmark. Table V-65 shows the percent change in cow production from the Benchmark model.

Stocker Systems

Intensive Stocker Production

Intensive stocker production decreased by 346,184 head from the Benchmark. The use of Northern-style (V1) cattle increased by 168,694 head, Semi-Intensive (V2) cattle decreased by 821,246 head, and Traditional (V3) increased by 306,369 head. The

Table V-65. Percent Change in Cow Production

Production Region		Northern-Style Cattle	Semi-Intensive Cattle	Traditional Cattle	Total Percent Change
North	(P1)	-3.84	0.00	0.00	-3.84
Northeast	(P2)	-10.43	+	0.00	-10.02
Central Mesa	(P3)	+623.36	-100.00	0.00	+358.08
Cordillera	(P4)	0.00	0.00	-28.89	-27.68
Pacific Coast	(P5)	+372.10	-100.00	0.00	-26.64
Southern Sierra Madre	(P6)	100.00	-100.00	0.00	-100.00
Veracruz	(P7)	-19.44	-52.11	+	-5.31
South	(P8)	0.00	+1.62	+0.56	+0.78
Yucatan	(P9)	0.00	-100.00	+20.58	+13.19
Totals		**+31.80**	**-59.63**	**+18.05**	**+0.94**

+ Indicates a positive level in the scenario compared to zero in the Benchmark..

Central Mesa (P3) production region is using 92,003 Traditional (V3) cattle, the Southern Sierra Madre (P6) is using 22,975 Northern-style (V1) cattle, and the Yucatan (P9) is using 31,453 Traditional (V3) cattle as intensive stockers. The Southern Sierra Madre (P6) production region increased total intensive stocker production by 189 head. The Veracruz (P7) production region decreased intensive stocker production by 25 head. Table V-66 shows the percent changes in the number of intensive stockers from the Benchmark model.

Table V-66. Percent Changes in Number of Intensive Stocker Cattle

Production Region		Northern-Style Cattle	Semi-Intensive Cattle	Traditional Cattle	Total Percent Change
North	(P1)	+5.15	0.00	-28.05	-10.72
Northeast	(P2)	-3.31	0.00	-49.36	-14.80
Central Mesa	(P3)	+652.16	-100.00	+	-15.82
Cordillera	(P4)	+14.03	-100.00	+151.94	-16.51
Pacific Coast	(P5)	+372.10	-100.00	+82.67	-11.85
Southern Sierra Madre	(P6)	+	-9.27	0.00	+0.07
Veracruz	(P7)	-9.87	+2.41	0.00	0.00
South	(P8)	0.00	0.00	0.00	0.00
Yucatan	(P9)	+23.33	-100.00	+	-21.50
Totals		**+17.56**	**-68.29**	**+46.02**	**-12.38**

+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Extensive Stocker Production

Traditional (V3) cattle are the only type of cattle used as extensive stockers in Scenario 4. Extensive stocker production decreased by 105,743 head from the Benchmark. The Veracruz (P7) production region is using 329,834 Traditional (V3) cattle as extensive stockers in Scenario 4. Table V-67 shows the percent change in the number of extensive stockers from the Benchmark model.

Table V-67. Percent Changes in Number of Extensive Stockers

Production Region		Traditional Cattle
North	(P1)	0.00
Northeast	(P2)	0.00
Central Mesa	(P3)	-100.00
Cordillera	(P4)	+33.42
Pacific Coast	(P5)	0.00
Southern Sierra Madre	(P6)	-13.90
Veracruz	(P7)	+
South	(P8)	0
Yucatan	(P9)	-3.96
Totals		**-6.35**

+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Grass-Finishing Systems

Total grass-finished cattle increased by a 29,394 head in Mexico in Scenario 4. In Scenario 4, 189,864 Northern-style (V1) cattle are being grass-finished. Usage of Semi-Intensive (V2) cattle decreased by 756,809 head and Traditional (V3) cattle increased by 596,338 head for grass-finishing. The Northeast (P2) production region is grass-finishing 91,178 head of Traditional (V3) cattle. The Cordillera (P4) is grass-finishing 109,743 Northern-style (V1) cattle and increased grass-finished Traditional(V3) cattle by 333,562 head. The Pacific Coast (P5) production region is grass-finishing 57,606 Northern-style

(V1) cattle and 156,443 Traditional (V3) cattle. The Southern Sierra Madre increased Semi-Intensive (V2) grass-finished cattle by 64,809 head and Traditional (V3) grass-finished cattle by 260,559 head from the Benchmark; it is grass-finishing 22,515 Northern-style (V1) cattle in Scenario 4. Table V-68 shows the percent change in grass-finished cattle in Mexico.

Table V-68. Percent Change in Grass-Finished Cattle

Production Region		Northern-Style Cattle	Semi-Intensive Cattle	Traditional Cattle	Total Percent Change
North	(P1)	0.00	0.00	+205.41	+205.41
Northeast	(P2)	0.00	0.00	+	+
Central Mesa	(P3)	0.00	-100.00	-100.00	-100.00
Cordillera	(P4)	+	-100.00	+292.72	+53.48
Pacific Coast	(P5)	+	-100.00	+	+120.74
Southern Sierra Madre	(P6)	+	+23.45	+67.92	+51.16
Veracruz	(P7)	0.00	-100.00	0.00	-100.00
South	(P8)	0.00	0.00	0.00	0.00
Yucatan	(P9)	0.00	-100.00	+79.89	+3.49
Totals		**+**	**-68.92**	**+32.30**	**+1.00**

+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Meat Production

Production of Cattle for Northern-Style (M1) and Mexican Fed (M2) Meat

Only Northern-style (V1) cattle can be used to produce Northern-style (M1) meat. Total cattle fed for Northern-style (M1) meat production did not change from the Benchmark. The La Laguna (F02), Northeast (F03), Central Mesa (F07), and Veracruz (F08) feedlot centers are operating at maximum capacity by feeding for Northern-style (M1) meat. The reduction in cattle fed for M1 meat in the Pacific Coast (F04) feedlot center is the same number of cattle fed for M1 meat increase in the Northwest (F01) feedlot center. The reduction in cattle fed for M1 meat in the Cordillera (F05) feedlot center is the same number as the increase in cattle fed for M1 meat in the Northeast (F03) feedlot center. The reduction in cattle fed for M1 meat in the Huasteca (F06) feedlot center is the same as the number of cattle fed for M1 meat increased in the South (F09) feedlot center. Table V-69 shows the percent change in cattle fed for Northern-style (M1) meat production from the Benchmark.

Table V-69. Percent Change in Cattle Fed for Northern-Style (M1) Meat Production

Feedlot Center		Northern-Style (V1) Cattle
Northwest	(F01)	+14.05
La Laguna	(F02)	0.00*
Northeast	(F03)	+2.17*
Pacific Coast	(F04)	-100.00
Cordillera	(F05)	-6.95
Huasteca	(F06)	-64.12
Central Mesa	(F07)	0.00*
Veracruz	(F08)	0.00*
South	(F09)	+
Yucatan	(F10)	0.00
Total		**0.00**

* Indicates scenario level equals maximum regional feedlot capacity.
+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Cattle fed for Mexican Fed (M2) meat decreased by 445,624 head from the Benchmark. Northern-style (V1) and Semi-Intensive (V2) cattle are not fed for M2 meat production in Scenario 4. Traditional (V3) cattle fed for M2 meat decreased by 397,611 head. Table V-70 shows the percent change in cattle fed for Mexican Fed (M2) meat production from the Benchmark. Table V-70 shows the percent change in Mexican Fed (M2) meat from the Benchmark model.

The La Laguna (F02), Northeast (F03), Central Mesa (F07), and Veracruz (F08) feedlot centers are operating at maximum capacity. The number of cattle in feedlots decreased by 445,624 head from the Benchmark. Table V-71 shows the changes in feedlot production and capacity.

Table V-70. Percent Change in cattle fed for Mexican Fed (M2) Meat Production

Feedlot Region		Semi-Intensive Cattle	Traditional Cattle	M2 Meat Production
Northwest	(F01)	0.00	-85.42	-85.42
La Laguna	(F02)	0.00	0.00	0.00*
Northeast	(F03)	0.00	-100.00	-100.00
Pacific Coast	(F04)	-100.00	-100.00	-100.00
Cordillera	(F05)	0.00	-100.00	-100.00
Huasteca	(F06)	0.00	0.00	0.00
Central Mesa	(F07)	0.00	0.00	0.00
Veracruz	(F08)	0.00	0.00	0.00
Tabasco	(F09)	0.00	-69.49	-69.49
Yucatan	(F10)	0.00	0.00	0.00
Total		-100.00	-94.16	-94.16

* Indicates scenario level equals maximum regional feedlot capacity.

Table V-71. Changes in Feedlot Production and Capacity

Feedlot Region		Percent Change in Cattle Fed	Change in Percent Feedlot Capacity
Northwest	(F01)	-46.86	-23.99
La Laguna	(F02)	0.00	0.00*
Northeast	(F03)	0.00	0.00*
Pacific Coast	(F04)	-100.00	-44.88
Cordillera	(F05)	-66.60	-59.14
Huasteca	(F06)	-64.12	-3.33
Central Mesa	(F07)	0.00	0.00*
Veracruz	(F08)	0.00	0.00*
South	(F09)	-57.82	-57.82
Yucatan	(F10)	0.00	0.00*
Total		**-37.78**	**-26.39**

* Indicates scenario level equals maximum regional feedlot capacity.

<u>Traditional (M3) Meat Production</u>

Production of Traditional (M3) TIF meat stopped and local production increased by 17,909,500 kilograms causing total Traditional (M3) meat to remain unchanged. The

Northeast (P2) production region is producing 17,909,540 kilograms of local M3 meat. Table V-72 shows the percent change in Traditional (M3) meat production.

Table V-72. Change in M3 Meat Production

Production Region		M3 Local Production	Total M3 Production
North	(P1)	+205.41	+205.41
Northeast	(P2)	+	+
Central Mesa	(P3)	-100.00	-100.00
Cordillera	(P4)	+49.09	+49.09
Pacific Coast	(P5)	+113.46	+113.46
Southern Sierra Madre	(P6)	+50.83	+50.83
Veracruz	(P7)	0.00	-100.00
South	(P8)	0.00	0.00
Yucatan	(P9)	0.00	0.00
Totals		**+3.10**	**0.00**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Cull (M4) Meat Production

Production of Cull (M4) meat by dairy cattle did not change from the Benchmark. Total cull (M4) meat production remained unchanged, although production of 8,465,000 kilograms were shifted from TIF production to local production. Table V-73 shows the percent change in Cull (M4) meat production.

Table V-73. Change in M4 Meat Production

Production Region		TIF Production	Local Production	Total Production
North	(P1)	-4.08	0.00	-2.07
Northeast	(P2)	0.00	-9.66	-9.66
Central Mesa	(P3)	0.00	+157.27	+157.27
Cordillera	(P4)	0.00	-7.35	-13.60-7.35
Pacific Coast	(P5)	0.00	-20.33	-20.33
Southern Sierra Madre	(P6)	0.00	-53.79	-53.79
Veracruz	(P7)	-11.95	-17.63	-12.11
South	(P8)	0.00	+0.75	+0.75
Yucatan	(P9)	-4.91	0.00	-2.89
Totals		**-7.69**	**+3.83**	**0**

Domestic Live Shipments

Northern Style (V1) Calf Shipments

Northern-style (V1) calf shipments increased by 57,468 head from the Benchmark. The Central Mesa (P3) production region increased shipments by 101,362 head. It is shipping 49,342 Northern-style (V1) calves to the Northeast (P2) production region. The Veracruz (P7) production region is shipping 22,975 V1 calves to the Southern Sierra Madre (P6) production region in Scenario 4. The Northeast is receiving 20,802 V1 calves more than in the Benchmark. Table V-74 shows the percent change in shipments of Northern-style (V1) calves from the Benchmark.

Table V-74. Percent Change in Northern-Style (V1) Calf Shipments

Source Production Region		Destination Production Region		% Change in Number of Cattle
North	(P1)	Northeast	(P2)	-16.06
Central Mesa	(P3)	Northeast	(P2)	+
Central Mesa	(P3)	Cordillera	(P4)	+104.19
Southern Sierra Madre	(P6)	Cordillera	(P4)	-100.00
Veracruz	(P7)	Cordillera	(P4)	-100.00
Veracruz	(P7)	Southern Sierra Madre	(P6)	+
Total				**+21.61**

+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Semi-Intensive (V2) Calf Shipments

Semi-Intensive (V2) calf shipments were reduced by 356,668 head from the Benchmark. The Veracruz (P7) production region is shipping 128,781 head to the Northeast (P3) and 73,336 head to the Southern Sierra Madre (P6) production regions. Table V-75 shows the percent change in Semi-Intensive (V2) calf shipments from the Benchmark.

Table V-75. Percent Change in Semi-Intensive (V2) Calf Shipments

Source Production Region		Destination Production Region		% Change in Number of Cattle
Veracruz	(P7)	Northeast	(P2)	+
Veracruz	(P7)	Central Mesa	(P3)	-100.00
Veracruz	(P7)	Cordillera	(P4)	-100.00
Veracruz	(P7)	Southern Sierra Madre	(P6)	+
South	(P8)	Southern Sierra Madre	(P6)	+1.62
Total				**-50.34**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Traditional (V3) Calf Shipments

Traditional (V3) calf shipments decreased by 459,937 head from the Benchmark. The North (P1) production region is shipping 62,062 more head than in the Benchmark. It is shipping 10,997 head to the Central Mesa (P3) and 141,767 head to the Pacific Coast (P5) production regions. Table V-76 shows the percent change in shipments of Traditional (V3) calves from the Benchmark model.

Table V-76. Percent Change in Traditional (V3) Calf Shipments

Source Production Region		Destination Production Region		% Change in Number of Cattle
North	(P1)	Northeast	(P2)	-51.02
North	(P2)	Central Mesa	(P3)	+
North	(P1)	Pacific Coast	(P5)	+
Cordillera	(P4)	Central Mesa	(P3)	-100.00
Cordillera	(P4)	Pacific Coast	(P5)	-100.00
Veracruz	(P7)	Southern Sierra Madre	(P6)	-100.00
South	(P8)	Southern Sierra Madre	(P6)	+3.90
Yucatan	(P9)	South	(P8)	-3.64
Total				**-36.95**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Total Calf Shipments

Total calf shipments declined by 759,136 head from the Benchmark. The North (P1) production region increased shipments by 33,521 head and the Central Mesa (P3) production region increased shipments by 101,362 head from the Benchmark. The Veracruz (P7) production region decreased calf shipments by 437,275 head. The Southern Sierra Madre (P6) production region is receiving 40,277 more calves than in the Benchmark. Table V-77 shows the percent change ion total calf shipments from the Benchmark model.

Table V-77. Percent Change in Total Calf Shipments

Source Production Region		Destination Production Region		% Change in Number of Cattle
North	(P1)	Northeast	(P2)	-33.55
North	(P1)	Central Mesa	(P3)	+
North	(P1)	Pacific Coast	(P5)	+
Central Mesa	(P3)	Northeast	(P2)	+
Central Mesa	(P3)	Cordillera	(P4)	+104.19
Central Mesa	(P3)	Pacific Coast	(P5)	-100.00
Cordillera	(P4)	Central Mesa	(P3)	-100.00
Cordillera	(P4)	Pacific Coast	(P5)	-100.00
Southern Sierra Madre	(P6)	Cordillera	(P4)	-100.00
Veracruz	(P7)	Northeast	(P2)	+
Veracruz	(P7)	Central Mesa	(P3)	-100.00
Veracruz	(P7)	Cordillera	(P4)	-100.00
Veracruz	(P7)	Southern Sierra Madre	(P6)	+39.39
South	(P8)	Southern Sierra Madre	(P6)	+3.10
Yucatan	(P9)	South	(P8)	-3.64
Total				**-34.21**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Stocker Shipments

Total stocker shipments increased by 272,622 head from the Benchmark. There are 684 Northern-style (V1) stockers being shipped from the Central Mesa (P3) production region to the Cordillera (P4) production region in Scenario 4. The Veracruz (P7) production region is shipping 122,651 Semi-Intensive (V2) stockers to the Southern Sierra Madre (P6) production region in Scenario 4. The Central Mesa (P3) production region is shipping 90,163 Traditional (V3) stockers to the Cordillera (P4) production region and the Veracruz (P7) production region is shipping 316,641 Traditional (V3) stockers to the Southern Sierra Madre (P6) production region. Table V-78 shows the percent change in total stocker shipments from the Benchmark model.

Table V-78. Percent Change in Total Stocker Shipments

Source Production Region		Destination Production Region		% Change in Number of Cattle
North	(P1)	Central Mesa	(P3)	-100.00
Northeast	(P2)	Central Mesa	(P3)	-100.00
Central Mesa	(P3)	Cordillera	(P4)	+
Veracruz	(P7)	Southern Sierra Madre	(P6)	+1136.99
Total				**+105.87**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Northern-Style (V1) Feeder Shipments

Total Northern-style (V1) feeders shipped did not change from the Benchmark. The Yucatan (P9) production region is shipping 2,917 head to the Tabasco (F09) feedlot center in Scenario 4. The Northwest (F02) feedlot center is receiving 12,202 more Northern-style feeders than in the Benchmark. Table V-79 shows the percent change in shipments of Northern-style feeders from the Benchmark model.

Semi-Intensive (V2) Feeder Shipments

There are no shipments of Semi-Intensive (V2) feeder cattle in Scenario 4.

Table V-79. Percent Change in Northern style (V1) Feeder Shipments

Source Production Region		Destination Feedlot Center		% Change in Number of Cattle
North	(P1)	Northwest	(F01)	+14.05
North	(P1)	La Laguna	(F02)	0.00
Northeast	(P2)	Northeast	(F03)	+2.17
Central Mesa	(P3)	Cordillera	(F05)	-100.00
Central Mesa	(P3)	Central Mesa	(F07)	0.00
Cordillera	(P4)	Cordillera	(F05)	-100.00
Pacific Coast	(P5)	Pacific Coast	(F04)	-100.00
Veracruz	(P7)	Huasteca	(F06)	-64.12
Veracruz	(P7)	Veracruz	(F08)	0.00
Yucatan	(P9)	Tabasco	(F09)	+
Yucatan	(P9)	Yucatan	(F10)	0.00
Total				**0.00**

+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Traditional (V3) Feeder Shipments

The South (P8) production region is shipping 7,627 Traditional (V3) feeder cattle to the Tabasco (F09) feedlot center in Scenario 4.

Total Feeder Shipments

Total feeder shipments declined by 445,624 head from the Benchmark model. The North (P1) production region decreased shipments by 104,979 feeder calves. Table V-80 shows the percent change in total feeder shipments from the Benchmark model.

Table V-80. Percent Change in Total Feeder Shipments

Source Production Region		Destination Feedlot Center		% Change in Number of Cattle
North	(P1)	Northwest	(F01)	-51.45
North	(P1)	La Laguna	(F02)	0.00
Northeast	(P2)	Northeast	(F03)	0.00
Central Mesa	(P3)	Cordillera	(F05)	-100.00
Central Mesa	(P3)	Central Mesa	(F07)	0.00
Cordillera	(P4)	Cordillera	(F05)	-100.00
Pacific Coast	(P5)	Pacific Coast	(F04)	-100.00
Veracruz	(P7)	Huasteca	(F06)	-64.12
Veracruz	(P7)	Veracruz	(F08)	0.00
South	(P8)	Tabasco	(F09)	-69.49
Yucatan	(P9)	Tabasco	(F09)	+
Yucatan	(P9)	Yucatan	(F10)	0.00
Total				**-38.43**

+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Domestic Meat Shipments

Northern-Style (M1) Meat Shipments

Total M1 meat shipments did not change from the Benchmark, nor did the amount shipped to each consumption region. Table V-81 shows the percent change in Northern-style (V1) meat shipments from the Benchmark.

Mexican Fed (M2) Meat Shipments

A total of 6,485,851 kilograms of Mexican Fed (M2) meat is being shipped to consumption regions throughout Mexico in Scenario 4. This is a 94.19 percent decrease from the Benchmark model. The Northwest (F01) feedlot center is shipping 4,695,226 kilograms of M2 meat to the Northwest (C1) consumption region and the Tabasco (F09) feedlot center is shipping 1,790,625 kilograms of M2 meat to the Yucatan (C7) consumption region.

Table V-81. Percent Change in Northern-Style (M1) Meat Shipments

Source Feedlot Center		Destination Consumption Region		% Change Kilograms
Northwest	(F01)	Northwest	(C1)	+14.05
La Laguna	(F02)	North Central	(C2)	0.00
La Laguna	(F02)	Central	(C5)	0.00
Northeast	(F03)	Northeast	(C3)	0.00
Northeast	(F03)	Central	(C5)	+4.42
Pacific Coast	(F04)	Northwest	(C1)	-100.00
Cordillera	(F05)	Tapatio	(C4)	0.00
Cordillera	(F05)	Central	(C5)	-13.48
Huasteca	(F06)	Gulf	(C6)	-64.12
Central Mesa	(F07)	Central	(C5)	0.00
Veracruz	(F08)	Gulf	(C6)	+13.21
Tabasco	(F09)	Yucatan	(C7)	0.00
Yucatan	(F10)	Yucatan	(C7)	0.00
Total				**0.00**

Shipments of Traditional (M3) Meat

There are no Traditional (M3) meat shipments in Scenario 4.

Shipments of Cull (M4) Meat

Cull (M4) meat shipments were reduced by 8,464,900 kilograms from the Benchmark. The North (P1) production region reduced M4 meat shipments by 1,907,230 kilograms. The Central (C7) consumption region is receiving 6,557,700 kilograms of Cull (M4) meat less than in the Benchmark. Table V-82 shows the percent change in domestic shipments of Cull (M4) meat within Mexico from the Benchmark model.

Table V-82. Change in M4 Meat Shipments

Source Region		Destination Region		% Change Kilograms
North	(P1)	Northeast	(C3)	+38.01
North	(P1)	Tapatio	(C4)	-8.36
Veracruz	(P7)	Central	(C5)	-11.95
Yucatan	(P9)	Central	(C5)	-4.91
Total				**-7.69**

Imports

Live imports did not change from the Benchmark model. Northern-style (M1) meat is not being imported in Scenario 4. Mexican Fed (M2) meat imports increased by 5,539,776 kilograms from the Benchmark. Table V-83 shows the percent change in Meat imports from the Benchmark model.

Table V-83. Change in Meat Imports

Consumption Region		M2 Meat Imports
Northwest	(C1)	+58.43
North Central	(C2)	0.00
Northeast	(C3)	0.00
Tapatio	(C4)	+
Central	(C5)	0.00
Gulf	(C6)	0.00
Yucatan	(C7)	+994.37
Total		**+24.05**

+ Indicates a positive level in the scenario compared to zero in the Benchmark.

Exports

Total live exports increased by 492,141 head. Northern-style (V1) steer calf exports increased by 406,444 head and Semi-Intensive (V2) steer calf exports increased by 109,141 head, while Northern-style (V1) feeder steer exports decreased by 23,317 head. Table V-84 shows the percent change in live exports from the Benchmark model.

Table V-84. Percent Change in Live Exports

Production Region		Northern-Style Steer Calves	Northern-Style Feeder	Semi-Intensive Steer Calves	Total
North	(P1)	-3.84	0.00	0.00	-3.84
Northeast	(P2)	0.00	-10.43	+	+44.81
Central Mesa	(P3)	+1275.10	0.00	0.00	+1275.10
Cordillera	(P4)	0.00	0.00	0.00	0.00
Pacific Coast	(P5)	372.10	0.00	0.00	+372.10
Southern Sierra Madre	(P6)	0.00	0.00	0.00	-100.00
Veracruz	(P7)	-19.45	0.00	0.00	-19.45
South	(P8)	-100.00	0.00	0.00	0.00
Yucatan	(P9)	+23.34	0.00	-100.00	-27.80
Totals		**+46.77**	**-10.43**	**+751.20**	**+44.45**

\+ Indicates a positive level in the scenario compared to zero in the Benchmark.

CHAPTER VI

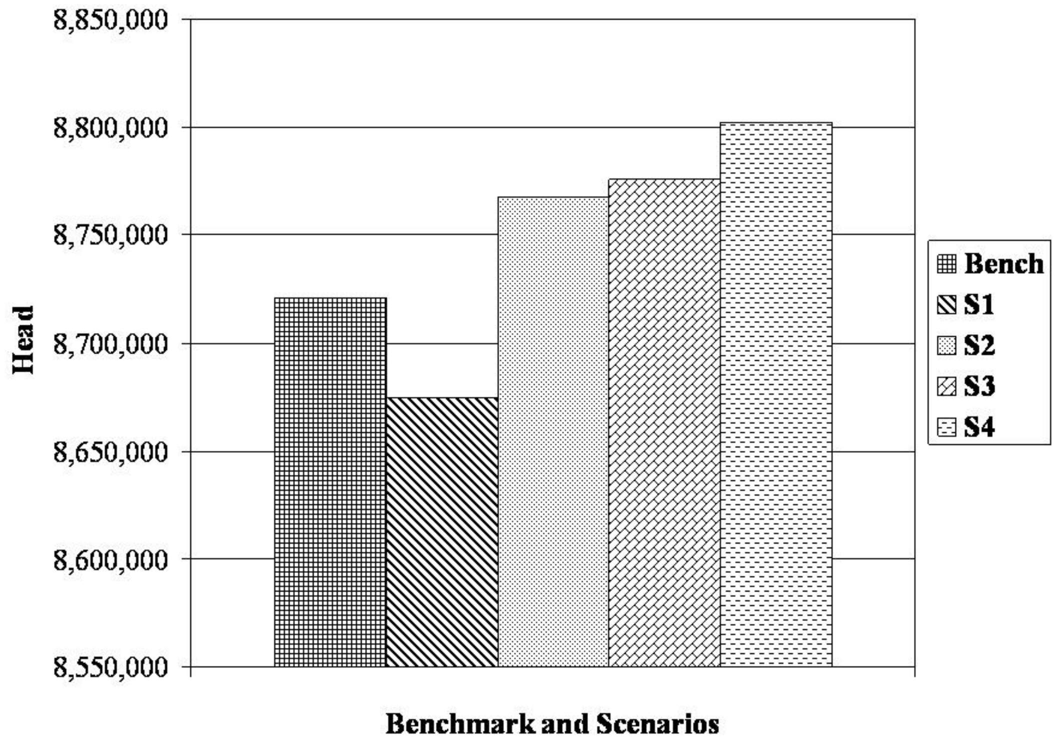
CONCLUSIONS

Four scenarios were compared to the Benchmark model. The Benchmark model was configured to represent the situation in of the Mexican cattle and beef industry in 2005. In the Benchmark model the North (P1) and Northeast (P2) production regions were included in the TB free zone; the remaining production regions were included in the TB restricted zone. In Scenario 1 (S1), the North (P1), Northeast (P2), and Pacific Coast (P5) production regions are included in the TB free zone; the remaining production region are included the TB restricted zone. In Scenario 2 (S2), the North (P1), Northeast (P2), and Central Mesa (P3) production regions are included in the TB free zone; the remaining production regions are included in the TB restricted zone. In Scenario 3 (S3), the North (P1), Northeast (P2), and Veracruz (P3) production regions are included in the TB free zone, the remaining production regions are included in the TB restricted zone. In Scenario 4 (S4) the North (P1), Northeast (P2), Central Mesa (P3), Pacific Coast (P5), and Veracruz (P7) production regions are included in the TB free zone; the remaining production regions are included in the TB restricted zone.

Cow Production

Overall, total cow production increases in each of the scenarios, except in Scenario 1. Figure VI-1 shows total cow production in the Benchmark and each of the scenarios. The biggest increase in cow production was in Scenario 4, where all three regions of interest were included in the TB free zone. Figure VI-2 shows cow production by cow type for the Benchmark and each of the scenarios. In general, Northern-style (V1) cow and Traditional (V3) cow numbers increased, while Semi-Intensive (V2) cow numbers decreased among the scenarios. Scenario 3 decreased the number of Traditional (V3) cows produced.

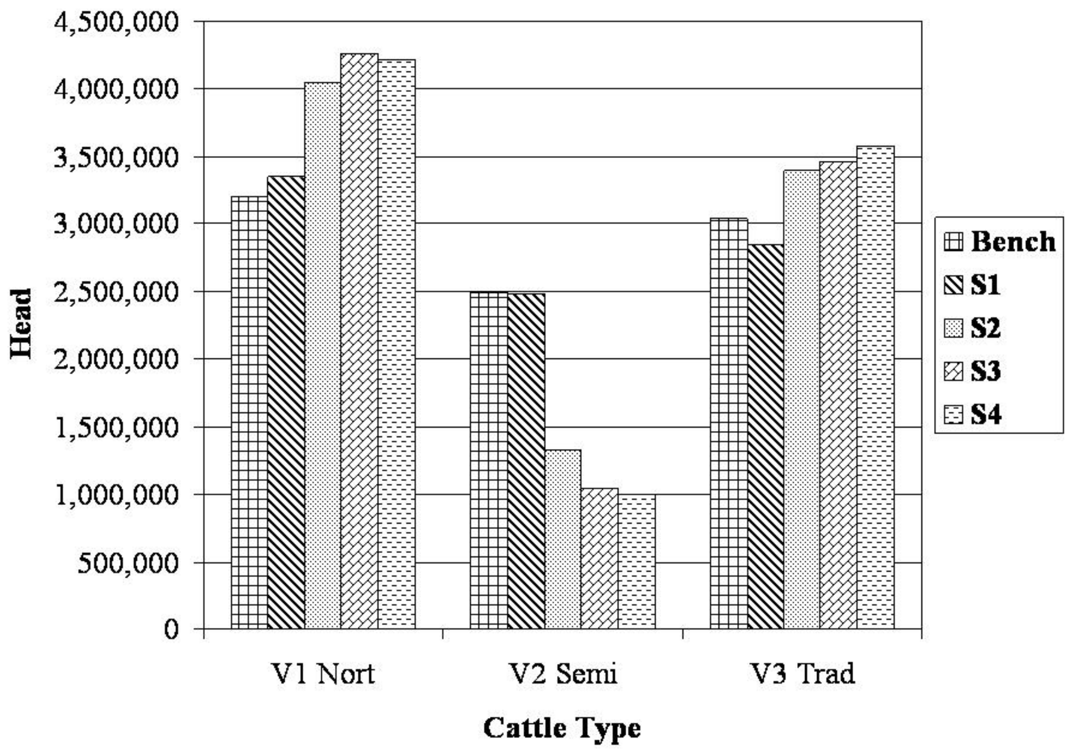
Figure VI-1. Total Cow Production by Scenario



Some regions were much more affected by the various regions by TB restrictions than other regions. The three regions affected the most by the scenarios were the Central Mesa (P3), Cordillera (P4), Pacific Cost (P5), and Veracruz (P7) production regions. Figures VI-3, VI-4, VI-5, and VI-6 show cow production by type and scenario to their respective production region. Comparing Figures VI-3 and VI-4 shows that the Central

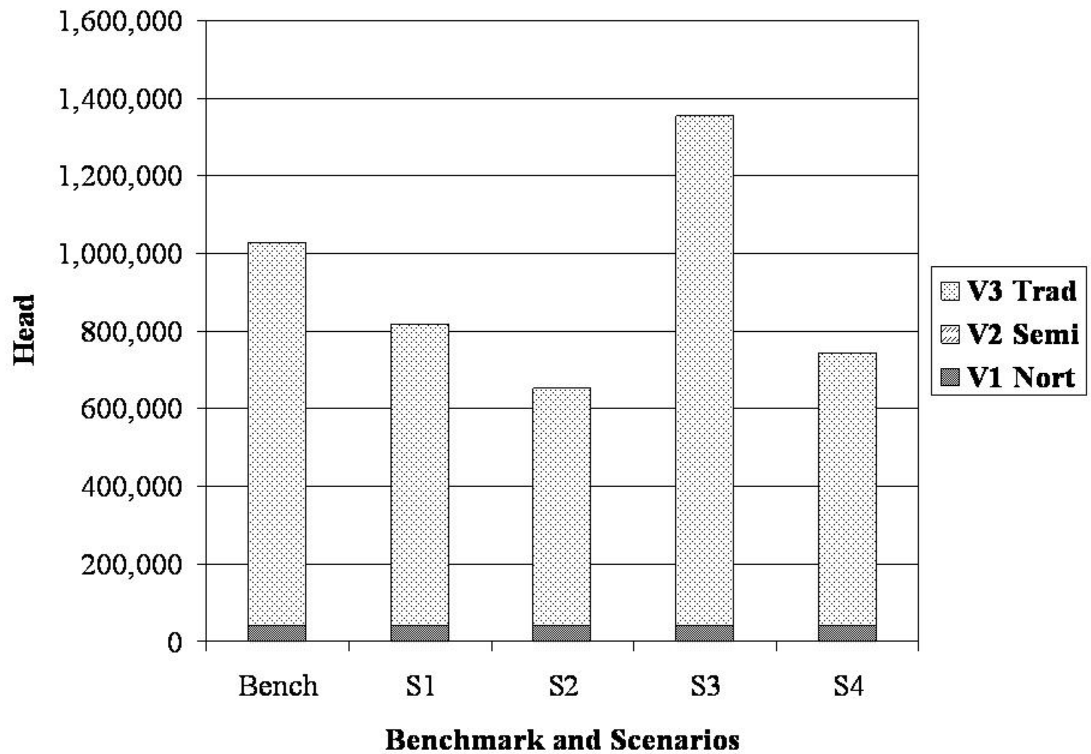
Mesa (P3) and Cordillera (P4) production regions are inversely related in cow production. When the Central Mesa (P3) production region is included in the TB free zone cow production increases in the Central Mesa (P3) production region and decreases in the Cordillera (P4) production region. The Central Mesa (P3) production region produces mainly Northern-style (V1) cows, except in Scenario 1. The Cordillera (P4) production region produces mainly Traditional (V3) cows.

Figure VI-2. Cow Production by Type



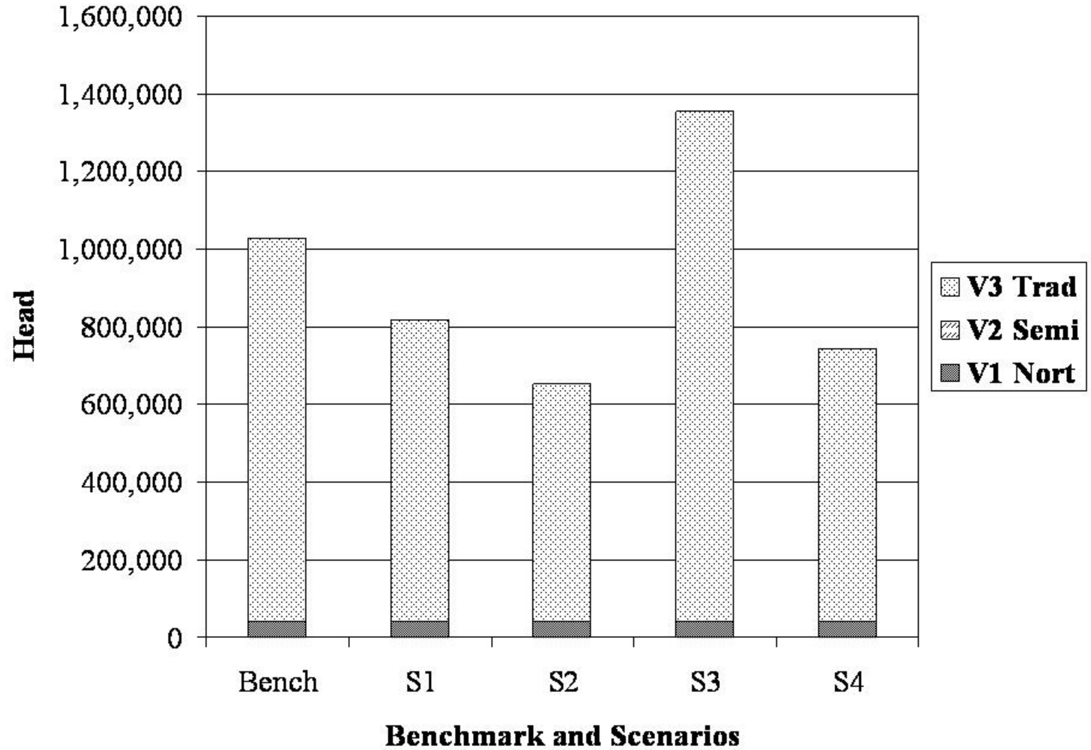
When the Pacific Coast (P5) production region is included in the TB free zone, the Pacific Coast (P5) production region produces mainly Northern (V1) style cows, otherwise it produces mainly Semi-Intensive (V2) cows and Northern-style (V1) cow production remains consistant. Overall, Semi-Intensive (V2) cow production decreased in all of the scenarios from the Benchmark.

Figure VI-3. Cow Production in the Central Mesa (P3) Production Region



Although the number of cows produced in the Veracruz (P7) production region remains constant in all of the scenarios, the composition changes. In Scenario 3 when the Veracruz (P7) production region included in the TB frees zone, along with the North (P1) and Northeast (P2) production regions, the Veracruz (P7) production region increases cow production slightly and mainly produce Northern-style (V1) cows. In the other scenarios and in the Benchmark, the Veracruz (P7) production region produces mainly Semi-Intensive (V2) cows or a combination of Semi-Intensive (V2) and Traditional (V3) cows.

Figure VI-4.   Cow Production in the Cordillera (P4) Production Region

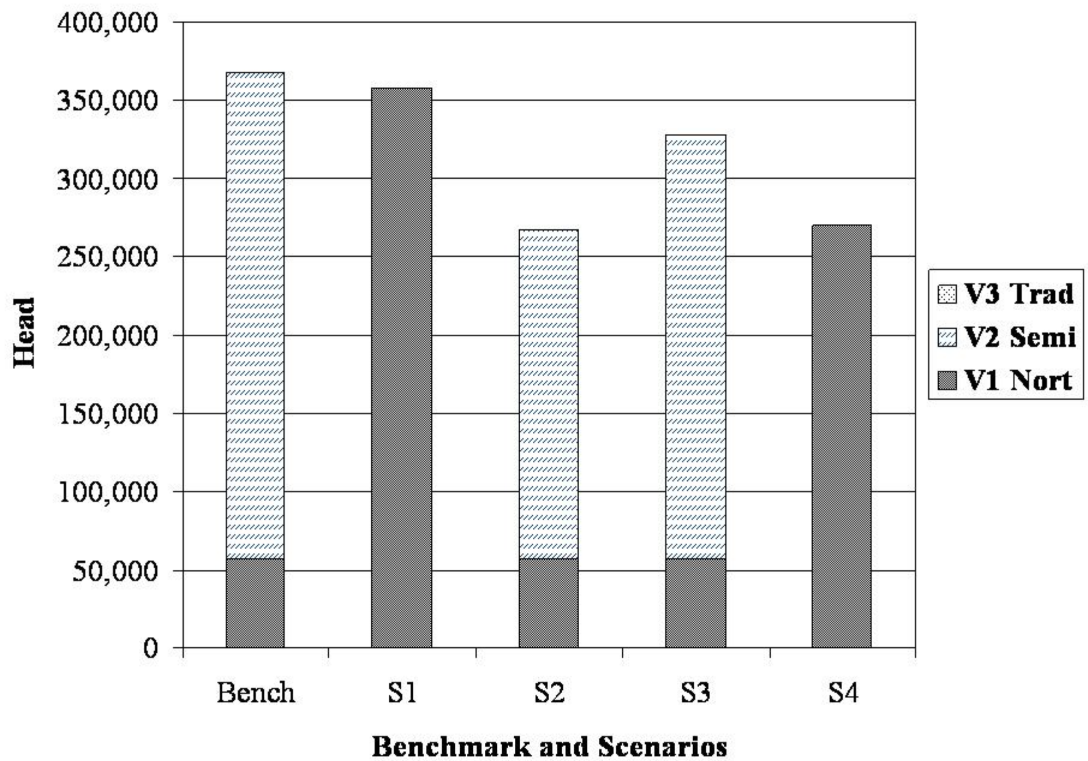


Stocker Production

<u>Intensive Stocker Production</u>

Overall, total intensive stocker declined in each of the scenarios from the Benchmark. Scenario 1 was the least effected of all the scenarios. In general the use of Semi-Intensive (V2) cattle for intensive stockers declined in all of the scenarios. Northern-style (V1) and Traditional (V3) intensive stockers generally increased in all of the scenarios. Figure VI-7 shows total intensive stockers by type and by scenario.

Figure VI-5. Cow Production in the Pacific Coast (P5) Production Region

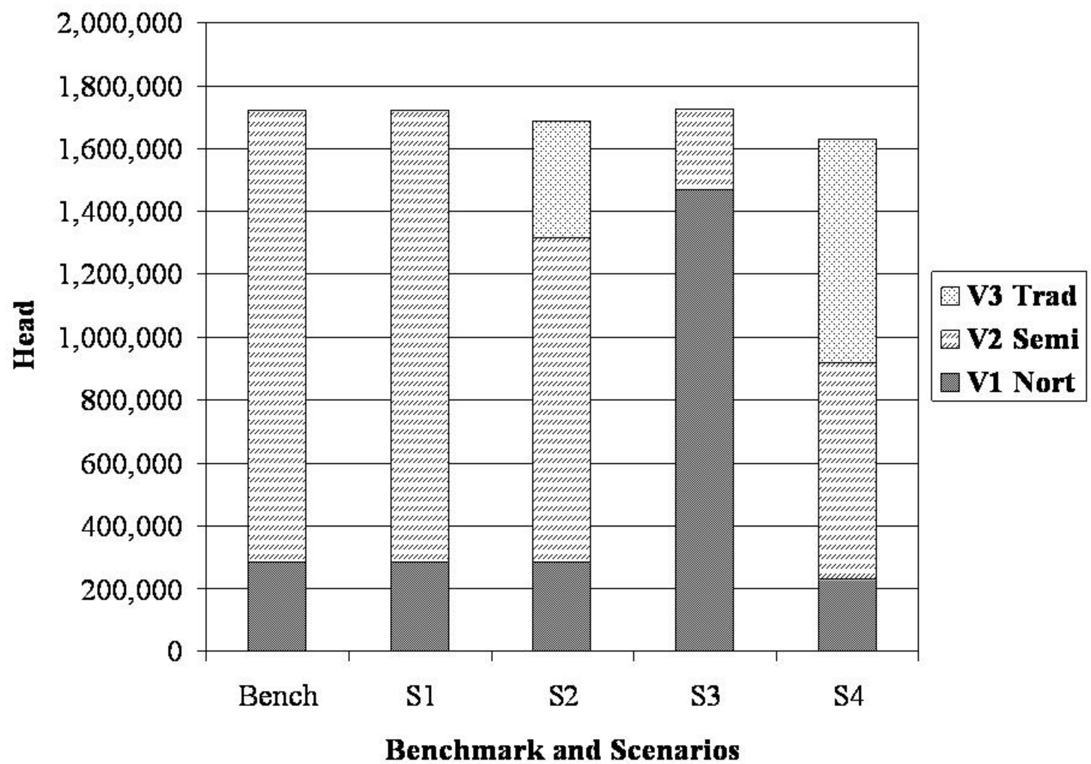


Extensive Stocker Production

Only Traditional (V3) cattle were used as extensive stockers. This is a realistic outcome of the model, because Traditional (V3) cattle are commonly the type of cattle to produce Traditional (M3) type of meat in Mexico. Except for in Scenario 1, extensive stocker number declined. Figure VI-8 shows extensive stocker numbers by type and by scenario.

Figure VI-9 shows the production regions most affected by the scenarios are the Central Mesa (P3), Cordillera (P4), and Veracruz (P7) production regions. When the Central Mesa (P3) production region is included in the TB free zone, there is no extensive stocker production in the Central Mesa (P3) production region and extensive stocker production increases in the Cordillera (P4) production region. The Central Mesa (P3) production region has an advantage in cow calf production versus grass finishing production and its production practices affect the production practices of the Cordillera (P4) production region. When the Veracruz (P7) production region is included in the TB free zone with the Central Mesa (P3) production region, it increases extensive stockers suggesting that the Veracruz (P7) production region has a comparative advantage in producing cattle for Traditional (M3) meat.

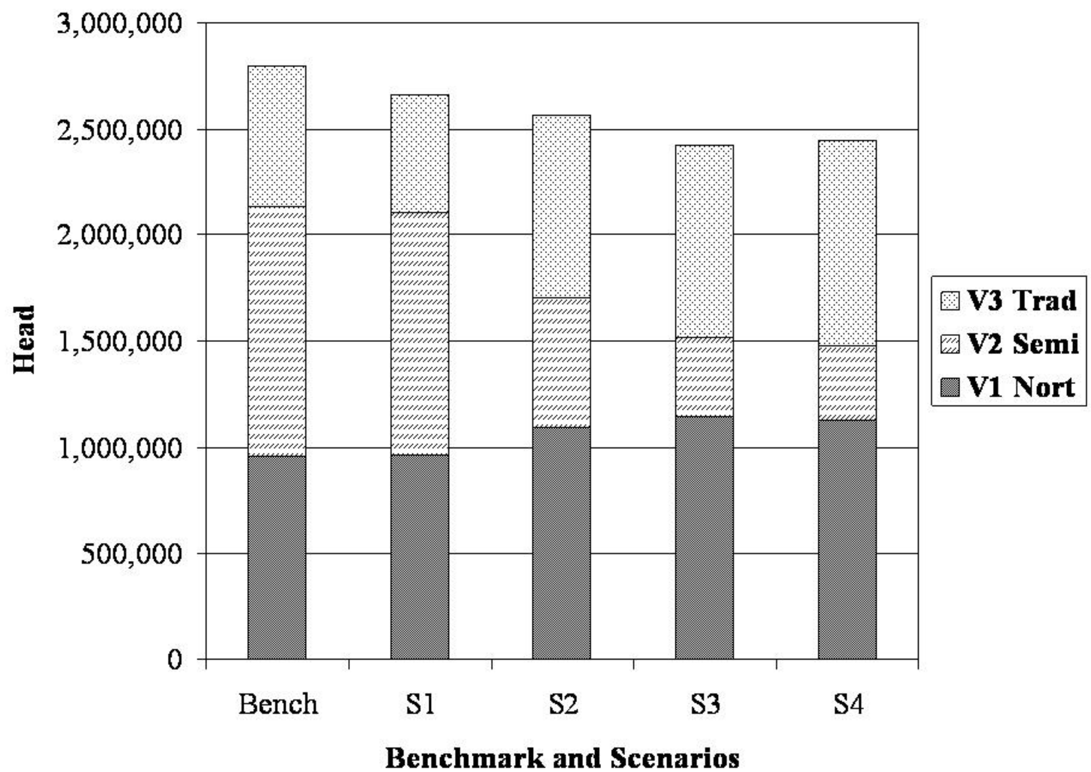
Figure VI-6. Cow Production in the Veracruz (P7) Production Region



Grass-Finishing

Total grass-finishing numbers do not vary much for two reasons. The first is that total Traditional (M3) meat consumption does not change from the Benchmark level. The second is because although the composition does change and the cattle produce different quantities of meat, Semi-Intensive (V1) cattle numbers decrease and Northern-style (V1) and Traditional (V3) cattle numbers increase roughly balancing the numbers out. Figure VI-10 shows grass-finishing cattle numbers by type and scenario. Figure VI-11 shows total grass finishing by production region. When the Central Mesa (P3) production region can not produce cattle for export, it becomes a stockering and grass-finishing production region.

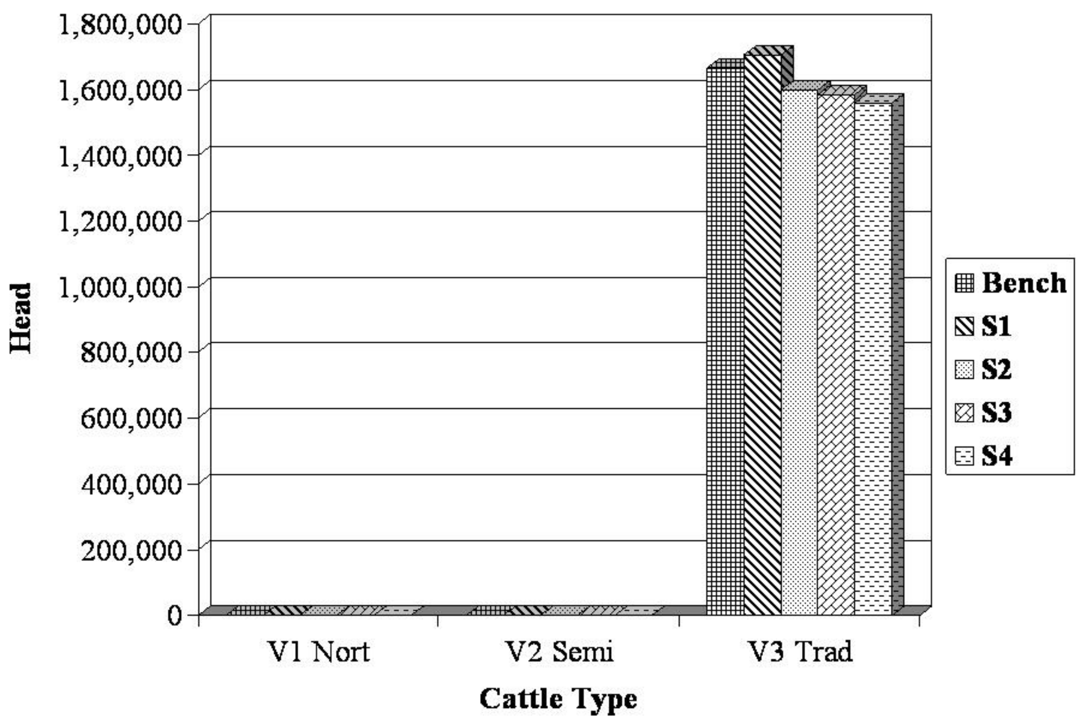
Figure VI-7. Total Intensive Stocker Production



Cattle Finished in Feedlots

Cattle fed for Northern-style (M1) meat does not vary among the Benchmark and the scenarios. As shown in figure VI-12, cattle fed for Mexican Fed (M2) meat declines in all the scenarios from the Benchmark. Figure-VI-13 shows total cattle feeding by feedlot center and scenario. The feedlot centers most affected by the scenarios are the Northwest (F01), Pacific Coast (F04), Cordillera (F05) and the Huasteca (F06) feedlot centers. The Northwest (F01) and Pacific Coast (F04) feedlot centers' numbers decline from the Benchmark in all the scenarios. The cattle numbers in the Cordillera (F05) feedlot center decline in all the scenarios except for Scenario 1. In Scenarios 1 and 3, the Huasteca feedlot center increase feedlot numbers from the Benchmark.

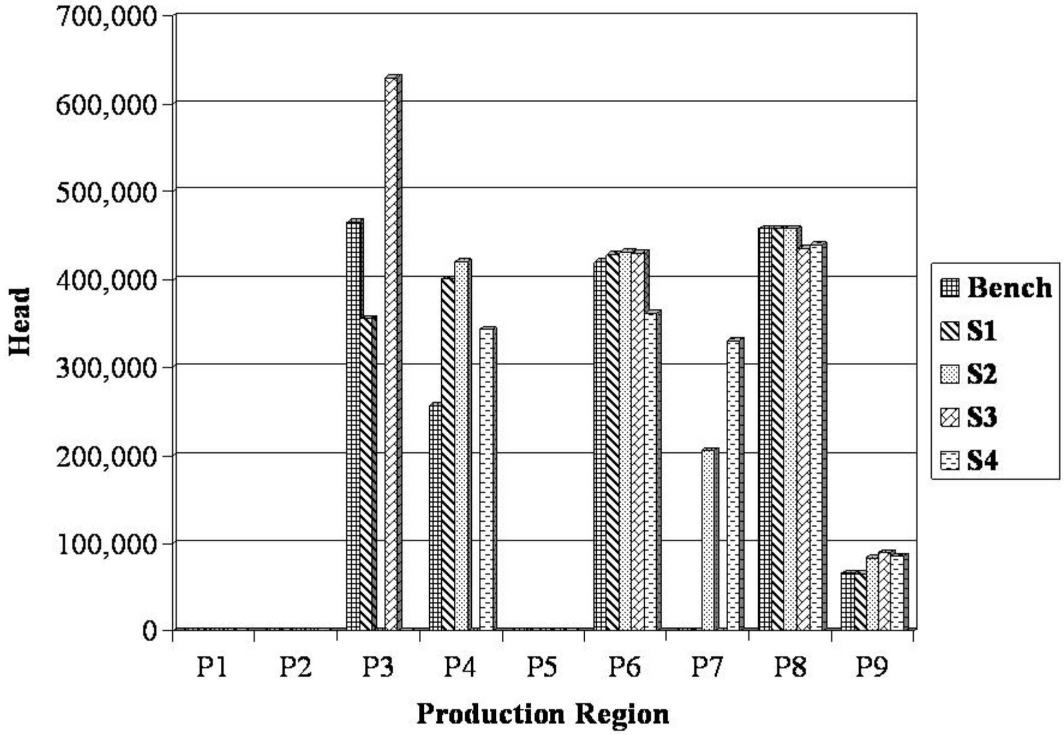
Figure VI-8. Total Extensive Stocker Production by Cattle Type



Calf and Stocker Shipments

In all scenarios total calf and stocker shipments declined as shown in Figure VI-14. This is a sign that as trade opens among regions in Mexico, cattle production becomes more efficient and cattle are produced closer to where they are consumed. Overall calf shipments declined in all the scenarios from the Benchmark. Stocker shipments increased in Scenarios 2 and 4, where the Central Mesa (P3) production region was included in the TB free zone.

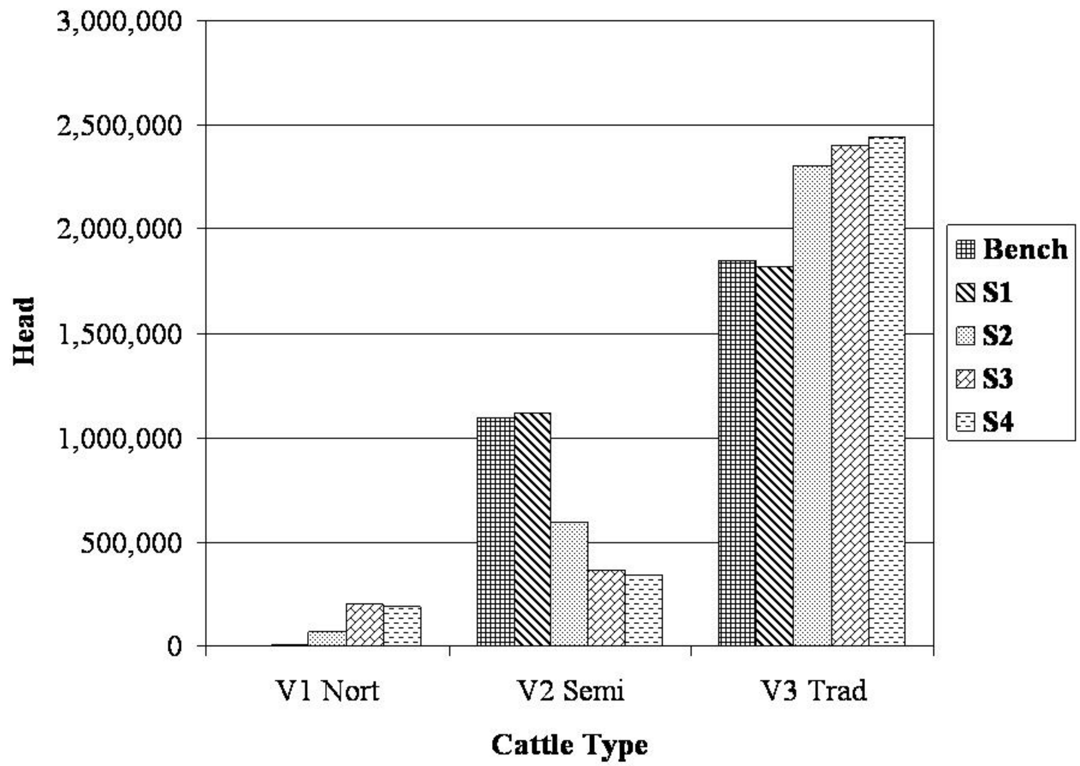
Figure VI-9. Total Extensive Stocker Production by Production Region



Meat Production

Grass-finishing cattle numbers match the impacts on Traditional (M3) meat and cow-calf numbers match the impact on Cull (M4) meat. Feedlot cattle numbers match the impacts on Northern-style (V1) and Mexican Fed (M2) meat. As trade is opened up, the production of Traditional (M3) and Cull (M4) meat for slaughter in TIF plants decrease. This is because the cattle produced for these types of meat are produced in the regions where they are consumed and do not need to be shipped. This is a sign of increased efficiency of cattle production in Mexico.

Figure VI-10. Total Grass-Finished Cattle by Type



Live Exports and Meat Imports

Figure VI-15 shows total cattle exports by scenario. Live exports increased over all the scenarios from the Benchmark. In Scenario 4, exports increased mainly from the Central Mesa (P3) production region, with the Pacific Coast (P5) and Veracruz (P7) production regions increasing exports very little. This suggests that the Central Mesa (P3) production region has a comparative advantage in cow-calf production rather than cattle finishing. When the Pacific Coast (P5) production region is included in the TB free zone it increases exports slightly. When the Veracruz (P7) production region is included in the TB free region it only increases exports if the Central (P3) and Veracruz (P7) production regions are not included, otherwise it decreases exports, this suggests that the

Veracruz (P7) production region has an advantage in stocker production and grass-finishing cattle.

Figure VI-11. Total Grass-Finished Cattle by Production Region

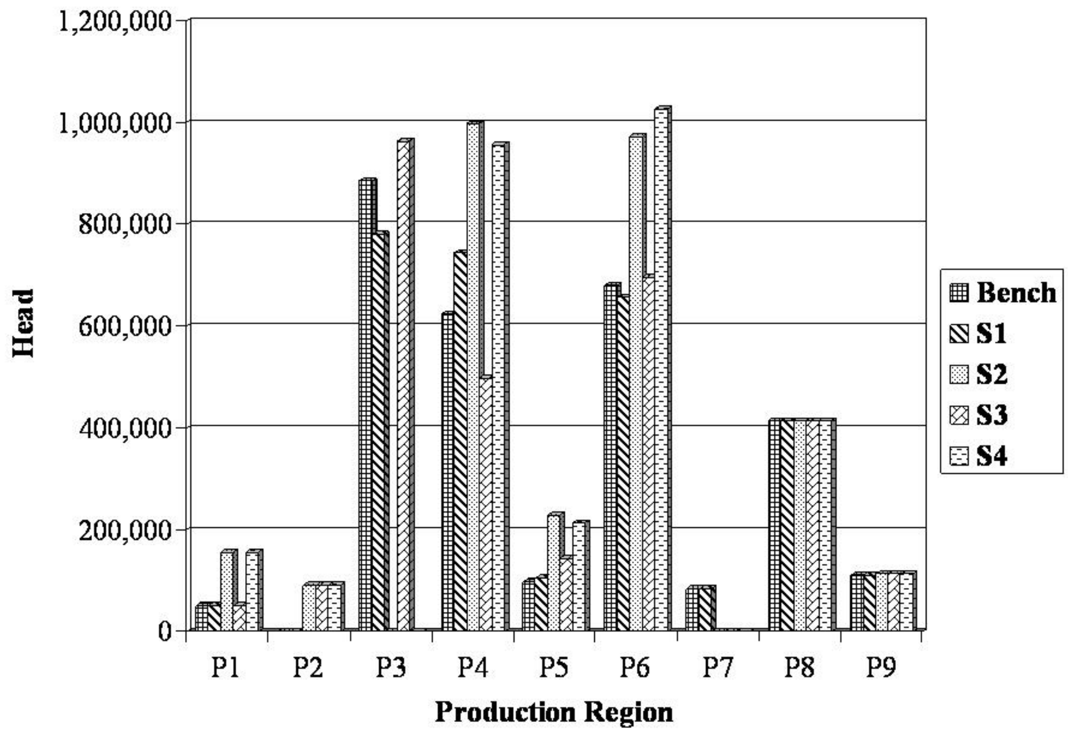
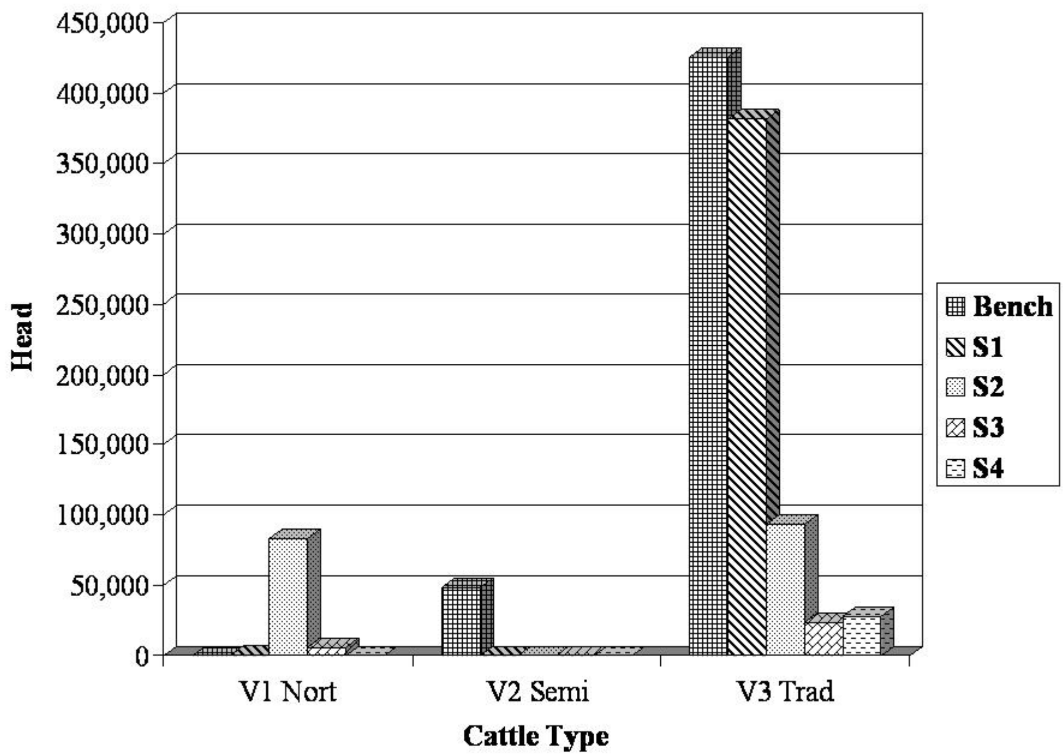


Figure VI-16 shows total beef imports in each of the scenarios. Northern-style (M1) meat is not being imported because, Mexico is meeting the consumption requirements for M1 meat through domestic production in all scenarios. Total Mexican Fed (M2) meat imports increase with the total decreases in cattle fed for M2 meat in order to meet the consumption requirements for M2 meat.

Overall Conclusions

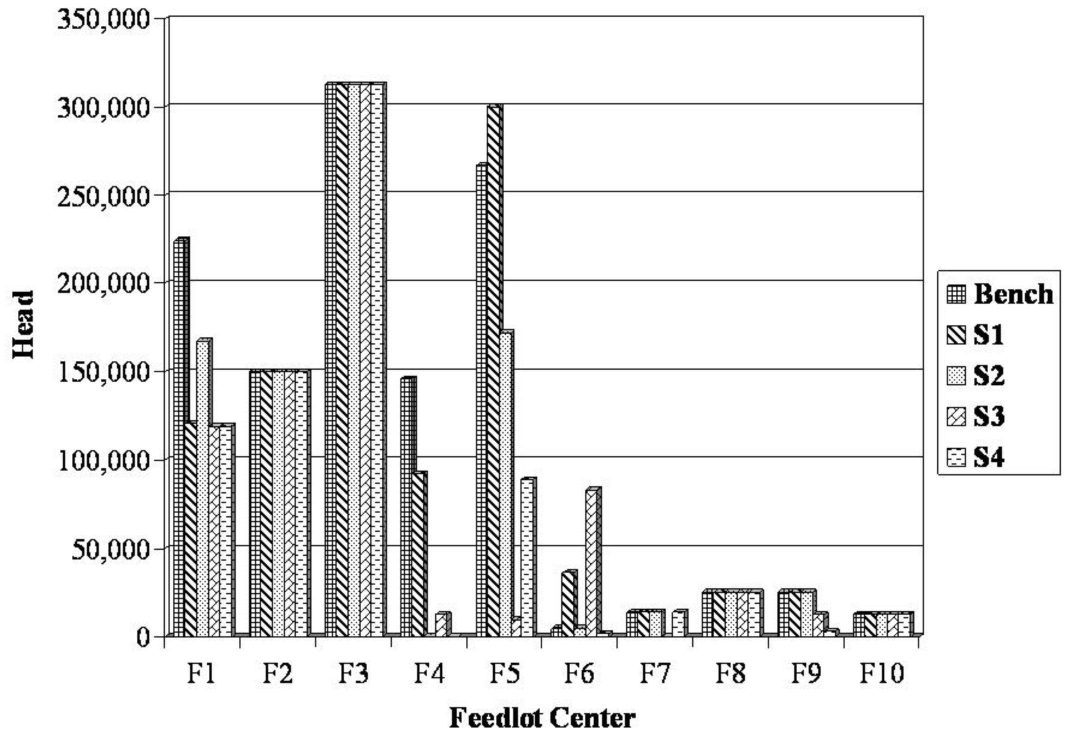
The Central Mesa (P3) and Cordillera (P4) production activities seem to be highly correlated. When the Central Mesa (P3) production region is allowed to export, cow-calf production increases and stockering and finishing activities decrease, implying that the Central Mesa (P3) production region has an advantage in cow-calf production. If the Veracruz (P7) production region is included in the TB free zone with the Central Mesa (P3) production region, it will export less cattle and increase extensive stockers, implying that it has an advantage in producing Traditional (V3) type meat for consumption within Mexico.

Figure VI-12. Cattle Fed for Mexican Fed (M2) Meat Production



In general, releasing trade and movement restrictions results in increased cattle exports and increased beef imports in Mexico. The result is increased value of beef cattle exports for Mexican producers; reduced level of cattle feedlot finishing in Mexico; and increased beef cost for Mexican consumers. Overall the increase in cow production and decrease in numbers of cattle finished in feedlots in all the scenarios implies that Mexico has a comparative advantage in cow-calf production rather than cattle finishing.

Figure VI-13. Total Cattle Fed for Northern-Style (M1) Meat and Mexican Fed (M2) Meat by Feedlot Center

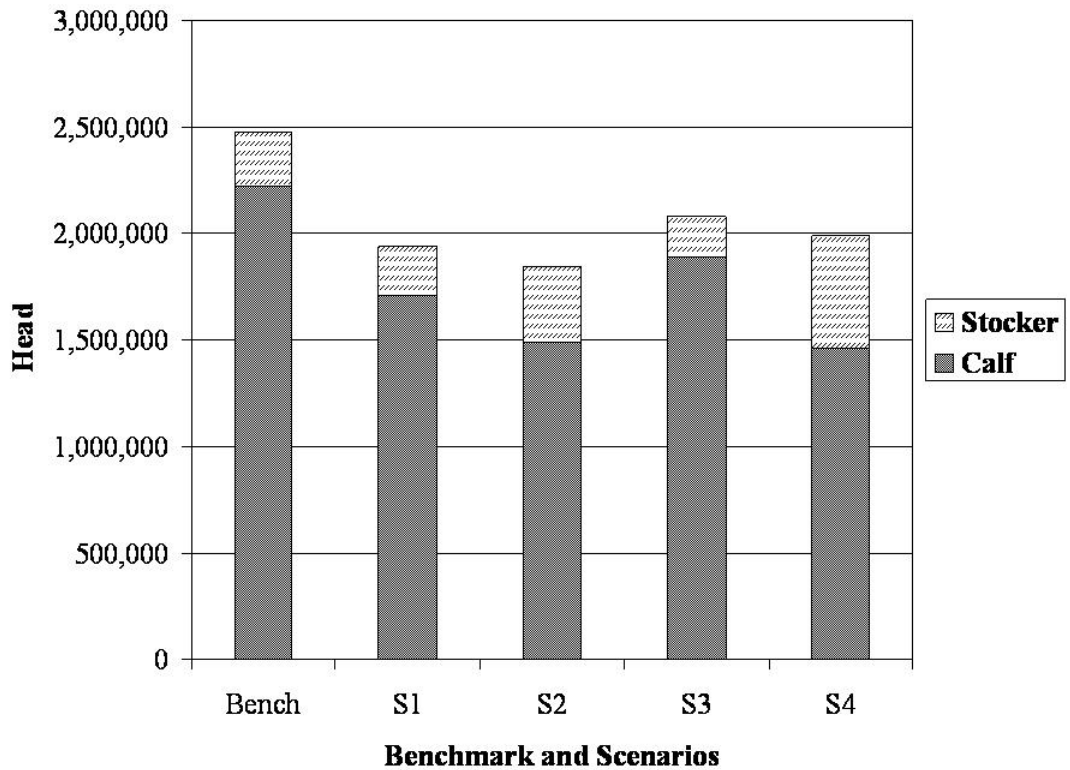


Limitations

Linear programming models have several limitations. The first of which is the model is extreme, meaning that it will utilize all its resources to produce the product that minimizes the cost of production the most. When using linear programming, one must understand that it shows tendencies, rather than exact numbers and that the market will not react in this way immediately, rather should be viewed as long run tendencies.

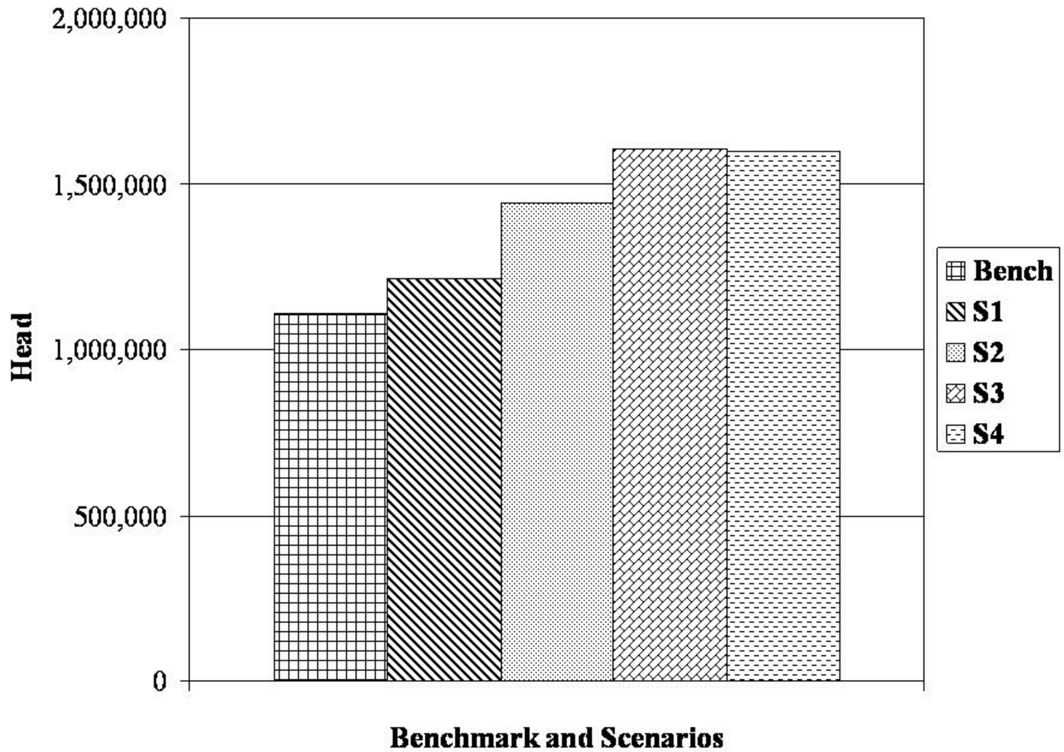
A linear programming model gives the flexibility to model things that statistical models are unable to reasonably model due to the lack of data. The negative side is that the burden of validating the model is on the researcher to verify to reasonability of the model. The model is subjectively validated rather than objectively evaluated. There are no statistical tests available to show the researcher how valid the model is. Instead, sensitivity tests were conducted and then the model output was compared to the market in 2005.

Figure VI-14. Total Calf and Stocker Shipments



Mexico is a developing country and is very difficult to model. Its economy is constantly changing and progressing, which causes modeling problems because of the need to constantly update data and information in the model. Obtaining data that are consistent, consecutive, and complete is difficult. The large amount of data used is an attempt to make up for the lack in quality of data obtained. Another problem is that the data used for this research was from 2005, which was the peak in cattle prices in the U.S., thus giving higher cattle prices than is being seen currently.

Figure VI-15. Total Live Exports

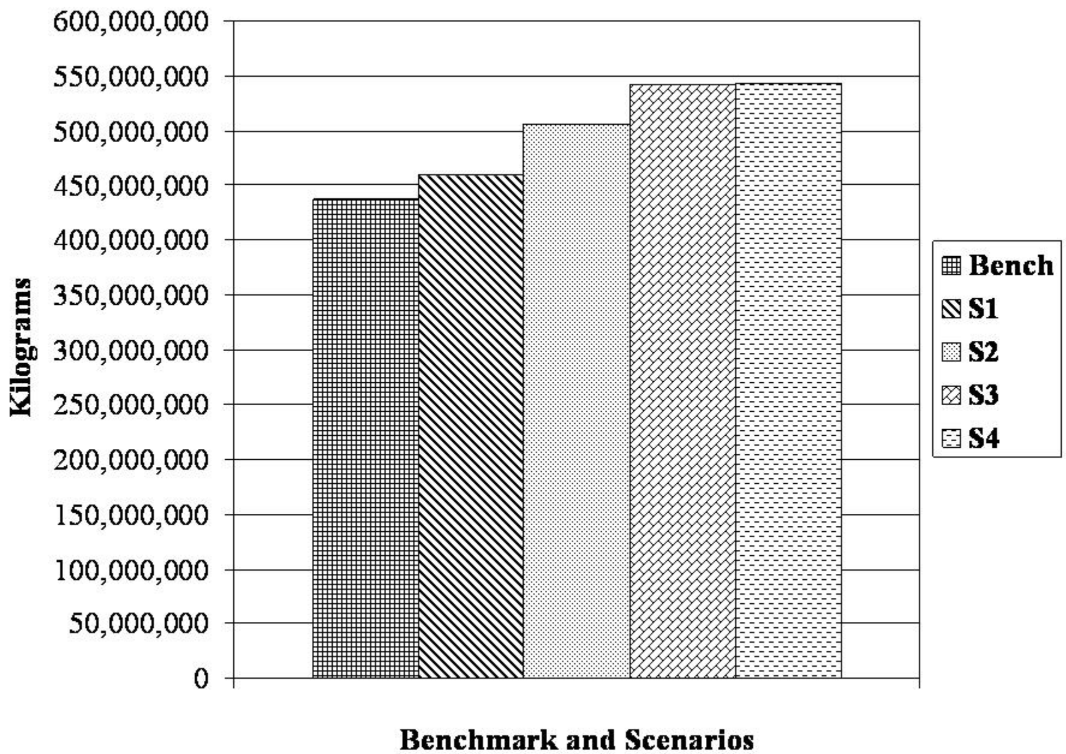


Further Work

The GANAMEX model could be used for numerous different research subjects regarding the Mexican beef cattle industry. The research topics which are a direct extension of this research include furthering the research to extend scenarios throughout Mexico and eventually making all of Mexico TB free, using prices from a year that is more comparable to the prices found throughout U.S. market cycle to make a more long run model; and to change beef demand in Mexico. One could change total beef demand within in Mexico, or change the percentage of each type of beef demand to see how the beef producers would react to meet these changes.

Moreover, this research and the GANAMEX model could be applied to research pertaining to other bovine diseases, general trade restrictions, and changes in technology regarding beef production.

Figure VI-16. Total Meat Imports



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APPENDICES

Appendix I

```
$title  Ganaderia Mexicana (GANAMEX)
$title Run = 2005 BENCHMARK
$offupper
OPTION SOLPRINT=Off;
****MAIN PROGRAM CODE***********************************************
$ontext
Each run of GANAMEX must include one each of the following input files:

Forage#.gms     contains forage limits and prices and regional indicies for each
Prod#.gms       contains animal system production parameters
Tran#.gms       contains cattle and meat transportation distances for each region,
                plus transportation costs, and load size
Dairy#.gms      contains dairy herd parameters
Cost#.gms       contains production cost parameters
Trade#.gms      contains import and export values for cattle and meat
Consum#.gms     contains population, consumption levels and profiles for each
                consumption region
  # is the unique file name end for each scenario
These input files are specified in the include statements below
$offtext

****BASIC REGIONAL DEFINITIONS*****************************************
set p "Production Regions" /P1NO, P2NE, P3ME, P4CO, P5PA, P6SS, P7VE, P8SU,
        P9YU/;

$ontext
Production Regions are defined as follows:
P1NO = Baja California, Baja California Sur, Sonora, Chihuahua and Coahuila; Key City
        = Chihuahua
P2NE = Nuevo Leon and Tamaulipas; Key City = Monterrey
P3ME = Durango, Zacatecas, San Luis Potosi and Aguascalientes; Key City = Zacatecas
P4CO = Queretero, Hidalgo, Puebla, Tlaxcala, Mexico, Morelos, Guanajuato, Jalisco,
        Michoacan, DF; Key City = Guadalajara
P5PA = Sinaloa and Mayarit; Key City = Culiacan
P6SS = Colima, Guerrero and Oaxaca; Key City = Oaxaca
P7VE =  Veracruz; Key City = Veracruz
P8SU = Tabasco and Chiapas; Key City = Villahermosa
P9YU =  Yucatan, Campeche, Quintana Roo; Key City = Merida
```

```
$offtext

set f "Feedlot Regions" /F01NW, F02LA, F03NE, F04PA, F05CO, F06HA, F07ME,
        F08VE, F09TB, F10YU/;
$ontext
Feedlot Regions are defined for following Key Cities:
F01NW = Mexicali
F02LA = Torreon
F03NE = Monterrey
F04PA = Culiacan
F05CO = Guadalajara
F06HA = Tampico
F07ME = San Luis Potosi
F08VE = Veracruz
F09TB = Villahermosa
F10YU = Merida
$offtext

set c "Consumption Regions" /C1NW, C2NC, C3NE, C4TP, C5CE, C6GO, C7YU/
      c1(c) /C1NW, C2NC/
      c3(c) /C4TP, C5CE/
      c4(c) /C4TP, C5CE/
      c5(c) /C1NW, C4TP/
      p3(p) /P3ME/
      p4(p) /P4CO/
      p5(p) /P5PA/;

$ontext
Consumption Regions are defined as follows:
C1NW = Baja California, Baja California Sur, Sonora, Sinaloa;
      Key City = Hermosillo  (For Mexicali Feedlot is Tijuana)
C2NC =  Chihuahua, Durango and Comarca Lagunera; Key City = Chihuahua
C3NE = Coahuila (sin torreon), Nuevo Leon, and Tamaulipas;
      Key City = Monterrey
C4TP =  Nayarit, Jalisco, Aguascalientes, Colima, Guanajuato, Zacatecas;
      Key City = Guadalajara
C5CE = San Luis Potosi, Queretero, Hidalgo, Puebla, Mexico, Michoacan,
      Tlaxcala, Guerrero, Oaxaca, DF; Key City =  Mexico
C6GO = Veracruz, Tabasco, Chiapas; Key City = Veracruz
C7YU = Campeche, Yucatan, Quintana Roo; Key City = Merida
$offtext

set v "cow-calf production systems" /V1NORT, V2SEMI, V3TRAD, V4CRIO/;
$ontext
Cow-calf production systems are defined as follows:
```

```
V1NORT = NORTE
V2SEMI = SEMI-INTENSIVE
V3TRAD = TRADICIONAL
V4CRIO = CRIOLLO
$offtext

$batinclude g:\2005be~1\prodbnch.gms p f c v
$batinclude g:\2005be~1\transbnch.gms p f c v
$batinclude g:\2005be~1\costbnch.gms p f c v
$batinclude g:\2005be~1\tradebnch.gms p f c v
$batinclude g:\2005be~1\foragebnch.gms p f c v
$batinclude g:\2005be~1\dairybnch.gms p f c v
$batinclude g:\2005be~1\consumbnch.gms p f c v

positive variables
        forg(p,z) "forage use"
        vb(p,v) "cow production"
        rint(p,v) "intensive repasto"
        rext(p,v) "extensive repasto"
        dairy(p,dc) "dairy calves"
        m4dy(p) "M4 dairy meat"
        exbm(p,vn) "export norte steer calves"
        exbh(p,vn) "export norte heifer calves"
        exmn(p,vn) "export norte feeder steers"
        exhn(p,vn) "export norte feeder heifers"
        exrod(rp,rv) "export rodeo steers"
        exsm(p,vm) "export semi-intensive steer calves"
        exsh(p,vm) "export semi-intensive heifer calves"
        e3(p,v) "potrero"
        e2s(p,v) "semi-intensive potrero"
        vacaimp(p) "imported slaughter cows"
        m4exp(p) "cull meat exports"
        s1m3(p) "TIF M3 production"
        s2m3(p) "local M3 production"
        s1m4(p) "TIF M4 production"
        s2m4(p) "local M4 production"
        s1e2(p,c) "TIF M2 (S-I potrero) slaughter and shipping"
        e1(f,vn) "M1 production"
        e2(f,v) "M2 production"
        s1m1(f) "TIF M1 production"
        s1m2(f) "TIF M2 production"
        tbec(v,p,pp) "ship calves"
        tnov(v,p,pp) "ship stockers"
        tfdr(v,p,f) "ship feeders"
        tm1(f,c) "ship M1 meat"
        tm2(f,c) "ship M2 meat"
```

```
        tm3(p,c) "ship M3 meat"
        tm4(p,c) "ship M4 meat"
        tlp1m3(rp,c1) "ship local M3 meat"
        tlp2m3(p,c) "ship local M3 meat"
        tlp3m3(p3,c3) "ship local M3 meat"
        tlp4m3(p4,c4) "ship local M3 meat"
        tlp5m3(p5,c5) "ship local M3 meat"
        tlp6m3(p,c) "ship local M3 meat"
        tlp7m3(p,c) "ship local M3 meat"
        tlp8m3(p,c) "ship local M3 meat"
        tlp9m3(p,c) "ship local M3 meat"
        tlp1m4(rp,c1) "ship local M4 meat"
        tlp2m4(p,c) "ship local M4 meat"
        tlp3m4(p3,c3) "ship local M4 meat"
        tlp4m4(p4,c4) "ship local M4 meat"
        tlp5m4(p5,c5) "ship local M4 meat"
        tlp6m4(p,c) "ship local M4 meat"
        tlp7m4(p,c) "ship local M4 meat"
        tlp8m4(p,c) "ship local M4 meat"
        tlp9m4(p,c) "ship local M4 meat"
        m1im(c) "import M1 meat"
        m2im(c) "import M2 meat"
        cabim(ip) "import Central American calves"
        canim(ir) "import Central American feeders";

equations
        forlimz(p,z) "pastizal limit"
        forlime(p,z) "esquilmas limit"
        forlimp(p,z) "praderas limit"
        forbal(p) "forage balance"
        pradbal(p) "pradera balance"
        vbbal1(p,v) "calf balance for v1nort cattle"
        vbbal2(p,v) "calf balance for v2semi cattle"
        vbbal3d(p,v) "calf balance for v3trad domestic only regions"
        vbbal3i(p,v) "calf balance for v3trad regions with imports"
        vbbal4d(p,v) "calf balance for v4crio domestic only regions"
        vbbal4e(p,v) "calf balance fro v4crio regions with exports"
        dairylim(p) "dairy calf limit"
        m4dylim(p) "dairy cow meat limit"
        rodlm(rp) "rodeo steer limit"
        maxvaca "slaughter cow import limit"
        rodmbal(rp) "rodeo steer balance"
        vbmbal(p,vn) "male calf balance"
        vbhbal(p,vn) "female calf balance"
        vsmbal(p,vm) "s-i male calf balance"
        vshbal(p,vm) "s-i female calf balance"
```

pnbal1(p,v) "Exportable stocker balance"
pnbal2(p,v) "Non-exportable stocker balance"
m3bal(p) "M3 meat balance"
m4bal(p) "M4 meat balance"
tlm3bal1(p) "local M3 shipping balance"
tlm3bal2(p) "local M3 shipping balance"
tlm3bal3(p) "local M3 shipping balance"
tlm3bal4(p) "local M3 shipping balance"
tlm3bal5(p) "local M3 shipping balance"
tlm3bal6(p) "local M3 shipping balance"
tlm3bal7(p) "local M3 shipping balance"
tlm3bal8(p) "local M3 shipping balance"
tlm3bal9(p) "local M3 shipping balance"
tlm4bal1(p) "local M4 shipping balance"
tlm4bal2(p) "local M4 shipping balance"
tlm4bal3(p) "local M4 shipping balance"
tlm4bal4(p) "local M4 shipping balance"
tlm4bal5(p) "local M4 shipping balance"
tlm4bal6(p) "local M4 Shipping balance"
tlm4bal7(p) "local M4 shipping balance"
tlm4bal8(p) "local M4 shipping balance"
tlm4bal9(p) "local M4 shipping balance"
tm3bal(p) "M3 meat shipping balance"
tm4bal(p) "M4 meat shipping balance"
tm2bal(p) "M2 (S-I potrero) shipping balance"
fnbali2(f,v) "feeder balance for central american feeder imports AND non-exportable stocker regions"
fnbali3(f,v) "feeder balance for"
fnbali4(f,v) "feeder balance for"
fnbalds(f,v) "feeder balance for non-central american feeder imports AND non-exportable stocker regions"
fnbalvn(f,v) "feeder balance exportable stocker regions"
fm1bal(f) "M1 meat balance"
fm2bal(f) "M2 meat balance"
fcapy(f) "feedlot capacity"
cablim "Central American calf limit"
canlim "Central American feeder limit"
spotlim(p) "semi-intensive potrero limit"
consum(c,m) "consumption requirements"
consum2(c,m) "consumption requirements"
consum3(c,m) "consumption requirements"
consum4(c,m) "consumption requirements"
consum5(c,m) "consumption requirements"
consum6(c,m) "consumption requirements"
consum7(c,m) "consumption requirements"
consum8(c,m) "consumption requirements"

```
        consum9(c,m) "consumption requirements"
        consum10(c,m) "consumption requirements"
        consum11(c,m) "consumption requirements"
        consum12(c,m) "consumption requirements"
        consum13(c,m) "consumption requirements"
        consum14(c,m) "consumption requirements"
        consum15(c,m) "consumption requirements"
        consum16(c,m) "consumption requirements"
        tbresb(v,p,pp) "TB calf shipping restrictions"
        tbresn(v,p,pp) "TB stocker shipping restrictions"
        tbexbm(p) "TB male calf export restrictions"
        tbexbh(p,vn) "Norte female calf export restrictions"
        tbexsh(p,vm) "Semi-Int female calf export restrictions"
        tbexhn(p,vn) "Norte female feeder export restrictions"
        exratio "limit export porportions of semi to norte";

forlimz(p,'pastizal').. forg(p,'pastizal') =l= zlim(p,'pastizal');

forlime(p,'esquilmas').. forg(p,'esquilmas')=l= zlim(p,'esquilmas') ;

forlimp(p,'praderas')..forg(p,'praderas') =l= zlim(p,'praderas');

forbal(p).. - forg(p,'pastizal')*(1/agostadj(p))- forg(p,'esquilmas')*esqadj(p)+
          sum(v,vb(p,v)*aufact(v)) + sum(v,rext(p,v)*r2au(v))+ sum(v,e3(p,v)* e3au(v))+
          sum(v,e2s(p,v)*e2sau(v)) =l= 0;

pradbal(p)..- forg(p,'praderas')*pradadj(p) + sum(v,rint(p,v)* r1au(v)) =l= 0;

alias (p,ppp);

set dp(p) "Non-Central American Importing Regions" /P1NO, P2NE, P3ME, P4CO,
          P5PA, P7VE, P9YU/;

set rc(p) "Non-Exporting Rodeo Calf Regions" /P2NE, P4CO, P5PA, P6SS, P7VE,
          P8SU, P9YU/;

set pfr(p) "TB free region" /P1NO, P2NE/;

set ptb(p) "TB restricted region" /P3ME, P4CO, P5PA, P6SS, P7VE, P8SU, P9YU/;

parameter TBlim(p) "export limits from TB restricted regions"
        /P1NO = 0,P2NE = 0,P3ME = 30000,P4CO = 15000, P5PA = 20000,P6SS = 10000,
          P7VE = 100000,P8SU = 0,P9YU = 35000/;

parameter APcost(p) "additional cost for exporting from AP regions"
```

```
/P1NO = 0,P2NE = 0,P3ME = 7.5,P4CO = 7.5, P5PA = 0,P6SS = 7.5, P7VE =
    7.5,P8SU = 7.5,P9YU = 0/;

exratio..-sum(pfr, exbm(pfr,'v1nort')) - sum(pfr,exbh(pfr,'v1nort')) +
    10*sum(pfr,exsm(pfr,'v2semi')) + 10*sum(pfr,exsh(pfr,'v2semi')) =l= 0;

tbresb(v,ptb,pfr)..tbec(v,ptb,pfr) =e= 0;

tbresn(v,ptb,pfr)..tnov(v,ptb,pfr) =e= 0;

tbexbm(ptb)..sum(vn,exbm(ptb,vn))+ sum(vn,exbh(ptb,vn)) +sum(vn,exmn(ptb,vn)) +
    sum(vn,exhn(ptb,vn)) + sum(vm,exsm(ptb,vm)) + sum(vm,exsh(ptb,vm)) =l=
    TBlim(ptb);


tbexbh(p,vn)..exbh(p,vn) =e= 0;

tbexsh(p,vm)..exsh(p,vm) =e= 0;

tbexhn(p,vn)..exhn(p,vn) =e= 0;


vbbal1(p,'V1NORT')..- vb(p,'V1NORT')* vqb('V1NORT')+
    rint(p,'V1NORT')*wtav('V1NORT') + rext(p,'V1NORT')*wtav('V1NORT')+
    exbm(p,'V1NORT')* wtm('V1NORT') + exbh(p,'V1NORT')* wth('V1NORT')+
    sum(pp,tbec('v1nort',p,pp)* wtav('v1nort')) - sum(ppp,tbec('v1nort',ppp,p)*
    wtav('v1nort')) =l= 0;

vbbal2(p,'v2semi')..- vb(p,'V2SEMI')* vqb('V2SEMI') +
    rint(p,'V2SEMI')*wtav('V2SEMI') + rext(p,'V2SEMI')*wtav('V2SEMI')+
    exsm(p,'v2semi')*wtm('v2semi')+ exsh(p,'v2semi')*wth('v2semi') +
    sum(pp,tbec('V2SEMI',p,pp)* wtav('V2SEMI')) -
    sum(ppp,tbec('V2SEMI',ppp,p)* wtav('V2SEMI')) =l= 0;

vbbal3d(DP,'v3trad')..- vb(DP,'V3TRAD')* vqb('V3TRAD')+
    rint(DP,'V3TRAD')*wtav('V3TRAD') + rext(DP,'V3TRAD')*wtav('V3TRAD')-
    DAIRY(DP,'V3TRAD')*dycalf + sum(pp,tbec('V3TRAD',DP,pp)*
    wtav('V3TRAD'))- sum(ppp,tbec('V3TRAD',ppp,DP)* wtav('V3TRAD')) =l= 0;

vbbal3i(IP,'v3trad')..- vb(IP,'V3TRAD')* vqb('V3TRAD')+
    rint(IP,'V3TRAD')*wtav('V3TRAD') + rext(IP,'V3TRAD')*wtav('V3TRAD')-
    DAIRY(IP,'V3TRAD')*DYCALF + sum(pp,tbec('V3TRAD',IP,pp)*
    wtav('V3TRAD')) - sum(ppp,tbec('V3TRAD',ppp,IP)* wtav('V3TRAD'))-
    cabim(ip)*cabwt =l= 0;
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```
vbbal4d(RC, 'V4CRIO')..- vb(RC,'V4CRIO')* vqb('V4CRIO')+
        rint(RC,'V4CRIO')*wtav('V4CRIO') + rext(RC,'V4CRIO')*wtav('V4CRIO')+
        sum(pp,tbec('V4crio',rc,pp)* wtav('V4crio')) - sum(ppp,tbec('V4crio',ppp,rc)*
        wtav('V4crio')) =l= 0;

vbbal4e(rp, 'V4CRIO')..- vb(rp,'V4CRIO')* vqb('V4CRIO')+
        rint(rp,'V4CRIO')*wtav('V4CRIO') + rext(rp,'V4CRIO')*wtav('V4CRIO')+
        sum(pp,tbec('V4crio',rp,pp)* wtav('V4crio')) - sum(ppp,tbec('V4crio',ppp,rp)*
        wtav('V4crio'))+ exrod(rp,'v4crio')*wtm('v4crio') =l= 0;

dairylim(p)..dairy(p,'v3trad') =l= dyfdr(p);

m4dylim(p)..m4dy(p) =l= dym4(p);

rodlm(rp)..sum(rv,exrod(rp,rv)) =l= rodlim(rp);

maxvaca..sum(p,vacaimp(p)) =l= vacalim;

rodmbal(rp)..sum(rv,exrod(rp,rv)* wtm('V4CRIO'))- vb(rp,'V4CRIO')* vqm('V4CRIO')
        =l= 0;

vbmbal(p,vn)..(exbm(p,vn)+ exmn(p,vn))*wtm(vn) - vb(p,vn)*vqm(vn) =l= 0;

vbhbal(p,vn)..(exbh(p,vn)+ exhn(p,vn))*wth(vn) - vb(p,vn)*vqh(vn) =l= 0;

vsmbal(p,vm)..exsm(p,vm)- vb(p,vm)*vqm(vm) =l= 0;

vshbal(p,vm)..exsh(p,vm)-vb(p,vm)*vqh(vm) =l=0;

set vs(v) "Non exportable stocker cattle" /V2SEMI, V3TRAD, V4CRIO/;

pnbal1(p,vn)..-rint(p,vn)* r1ndwt(vn) - rext(p,vn)* r2ndwt(vn)+ exmn(p,vn)*
        (wtrnd(vn)* (2/(1+wtfact))) + exhn(p,vn)* (wtrnd(vn)*((1+wtfact)/2)) +
        e3(p,vn)* wtrnd(vn) + e2s(p,vn)* wtrnd(vn)+sum(pp,tnov(vn,p,pp)* wtrnd(vn)) +
        sum(f,tfdr(vn,p,f)* wtrnd(vn)) - sum(ppp,tnov(vn,ppp,p)* wtrnd(vn)) =l= 0;

pnbal2(p,vs)..-rint(p,vs)* r1ndwt(vs) - rext(p,vs)* r2ndwt(vs)+ e3(p,vs)* wtrnd(vs) +
        e2s(p,vs)* wtrnd(vs)+ sum(pp,tnov(vs,p,pp)* wtrnd(vs)) + sum(f,tfdr(vs,p,f)*
        wtrnd(vs)) - sum(ppp,tnov(vs,ppp,p)* wtrnd(vs)) =l= 0;

m3bal(p)..+ s2m3(p) + s1m3(p) - sum(v,e3(p,v)* e3carc(v)) =l= 0;

m4bal(p)..+s2m4(p) + s1m4(p) - sum(v,vb(p,v)* m4q(v)) - m4dy(p) =l= 0;

tlm3bal1('P1NO')..-s2m3('P1NO') + sum((rp,c1),tlp1m3(rp,c1)) =l= 0;
```

```
tlm3bal2('p2NE')..-s2m3('p2NE') + tlp2m3('p2NE','c3NE') =l= 0;

tlm3bal3('P3ME')..-s2m3('P3ME') + sum(c3,tlp3m3('P3ME',c3)) =l= 0;

tlm3bal4('P4CO')..-s2m3('P4CO') + sum(c4,tlp4m3('P4CO',c4)) =l= 0;

tlm3bal5('P5PA')..-s2m3('P5PA') + sum(c5,tlp5m3('P5PA',c5)) =l= 0;

tlm3bal6('P6SS')..-s2m3('P6SS') + tlp6m3('P6SS','C5ce') =l= 0;

tlm3bal7('p7ve')..-s2m3('P7VE') + tlp7m3('P7VE','C6GO') =l= 0;

tlm3bal8('P8SU')..-s2m3('P8SU') + tlp8m3('P8SU','C6GO') =l= 0;

tlm3bal9('P9YU')..-s2m3('P9YU') + tlp9m3('P9YU','C7YU') =l= 0;

tlm4bal1('P1NO')..-s2m4('P1NO') + sum(c1,tlp1m4('P1NO',c1)) =l= 0;

tlm4bal2('p2NE')..-s2m4('p2NE') + tlp2m4('p2NE','c3NE') =l= 0;

tlm4bal3('P3ME')..-s2m4('P3ME') + sum(c3,tlp3m4('P3ME',c3)) =l= 0;

tlm4bal4('P4CO')..-s2m4('P4CO') + sum(c4,tlp4m4('P4CO',c4)) =l= 0;

tlm4bal5('P5PA')..-s2m4('P5PA') + sum(c5,tlp5m4('P5PA',c5)) =l= 0;

tlm4bal6('p6SS')..-s2m4('p6SS') + tlp6m4('p6SS','c5ce') =l= 0;

tlm4bal7('p7VE')..-s2m4('p7VE') + tlp7m4('p7VE','c6GO') =l= 0;

tlm4bal8('p8SU')..-s2m4('p8SU') + tlp8m4('p8SU','c6GO') =l= 0;

tlm4bal9('p9YU')..-s2m4('p9YU') + tlp9m4('p9YU','c7YU') =l= 0;

tm3bal(p)..-s1m3(p) + sum(c,tm3(p,c)) =l= 0;

tm4bal(p)..-s1m4(p)- vacaimp(p)* impvcarc + m4exp(p)+ sum(c,tm4(p,c)) =l= 0;

tm2bal(p)..-sum(v,e2s(p,v)* e2scarc(v))+ sum(c,s1e2(p,c)) =l= 0;

set fd(f) "Non-Central American Importing Feedlot Regions" /F02LA, F03NE, F05CO,
        F07ME, F09TB, F10YU/;

fnbali3(ir,'v3trad')..-sum(p,tfdr('v3trad',p,ir)*wtrnd('v3trad'))- canim(ir)*canwt +
        e2(ir,'v3trad')*wtrnd('v3trad') =l= 0;
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```
fnbali2(ir,'v2semi')..-sum(p,tfdr('v2semi',p,ir)*wtrnd('v2semi')) +
          e2(ir,'v2semi')*wtrnd('v2semi') =l= 0;

fnbali4(ir,'v4crio')..-sum(p,tfdr('v4crio',p,ir)*wtrnd('v4crio')) +
          e2(ir,'v4crio')*wtrnd('v4crio') =l= 0;

fnbalds(fd,vs)..-sum(p,tfdr(vs,p,fd)*wtrnd(vs))+ e2(fd,vs)*wtrnd(vs) =l= 0;

fnbalvn(f,vn)..-sum(p,tfdr(vn,p,f)*wtrnd(vn))+ e1(f,vn)*wtrnd(vn) + e2(f,vn)*wtrnd(vn)
          =l= 0;

fm1bal(f)..-sum(vn,e1(f,vn)* e1carc(vn))+ sum(c,tm1(f,c)) =l= 0;

fm2bal(f)..-sum(v,e2(f,v)* e2carc(v))+ sum(c,tm2(f,c)) =l= 0;

fcapy(f)..sum(vn,e1(f,vn)) + sum(v,e2(f,v)) =l= fprod(f);

spotlim(p)..sum(v,e2s(p,v)) =l= e2slim(p);

cablim..sum(ip,cabim(ip)) =l= cabmax;

canlim..sum(ir,canim(ir)) =l= canmax;

consum(c,'M1NOR')..sum(f,tm1(f,c)) + m1im(c) =g= conctot(c,'M1NOR');

consum2(c,'M2FED')..sum(f,tm2(f,c)) + sum(p,s1e2(p,c)) + m2im(c) =g=
          conctot(c,'M2FED');

consum3('C1NW','M3TRA')..tlp1m3('P1NO','C1NW') + tlp5m3('P5PA','C1NW') +
          sum(p,tm3(p,'C1NW')) =g= conctot('C1NW','M3TRA');

consum4('C2NC','M3TRA')..tlp1m3('P1NO','C2NC') + sum(p,tm3(p,'C2NC')) =g=
          conctot('C2NC','M3TRA');

consum5('C3NE','M3TRA')..tlp2m3('P2NE','C3NE') + sum(p,tm3(p,'C3NE'))
       =g= conctot('C3NE','M3TRA');

consum6('C4TP','M3TRA')..tlp3m3('P3ME','c4TP') + tlp4m3('P4CO','c4TP') +
          tlp5m3('P5PA','c4TP')+ sum(p,tm3(p,'C4TP')) =g= conctot('C4TP','M3TRA');

consum7('C5CE','M3TRA')..tlp3m3('P3ME','c5CE') + tlp4m3('P4CO','c5CE') +
          tlp6m3('P6SS','c5CE')+ sum(p,tm3(p,'C5CE')) =g= conctot('C5CE','M3TRA');

consum8('C6GO','M3TRA')..tlp7m3('P7VE','c6GO') + tlp8m3('P8SU','c6GO') +
          sum(p,tm3(p,'C6GO')) =g= conctot('C6GO','M3TRA');
```

```
consum9('C7YU','M3TRA')..tlp9m3('P9YU','c7YU') + sum(p,tm3(p,'C7YU')) =g=
        conctot('C7YU','M3TRA');

consum10('C1NW','M4DES')..tlp1m4('P1NO','c1NW') + tlp5m4('p5PA','c1NW') +
        sum(p,tm4(p,'C1NW'))=g= conctot('C1NW','M4DES');

consum11('C2NC','M4DES')..tlp1m4('P1NO','c2NC') + sum(p,tm4(p,'C2NC')) =g=
        conctot('C2NC','M4DES');

consum12('C3NE','M4DES')..tlp2m4('P2NE','c3NE') + sum(p,tm4(p,'C3NE')) =g=
        conctot('C3NE','M4DES');

consum13('C4TP','M4DES')..tlp3m4('P3ME','c4TP') + tlp4m4('P4CO','c4TP') +
        tlp5m4('P5PA','c4TP')+ sum(p,tm4(p,'C4TP')) =g= conctot('C4TP','M4DES');

consum14('C5CE','M4DES')..tlp3m4('P3ME','c5ce') + tlp4m4('P4CO','c5CE') +
        tlp6m4('P6SS','c5ce') + sum(p,tm4(p,'C5CE')) =g= conctot('C5CE','M4DES');

consum15('C6GO','M4DES')..tlp7m4('P7VE','c6GO') + tlp8m4('P8SU','c6GO') +
        sum(p,tm4(p,'C6GO')) =g= conctot('C6GO','M4DES');

consum16('C7YU','M4DES')..tlp9m4('P9YU','c7YU') + sum(p,tm4(p,'C7YU')) =g=
        conctot('C7YU','M4DES');

free variable cost "national minimum cost";

VARIABLES
  A
  B
  D
  H
  J
  K
  N
  O
  Q
  R
  S
  T
  U
  Y

EQUATIONS
  FORGUSE
  PRODCOST
  DAIRVALUE
```

```
   EXPLIVE
   PROTCOST
   COWIMP
   CULMEATEXP
   SLTRCOST
   X
   FEEDCOST
   SHIPLIVE
   SHIPMEAT
   MEATIMP
   CAIMP
   OBJ;

FORGUSE..  A =E= sum(p,forg(p,'pastizal')*ppast(p))+
        sum(p,forg(p,'esquilmas')*pesq(p)) + sum(p,forg(p,'praderas')*pprad(p));
PRODCOST..  B =E= sum((p,v),vb(p,v)*vcst(p,v))+ sum((p,v),rint(p,v)* r1cstp(p)) +
        sum((p,v),rext(p,v)*r2cstp(p,v));
DAIRVALUE..  D =E= sum(p,dairy(p,'V3TRAD')*dyval) +
        sum(p,m4dy(p)*(m4pex*0.9));
EXPLIVE..  H =E= -sum((p,vn),exbm(p,vn)*(expm(vn)- xcostpie(p)*wtm(vn)-
        (APcost(p)*camb))) - sum((p,vn),exbh(p,vn)*(exph(vn)- xcostpie(p)*wth(vn)-
        (APcost(p)*camb))) - sum((p,vn),exmn(p,vn)*(expmn(vn)-
        xcostpie(p)*(wtrnd(vn)*(2/1+wtfact) -(APcost(p)*camb))))-
        sum((p,vn),exhn(p,vn)*(exphn(vn)-xcostpie(p)*(wtrnd(vn) *((1+wtfact)/2)-
        (APcost(p)*camb))))- exrod('P1NO','V4CRIO') *(prodeo-
        xcostpie('P1NO')*wtm('V4CRIO')-(APcost('P1NO')*camb)) -
        exrod('P3ME','V4CRIO')*(prodeo- xcostpie('P3ME')*wtm('V4CRIO') -
        (APcost('P3ME')*camb)) - sum((p,vm),exsm(p,vm)*(expsm(vm)-
        xcostpie(p)*wtm(vm)-(APcost(p)*camb))) - sum((p,vm),exsh(p,vm)*(expsh(vm)-
        xcostpie(p)*wth(vm)-(APcost(p)* camb)));
PROTCOST..  J =E= sum((p,v),e3(p,v)*e3cstp(p,v))+ sum((p,v),e2s(p,v)*e2scost(p,v));
COWIMP..  K =E= sum(p,vacaimp(p)*(imvacp+ xcostpie(p)*(vacawt/2.2046)));
CULMEATEXP..  N =E= sum(p,m4exp(p)*((.9*m4pex)-xcostm4(p)));
SLTRCOST..  O =E= sum(p,s1m3(p)*s1cst)+ sum(p,s2m3(p)*s2cst) +
        sum(p,s1m4(p)*s1cst) + sum(p,s2m4(p)*s2cst);
X..  Q =E= sum((p,c),s1e2(p,c)*(s1cst + m34un(p,c)));
FEEDCOST..  R =E= sum((f,vn),e1(f,vn)*fdcste1(f,vn))+ sum((f,v),e2(f,v)*fdcste2(f,v));
SHIPLIVE..  S =E= sum((v,p,pp),tbec(v,p,pp)*piepun(p,pp)*wtav(v)) +
        sum((v,p,pp),tnov(v,p,pp)*wtrnd(v)*piepun(p,pp))+
        sum((v,p,f),tfdr(v,p,f)*wtrnd(v)*piefun(p,f));
SHIPMEAT..  T =E= sum((f,c),tm1(f,c)*(m12un(f,c)+s1cst)) +
        sum((f,c),tm2(f,c)*(m12un(f,c)+s1cst)) + sum((p,c),tm3(p,c)*m34un(p,c))+
        sum((p,c),tm4(p,c) *m34un(p,c));
MEATIMP..  U =E= sum(c,m1im(c)*(mcostmeat(c)+pm1imp))+
        sum(c,m2im(c)*(mcostmeat(c)+pm2imp));
CAIMP..  Y =E= sum(ip,cabim(ip)*capb*cabwt) + sum(ir,canim(ir)*capn*canwt);
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```
obj..  cost =e= A + B + D + H + J + K - N + O + Q + R + S + T + U + Y;

MODEL BENCH2005 "GANAMEX benchmark for year 2005" /all/;

OPTION LIMROW=15, LIMCOL=15;

solve BENCH2005 using lp minimizing cost;

***FORAGES*******************************************************

PARAMETER FORUSE "Regional Forage Use";
      FORUSE(P,Z) = FORG.L(P,Z);

PARAMETER FORTYP "Total Forage Use by Type";
      FORTYP(Z) = SUM(P, FORG.L(P,Z));

PARAMETER REGFORU "Total Regional Forage Use";
      REGFORU(P) = SUM(Z, FORG.L(P,Z));

PARAMETER TOTFORU "Total Forage Use";
      TOTFORU = SUM ([P,Z], FORG.L(P,Z));

PARAMETER PERCFORU "Percent of Available Forage Used";
      PERCFORU(P,Z) = FORG.L(P,Z)/ZLIM(P,Z);

PARAMETER PERFORTYP "Percent of Total Forage Type Used";
      PERFORTYP(Z) = SUM(P,FORLIMZ.L(P,Z) + FORLIME.L(P,Z) +
         FORLIMP.L(P,Z))/SUM(P,ZLIM(P,Z))*100;

PARAMETER PEREGFORU "Percent of Total Forage Use by Region";
      PEREGFORU(P) = SUM(Z,FORLIMZ.L(P,Z) + FORLIME.L(P,Z) +
         FORLIMP.L(P,Z))/SUM(Z,ZLIM(P,Z))*100;

DISPLAY FORUSE, FORTYP, REGFORU, TOTFORU, PERCFORU, PERFORTYP,
         PEREGFORU;


***COW PRODUCTION************************************************

PARAMETER COWREG "Cow Production by Region";
  COWREG(P,V) = VB.L(P,V);

PARAMETER COWPROD(P)  "Total Cow Production by Region";
   COWPROD(P) = SUM([V],VB.L(P,V));

PARAMETER REGPROD(V)  "Total Regional Production by Cattle Type";
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```
   REGPROD(V) = SUM(P, VB.L(P,V));

PARAMETER TOTCOW "Total Cow Production";
   TOTCOW = SUM([P,V], VB.L(P,V));

DISPLAY COWREG, COWPROD, REGPROD, TOTCOW;

***POTRERO PRODUCTION**********************************************

PARAMETER E3PROD "Potrero Production";
      E3PROD(P,V) = E3.L(P,V);

PARAMETER REGE3 "Regional Potrero Production";
      REGE3(P) = SUM(V,E3.L(P,V));

PARAMETER TYPE3 "Potrero Production by Type of Cow";
      TYPE3(V) = SUM(P,E3.L(P,V));

PARAMETER TOTE3 "Total Potrero Production";
      TOTE3 = SUM([P,V], E3.L(P,V));

DISPLAY E3PROD, REGE3, TYPE3, TOTE3;

PARAMETER E2SPROD "Semi-Intensive Potrero Production";
      E2SPROD(P,V) = E2S.L(P,V);

PARAMETER REGE2S "Regional Semi-Intensive Potrero Production";
      REGE2S(P) = SUM(V,E2S.L(P,V));

PARAMETER TYPE2S "Semi-Intensive Potrero Production by Type of Cattle";
      TYPE2S(V) = SUM(P,E2S.L(P,V));

PARAMETER TOTE2S "Total Semi-Intensive Potrero Production";
      TOTE2S = SUM([P,V], E2S.L(P,V));

DISPLAY E2SPROD, REGE2S, TYPE2S, TOTE2S;

***REPASTOS********************************************************

PARAMETER INTREP "Intensive Repasto";
      INTREP(P,V) = RINT.L(P,V);

PARAMETER REGINTREP "Total Regional Intensive Repasto";
      REGINTREP(P) = SUM(V, RINT.L(P,V));

PARAMETER COWINTREP "Total Intensive Repasto by Cattle Type";
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      COWINTREP(V) =  SUM(P, RINT.L(P,V));

PARAMETER TOTINTREP "Total Intensive Repasto";
      TOTINTREP = SUM([P,V], RINT.L(P,V));

DISPLAY INTREP, REGINTREP, COWINTREP, TOTINTREP;

PARAMETER EXTREP "Extensive Repasto";
      EXTREP(P,V) = REXT.L(P,V);

PARAMETER REGEXTREP "Total Regional Extensive Repasto";
      REGEXTREP(P) = SUM(V, REXT.L(P,V));

PARAMETER COWEXTREP "Total Extensive Repasto by Cow Type";
      COWEXTREP(V) =  SUM(P, REXT.L(P,V));

PARAMETER TOTEXTREP "Total Extensive Repasto";
      TOTEXTREP = SUM([P,V], REXT.L(P,V));

DISPLAY EXTREP, REGEXTREP, COWEXTREP, TOTEXTREP;

***MEAT PRODUCTION**************************************************

PARAMETER MEATPROD "Dairy M4 Meat Production by Region (kg)";
      MEATPROD(P) = M4DY.L(P);

PARAMETER TDPROD "Total Dairy M4 Meat Production by Region (kg)";
      TDPROD = SUM(P, M4DY.L(P));

DISPLAY MEATPROD, TDPROD;

PARAMETER TIM3 "M3 TIF Production by Region (kg)";
      TIM3(P) = S1M3.L(P);

PARAMETER TTIM3 "Total M3 TIF Production (kg)";
      TTIM3 = sum(p, S1M3.L(P));

PARAMETER LOM3 "M3 Local Production by Region (kg)";
      LOM3(P) = S2M3.L(P);

PARAMETER TLOM3 "Total M3 Local Production (kg)";
      TLOM3 = sum(p, S2M3.L(P));

PARAMETER RM3 "M3 Production by Region (kg)";
      RM3(P) = S1M3.L(P) + S2M3.L(P);
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PARAMETER TOTM3 "Total M3 Production (kg)";
       TOTM3 = SUM(P, S1M3.L(P) + S2M3.L(P));

DISPLAY TIM3, TTIM3, LOM3, TLOM3, RM3, TOTM3;

PARAMETER TIM4 "M4 TIF Production by Region (kg)";
       TIM4(P) = S1M4.L(P);

PARAMETER TTIM4 "Total M4 TIF Production (kg)";
       TTIM4 =  SUM(P, S1M4.L(P));

PARAMETER LOM4 "M4 Local Production by Region (kg)";
       LOM4(P) = S2M4.L(P);

PARAMETER TLOM4 "Total M4 Local Production (kg)";
       TLOM4 =  SUM(P, S2M4.L(P));

PARAMETER RM4 "Regional M4 Production (kg)";
       RM4(P) = S1M4.L(P) + S2M4.L(P);

PARAMETER TOTM4 "Total M4 Production (kg)";
       TOTM4 = SUM(P, S1M4.L(P) + S2M4.L(P));

DISPLAY TIM4, TTIM4, LOM4, TLOM4, RM4, TOTM4;

PARAMETER TIM2 "M2 TIF (S-I Potrero) Slaughter and Shipping";
       TIM2(p,c) = S1E2.L(P,C);

PARAMETER RTIM2 "Regional Production M2 (S-I Potrero) TIF Slaughter and
Shipping";
       RTIM2(P) = SUM(C, S1E2.L(P,C));

PARAMETER CTIM2 "Regional Consumption M2 (S-I) TIF Slaughter and Shipping";
       CTIM2(C) = SUM(P, S1E2.L(P,C));

PARAMETER TTIM2 "Total M2 (S-I Potrero) TIF Slaughter and Shipping";
       TTIM2 = SUM([P,C], S1E2.L(P,C));

DISPLAY TIM2, RTIM2, CTIM2, TTIM2;

PARAMETER FEDM2 "M2 Production from Feedlots (hd)";
       FEDM2(F,V) = E2.L(F,V);

PARAMETER FEDRM2 "M2 Production from Feedlots by Feeder Region (hd)";
       FEDRM2(F) = SUM(V, E2.L(F,V));
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PARAMETER TYPFM2 "Type of Cow Used for M2 Fed Meat (hd)";
      TYPFM2(V) = SUM(F, E2.L(F,V));

PARAMETER TFEDM2 "Total M2 Fed Meat Produced (hd)";
      TFEDM2 = SUM([F,V], E2.L(F,V));

DISPLAY FEDM2, FEDRM2, TYPFM2, TFEDM2;

PARAMETER M1PROD "M1 Production (hd)";
      M1PROD(F,VN) = E1.L(F,VN);

PARAMETER M1FEDR "M1 Production by Feedlot Region (hd)";
      M1FEDR(F) = SUM(VN, E1.L(F,VN));

PARAMETER TM1PROD "Total M1 Production (hd)";
      TM1PROD = SUM([F,VN], E1.L(F,VN));

DISPLAY M1PROD, M1FEDR, TM1PROD;

PARAMETER FEDRM1M2 "M1 and M2 Production by Feedlot Region (hd)";
      FEDRM1M2(F) = SUM(V, E2.L(F,V)) + SUM(VN, E1.L(F,VN));

PARAMETER TOTM1M2 "Total M1 and M2 Production (hd)";
      TOTM1M2 = SUM([F,V], E2.L(F,V)) + SUM([F,VN], E1.L(F,VN));

DISPLAY FEDRM1M2, TOTM1M2;

***SHIPPING***********************************************************

PARAMETER SHIPV1 "V1 Calves Shipped";
      SHIPV1('V1NORT',P,PP) = TBEC.L('V1NORT',P,PP);

PARAMETER SRSHIPV1 "Total V1 Calves Shipped By Source Region";
      SRSHIPV1('V1NORT',P) = SUM(PP, TBEC.L('V1NORT',P,PP));

PARAMETER DRSHIPV1 "Total V1 Calves Shipped By Destination Region";
      DRSHIPV1('V1NORT',PP) = SUM(P, TBEC.L('V1NORT',P,PP));

PARAMETER TSHIPV1 "Total V1 Calves Shipped";
      TSHIPV1('V1NORT') = SUM([P,PP], TBEC.L('V1NORT',P,PP));

PARAMETER SHIPV2 "V2 Calves Shipped";
      SHIPV2('V2SEMI',P,PP) = TBEC.L('V2SEMI',P,PP);

PARAMETER SRSHIPV2 "Total V2 Calves Shipped By Source Region";
      SRSHIPV2('V2SEMI',P) = SUM(PP, TBEC.L('V2SEMI',P,PP));
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PARAMETER DRSHIPV2 "Total V2 Calves Shipped By Destination Region";
      DRSHIPV2('V2SEMI',PP) = SUM(P, TBEC.L('V2SEMI',P,PP));

PARAMETER TSHIPV2 "Total V2 Calves Shipped";
      TSHIPV2('V2SEMI') = SUM((P,PP), TBEC.L('V2SEMI',P,PP));

PARAMETER SHIPV3 "V3 Calves Shipped";
      SHIPV3('V3TRAD',P,PP) = TBEC.L('V3TRAD',P,PP);

PARAMETER SRSHIPV3 "Total V3 Calves Shipped By Source Region";
      SRSHIPV3('V3TRAD',P) = SUM(PP, TBEC.L('V3TRAD',P,PP));

PARAMETER DRSHIPV3 "Total V3 Calves Shipped By Destination Region";
      DRSHIPV3('V3TRAD',PP) = SUM(P, TBEC.L('V3TRAD',P,PP));

PARAMETER TSHIPV3 "Total V3 Calves Shipped";
      TSHIPV3('V3TRAD') = SUM((P,PP), TBEC.L('V3TRAD',P,PP));

PARAMETER SHIPV4 "V4 Calves Shipped";
      SHIPV4('V4CRIO',P,PP) = TBEC.L('V4CRIO',P,PP);

PARAMETER SRSHIPV4 "Total V4 Calves Shipped By Source Region";
      SRSHIPV4('V4CRIO',P) = SUM(PP, TBEC.L('V4CRIO',P,PP));

PARAMETER DRSHIPV4 "Total V4 Calves Shipped By Destination Region";
      DRSHIPV4('V4CRIO',PP) = SUM(P, TBEC.L('V4CRIO',P,PP));

PARAMETER TSHIPV4 "Total V4 Calves Shipped";
      TSHIPV4('V4CRIO') = SUM((P,PP), TBEC.L('V4CRIO',P,PP));

PARAMETER SHIPCL "Calves Shipped";
      SHIPCL(P,PP) = SUM(V,TBEC.L(V,P,PP));

PARAMETER SRSHIPCL "Total Calves Shipped By Source Region";
      SRSHIPCL(P) = SUM((V,PP), TBEC.L(V,P,PP));

PARAMETER DRSHIPCL "Total Calves Shipped By Destination Region";
      DRSHIPCL(PP) = SUM((V,P), TBEC.L(V,P,PP));

PARAMETER TSHIPCL "Total Calves Shipped";
      TSHIPCL = SUM((V,P,PP), TBEC.L(V,P,PP));

DISPLAY SHIPV1, SRSHIPV1, DRSHIPV1, TSHIPV1, SHIPV2, SRSHIPV2,
         DRSHIPV2, TSHIPV2, SHIPV3, SRSHIPV3, DRSHIPV3, TSHIPV3, SHIPV4,
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        SRSHIPV4, DRSHIPV4, TSHIPV4, SHIPCL, SRSHIPCL, DRSHIPCL,
        TSHIPCL;

PARAMETER SHIPV1S "V1 Stockers Shipped";
      SHIPV1S('V1NORT',P,PP) = TNOV.L('V1NORT',P,PP);

PARAMETER SRSHIPV1S "Total V1 Stockers Shipped By Source Region";
      SRSHIPV1S('V1NORT',P) = SUM(PP, TNOV.L('V1NORT',P,PP));

PARAMETER DRSHIPV1S "Total V1 Stockers Shipped By Destination Region";
      DRSHIPV1S('V1NORT',PP) = SUM(P, TNOV.L('V1NORT',P,PP));

PARAMETER TSHIPV1S "Total V1 Stockers Shipped";
      TSHIPV1S('V1NORT') = SUM((P,PP), TNOV.L('V1NORT',P,PP));

PARAMETER SHIPV2S "V2 Stockers Shipped";
      SHIPV2S('V2SEMI',P,PP) = TNOV.L('V2SEMI',P,PP);

PARAMETER SRSHIPV2S "Total V2 Stockers Shipped By Source Region";
      SRSHIPV2S('V2SEMI',P) = SUM(PP, TNOV.L('V2SEMI',P,PP));

PARAMETER DRSHIPV2S "Total V2 Stockers Shipped By Destination Region";
      DRSHIPV2S('V2SEMI',PP) = SUM(P, TNOV.L('V2SEMI',P,PP));

PARAMETER TSHIPV2S "Total V2 Stockers Shipped";
      TSHIPV2S('VSEMI') = SUM((P,PP), TNOV.L('V2SEMI',P,PP));

PARAMETER SHIPV3S "V3 Stockers Shipped";
      SHIPV3S('V3TRAD',P,PP) = TNOV.L('V3TRAD',P,PP);

PARAMETER SRSHIPV3S "Total V3 Stockers Shipped By Source Region";
      SRSHIPV3S('V3TRAD',P) = SUM(PP, TNOV.L('V3TRAD',P,PP));

PARAMETER DRSHIPV3S "Total V3 Stockers Shipped By Destination Region";
      DRSHIPV3S('V3TRAD',PP) = SUM(P, TNOV.L('V3TRAD',P,PP));

PARAMETER TSHIPV3S "Total V3 Stockers Shipped";
      TSHIPV3S('V3TRAD') = SUM((P,PP), TNOV.L('V3TRAD',P,PP));

PARAMETER SHIPV4S "V4 Stockers Shipped";
      SHIPV4S('V4CRIO',P,PP) = TNOV.L('V4CRIO',P,PP);

PARAMETER SRSHIPV4S "Total V4 Stockers Shipped By Source Region";
      SRSHIPV4S('V4CRIO',P) = SUM(PP, TNOV.L('V4CRIO',P,PP));

PARAMETER DRSHIPV4S "Total V4 Stockers Shipped By Destination Region";
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      DRSHIPV4S('V4CRIO',PP) = SUM(P, TNOV.L('V4CRIO',P,PP));

PARAMETER TSHIPV4S "Total V4 Stockers Shipped";
      TSHIPV4S('V4CRIO') = SUM((P,PP), TNOV.L('V4CRIO',P,PP));

PARAMETER SHIPS "Stockers Shipped";
      SHIPS(P,PP) = SUM(V,TNOV.L(V,P,PP));

PARAMETER SRSHIPS "Total Stockers Shipped By Source Region";
      SRSHIPS(P) = SUM((V,PP), TNOV.L(V,P,PP));

PARAMETER DRSHIPS "Total Stockers Shipped By Destination Region";
      DRSHIPS(PP) = SUM((V,P), TNOV.L(V,P,PP));

PARAMETER TSHIPS "Total Stockers Shipped";
      TSHIPS = SUM((V,P,PP), TNOV.L(V,P,PP));

DISPLAY SHIPV1S, SRSHIPV1S, DRSHIPV1S, TSHIPV1S, SHIPV2S, SRSHIPV2S,
         DRSHIPV2S, TSHIPV2S, SHIPV3S, SRSHIPV3S, DRSHIPV3S, TSHIPV3S,
         SHIPV4S, SRSHIPV4S, DRSHIPV4S, TSHIPV4S, SHIPS, SRSHIPS,
         DRSHIPS, TSHIPS;

PARAMETER SHIPV1F "V1 Feeders Shipped";
      SHIPV1F('V1NORT',P,F) = TFDR.L('V1NORT',P,F);

PARAMETER SRSHIPV1F "Total V1 Feeders Shipped By Source Region";
      SRSHIPV1F('V1NORT',P) = SUM(F, TFDR.L('V1NORT',P,F));

PARAMETER DRSHIPV1F "Total V1 Feeders Shipped By Destination Region";
      DRSHIPV1F('V1NORT',F) = SUM(P, TFDR.L('V1NORT',P,F));

PARAMETER TSHIPV1F "Total V1 Feeders Shipped";
      TSHIPV1F('V1NORT') = SUM((P,F), TFDR.L('V1NORT',P,F));

PARAMETER SHIPV2F "V2 Feeders Shipped";
      SHIPV2F('V2SEMI',P,F) = TFDR.L('V2SEMI',P,F);

PARAMETER SRSHIPV2F "Total V2 Feeders Shipped By Source Region";
      SRSHIPV2F('V2SEMI',P) = SUM(F, TFDR.L('V2SEMI',P,F));

PARAMETER DRSHIPV2F "Total V2 Feeders Shipped By Destination Region";
      DRSHIPV2F('V2SEMI',F) = SUM(P, TFDR.L('V2SEMI',P,F));

PARAMETER TSHIPV2F "Total V2 Feeders Shipped";
      TSHIPV2F('V2SEMI') = SUM((P,F), TFDR.L('V2SEMI',P,F));
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PARAMETER SHIPV3F "V3 Feeders Shipped";
      SHIPV3F('V3TRAD',P,F) = TFDR.L('V3TRAD',P,F);

PARAMETER SRSHIPV3F "Total V3 Feeders Shipped By Source Region";
      SRSHIPV3F('V3TRAD',P) = SUM(F, TFDR.L('V3TRAD',P,F));

PARAMETER DRSHIPV3F "Total V3 Feeders Shipped By Destination Region";
      DRSHIPV3F('V3TRAD',F) = SUM(P, TFDR.L('V3TRAD',P,F));

PARAMETER TSHIPV3F "Total V3 Feeders Shipped";
      TSHIPV3F('V3TRAD') = SUM((P,F), TFDR.L('V3TRAD',P,F));

PARAMETER SHIPV4F "V4 Feeders Shipped";
      SHIPV4F('V4CRIO',P,F) = TFDR.L('V4CRIO',P,F);

PARAMETER SRSHIPV4F "Total V4 Feeders Shipped By Source Region";
      SRSHIPV4F('V4CRIO',P) = SUM(F, TFDR.L('V4CRIO',P,F));

PARAMETER DRSHIPV4F "Total V4 Feeders Shipped By Destination Region";
      DRSHIPV4F('V4CRIO',F) = SUM(P, TFDR.L('V4CRIO',P,F));

PARAMETER TSHIPV4F "Total V4 Feeders Shipped";
      TSHIPV4F('V4CRIO') = SUM((P,F), TFDR.L('V4CRIO',P,F));

PARAMETER SHIPF "Feeders Shipped";
      SHIPF(P,F) = SUM(V,TFDR.L(V,P,F));

PARAMETER SRSHIPF "Total Feeders Shipped By Source Region";
      SRSHIPF(P) = SUM((V,F), TFDR.L(V,P,F));

PARAMETER DRSHIPF "Total Feeders Shipped By Destination Region";
      DRSHIPF(F) = SUM((V,P), TFDR.L(V,P,F));

PARAMETER TSHIPF "Total Feeders Shipped";
      TSHIPF = SUM((V,P,F), TFDR.L(V,P,F));


DISPLAY SHIPV1F, SRSHIPV1F, DRSHIPV1F, TSHIPV1F, SHIPV2F, SRSHIPV2F,
         DRSHIPV2F, TSHIPV2F, SHIPV3F, SRSHIPV3F, DRSHIPV3F, TSHIPV3F,
         SHIPV4F, SRSHIPV4F, DRSHIPV4F, TSHIPV4F, SHIPF, SRSHIPF,
         DRSHIPF, TSHIPF;

PARAMETER SHIPM1 "Ship M1 Meat";
      SHIPM1(F,C) = TM1.L(F,C);

PARAMETER SRSHIPM1 "Total M1 Meat Shipped By Source Region";
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        SRSHIPM1(F) = SUM(C, TM1.L(F,C));

PARAMETER DRSHIPM1 "Total M1 Meat Shipped By Destination Region";
        DRSHIPM1(C) = SUM(F, TM1.L(F,C));

PARAMETER TSHIPM1 "Total M1 Meat Shipped";
        TSHIPM1 = SUM((F,C), TM1.L(F,C));

PARAMETER SHIPM2 "Ship M2 Meat";
        SHIPM2(F,C) = TM2.L(F,C);

PARAMETER SRSHIPM2 "Total M2 Meat Shipped By Source Region";
        SRSHIPM2(F) = SUM(C, TM2.L(F,C));

PARAMETER DRSHIPM2 "Total M2 Meat Shipped By Destination Region";
        DRSHIPM2(C) = SUM(F, TM2.L(F,C));

PARAMETER TSHIPM2 "Total M2 Meat Shipped";
        TSHIPM2 = SUM((F,C), TM2.L(F,C));

PARAMETER SHIPM3 "Ship M3 Meat";
        SHIPM3(P,C) = TM3.L(P,C);

PARAMETER SRSHIPM3 "Total M3 Meat Shipped By Source Region";
        SRSHIPM3(P) = SUM(C, TM3.L(P,C));

PARAMETER DRSHIPM3 "Total M3 Meat Shipped By Destination Region";
        DRSHIPM3(C) = SUM(P, TM3.L(P,C));

PARAMETER TSHIPM3 "Total M3 Meat Shipped";
        TSHIPM3 = SUM((P,C), TM3.L(P,C));

PARAMETER SHIPM4 "Ship M4 Meat";
        SHIPM4(P,C) = TM4.L(P,C);

PARAMETER SRSHIPM4 "Total M4 Meat Shipped By Source Region";
        SRSHIPM4(P) = SUM(C, TM4.L(P,C));

PARAMETER DRSHIPM4 "Total M4 Meat Shipped By Destination Region";
        DRSHIPM4(C) = SUM(P, TM4.L(P,C));

PARAMETER TSHIPM4 "Total M4 Meat Shipped";
        TSHIPM4 = SUM((P,C), TM4.L(P,C));

PARAMETER SHIPM3M4 " Ship M3 and M4 Combined";
        SHIPM3M4(P,C) = TM3.L(P,C)+ TM4.L(P,C);
```

```
DISPLAY SHIPM1, SRSHIPM1, DRSHIPM1, TSHIPM1, SHIPM2, SRSHIPM2,
        DRSHIPM2, TSHIPM2, SHIPM3, SRSHIPM3, DRSHIPM3, TSHIPM3,
        SHIPM4, SRSHIPM4, DRSHIPM4, TSHIPM4, SHIPM3M4;

***CONSUMPTION*****************************************************

PARAMETER CONSUMP "Meat Consumption by Region and Type";
   CONSUMP(C,M) = CONSUM.L(C,M)+CONSUM2.L(C,M)+CONSUM3.L(C,M)
        +CONSUM4.L(C,M)+CONSUM5.L(C,M)+CONSUM6.L(C,M)+CONSUM7.L(
        C,M)
        +CONSUM8.L(C,M)+CONSUM9.L(C,M)+CONSUM10.L(C,M)+CONSUM11.
        L(C,M)
        +CONSUM12.L(C,M)+CONSUM13.L(C,M)+CONSUM14.L(C,M)+CONSUM1
        5.L(C,M) +CONSUM16.L(C,M);

PARAMETER MEATYPE(M) "Total Meat Consumption by Type";
   MEATYPE(M) = SUM(C, CONSUM.L(C,M) + CONSUM2.L(C,M) +
        CONSUM3.L(C,M) + CONSUM4.L(C,M) + CONSUM5.L(C,M) +
        CONSUM6.L(C,M) + CONSUM7.L(C,M) + CONSUM8.L(C,M) +
        CONSUM9.L(C,M) + CONSUM10.L(C,M) + CONSUM11.L(C,M) +
        CONSUM12.L(C,M) + CONSUM13.L(C,M) + CONSUM14.L(C,M) +
        CONSUM15.L(C,M) + CONSUM16.L(C,M));

PARAMETER REGCONS(C) "Total Meat Consumption by Consumption Region";
   REGCONS(C) = SUM(M, CONSUM.L(C,M) + CONSUM2.L(C,M) +
        CONSUM3.L(C,M) + CONSUM4.L(C,M) + CONSUM5.L(C,M) +
        CONSUM6.L(C,M) + CONSUM7.L(C,M) + CONSUM8.L(C,M) +
        CONSUM9.L(C,M) + CONSUM10.L(C,M) + CONSUM11.L(C,M) +
        CONSUM12.L(C,M) + CONSUM13.L(C,M) + CONSUM14.L(C,M) +
        CONSUM15.L(C,M) + CONSUM16.L(C,M));

PARAMETER TOTCONS "Total Meat Consumption";
   TOTCONS = SUM([C,M], (CONSUM.L(C,M) + CONSUM2.L(C,M) +
        CONSUM3.L(C,M) + CONSUM4.L(C,M) + CONSUM5.L(C,M) +
        CONSUM6.L(C,M) + CONSUM7.L(C,M) + CONSUM8.L(C,M) +
        CONSUM9.L(C,M) + CONSUM10.L(C,M) + CONSUM11.L(C,M) +
        CONSUM12.L(C,M) + CONSUM13.L(C,M) + CONSUM14.L(C,M) +
        CONSUM15.L(C,M) + CONSUM16.L(C,M)));

DISPLAY CONSUMP, MEATYPE, REGCONS, TOTCONS;

***LIVE IMPORTS****************************************************

PARAMETER IMPSLCOW "Imported Slaughter Cows by Region";
     IMPSLCOW(P) = VACAIMP.L(P);
```

```
PARAMETER TOTIMSLC "Total Imported Slaughter Cows";
      TOTIMSLC = SUM(P,VACAIMP.L(P));

DISPLAY IMPSLCOW, TOTIMSLC;

PARAMETER IMPCAC "Import Central American Calves";
      IMPCAC(IP) = CABIM.L(IP);

PARAMETER TIMPCAC "Total Central AMerican Calf Import";
      TIMPCAC = SUM(IP, CABIM.L(IP));

PARAMETER IMPCAF "Import Central American Feeders";
      IMPCAF(IR) = CANIM.L(IR);

PARAMETER TIMPCAF "Total Central American Feeder Import";
      TIMPCAF = SUM(IR, CANIM.L(IR));

DISPLAY IMPCAC, TIMPCAC, IMPCAF, TIMPCAF;

***MEAT
IMPORTS**************************************************************

PARAMETER IMPM1 "M1 Meat Imports";
      IMPM1(C) = M1IM.L(C);

PARAMETER TIMPM1 "Total M1 Meat Imports";
      TIMPM1 = SUM(C, M1IM.L(C));

PARAMETER IMPM2 "M2 Meat Imports";
      IMPM2(C) = M2IM.L(C);

PARAMETER TIMPM2 "Total M2 Meat Imports";
      TIMPM2 = SUM(C, M2IM.L(C));

PARAMETER RTMIMP "Total Meat Imports by Region";
      RTMIMP(C) = M1IM.L(C)+ M2IM.L(C);

PARAMETER TMIMP "Total Meat Imports";
      TMIMP = SUM(C, M2IM.L(C))+ SUM(C, M1IM.L(C));

DISPLAY IMPM1, TIMPM1, IMPM2, TIMPM2, RTMIMP, TMIMP;


***LIVE EXPORTS******************************************************
```

```
PARAMETER EXNST "Norte Steer Calf Export";
      EXNST(P,VN) = EXBM.L(P,VN);

PARAMETER TEXNST "Total Norte Steer Calf Export";
      TEXNST = SUM((P,VN), EXBM.L(P,VN));

PARAMETER EXNHC "Norte Heifer Calf Export";
      EXNHC(P,VN) = EXBH.L(P,VN);

PARAMETER EXNFS "Norte Feeder Steer Exports";
      EXNFS(P,VN) = EXMN.L(P,VN);

PARAMETER TEXNFS "Total Norte Feeder Steer Exports";
      TEXNFS = SUM((P,VN), EXMN.L(P,VN))

PARAMETER EXNFH "Norte Feeder Heifer Exports";
      EXNFH(P,VN) = EXHN.L(P,VN);

PARAMETER EXNLIVE "Norte Live Exports: Steer Calves, Heifer Calves, Feeder
Steers, Feeder Heifers";
      EXNLIVE(P,VN) = EXBM.L(P,VN) + EXBH.L(P,VN)+
EXMN.L(P,VN)+EXHN.L(P,VN);

PARAMETER REGNLIVEX "Norte Live Exports by Region";
      REGNLIVEX(P) = SUM(VN, EXBM.L(P,VN) + EXBH.L(P,VN)+
         EXMN.L(P,VN) + EXHN.L(P,VN));

PARAMETER TOTNLIVEX "Total Norte Live Exports";
      TOTNLIVEX = SUM([P,VN],EXBM.L(P,VN) + EXBH.L(P,VN)+
         EXMN.L(P,VN) + EXHN.L(P,VN));

PARAMETER EXSST "Semi-Intensive Steer Calf Exports";
      EXSST(P,VM) = EXSM.L(P,VM);

PARAMETER TEXSST "Total Semi-Intensive Steer Calf Exports";
      TEXSST = SUM((P,VM), EXSM.L(P,VM));

PARAMETER EXSHC "Semi-Intensive Heifer Calf Exports";
      EXSHC(P,VM) = EXSH.L(P,VM);

PARAMETER REGSLIVEX "Semi-Intensive Live Exports by Region";
      REGSLIVEX(P) = SUM((VM), EXSM.L(P,VM) + EXSH.L(P,VM));

PARAMETER EXSLIVE "Semi-Intensive Live Exports: Steer Calves and Heifer
Calves";
      EXSLIVE(P,VM) = EXSM.L(P,VM) + EXSH.L(P,VM);
```

```
PARAMETER TOTSLIVEX "Total Semi-Intensive Live Exports";
      TOTSLIVEX = SUM([P,VM], EXSM.L(P,VM) + EXSH.L(P,VM));

PARAMETER RODEO "Export Rodeo Steers";
      RODEO(RP,RV) = EXROD.L(RP,RV);

PARAMETER TOTRODEO "Total Rodeo Steers Exported";
      TOTRODEO = SUM([RP,RV], EXROD.L(RP,RV));

PARAMETER TOTPLIVEX "Total Norte and Semi-Intensive Live Exports By Region";
      TOTPLIVEX(P) = SUM([VN],EXBM.L(P,VN) + EXBH.L(P,VN)+
         EXMN.L(P,VN)+EXHN.L(P,VN)) + SUM([VM], EXSM.L(P,VM) +
         EXSH.L(P,VM));

PARAMETER TOTNSLIVEX "Total Norte and Semi-Intensive Live Exports";
      TOTNSLIVEX = SUM([P,VN],EXBM.L(P,VN) + EXBH.L(P,VN)+
         EXMN.L(P,VN)+EXHN.L(P,VN)) + SUM([P,VM], EXSM.L(P,VM) +
         EXSH.L(P,VM));

PARAMETER TOTLIVEX "Total Live Exports";
      TOTLIVEX = SUM([P,VN],EXBM.L(P,VN) + EXBH.L(P,VN)+
         EXMN.L(P,VN)+EXHN.L(P,VN)) + SUM([P,VM], EXSM.L(P,VM) +
         EXSH.L(P,VM)) + SUM([RP,RV], EXROD.L(RP,RV));

DISPLAY EXNST, TEXNST, EXNHC, EXNFS, TEXNFS, EXNFH, EXNLIVE,
         REGNLIVEX, TOTNLIVEX, EXSST, TEXSST, EXSHC, REGSLIVEX,
         EXSLIVE, TOTSLIVEX, RODEO, TOTRODEO, TOTPLIVEX, TOTNSLIVEX,
         TOTLIVEX;

***MEAT EXPORTS****************************************************

PARAMETER CULLEXP "Cull Meat Exports";
      CULLEXP(P) = M4EXP.L(P);

PARAMETER TCULLEXP "Total Cull Meat Exports";
      tcullexp = sum(p, m4exp.l(p));

display cullexp, tcullexp;

***VALUES***************

PARAMETER COSTKG "Cost per Kg of Meat";
      COSTKG = COST.L / (SUM([C,M], (CONSUM.L(C,M) + CONSUM2.L(C,M) +
         CONSUM3.L(C,M) + CONSUM4.L(C,M) + CONSUM5.L(C,M) +
         CONSUM6.L(C,M) + CONSUM7.L(C,M) + CONSUM8.L(C,M) +
```

```
        CONSUM9.L(C,M) + CONSUM10.L(C,M) + CONSUM11.L(C,M) +
        CONSUM12.L(C,M) + CONSUM13.L(C,M) + CONSUM14.L(C,M) +
        CONSUM15.L(C,M) + CONSUM16.L(C,M))));

PARAMETER TOTDOMCST "Total Domestic Cost";
      TOTDOMCST = (COST.L - H.L) / (SUM([C,M], (CONSUM.L(C,M) +
        CONSUM2.L(C,M) + CONSUM3.L(C,M) + CONSUM4.L(C,M) +
        CONSUM5.L(C,M) + CONSUM6.L(C,M) + CONSUM7.L(C,M) +
        CONSUM8.L(C,M) + CONSUM9.L(C,M) + CONSUM10.L(C,M) +
        CONSUM11.L(C,M) + CONSUM12.L(C,M) + CONSUM13.L(C,M) +
        CONSUM14.L(C,M) + CONSUM15.L(C,M) + CONSUM16.L(C,M))));

PARAMETER EXPVAL "Value of Exports";
      EXPVAL = -H.L;

PARAMETER OBJFUNC "Objective Function Value";
      OBJFUNC = COST.L;

PARAMETER C5CONIND "C5 consumption index";
      C5CONIND = CONQNDX("C5CE");

DISPLAY COSTKG, TOTDOMCST, EXPVAL, OBJFUNC, C5CONIND;
```

Appendix II

```
*****SECTION: PRODUCTION*******************************************

parameter wtm(v) "macho weaning weight, kg"
        /V1NORT = 180, V2SEMI = 160, V3TRAD = 140, V4CRIO = 120/;

scalar wtfact "heifer weight factor" /0.9/;

parameter wth(v) "hembra weaning weight, kg";
       wth(v) = wtm(v) * wtfact;

parameter wtav(v) "average calf weaning weight, kg";
       wtav(v) = (wtm(v) + wth(v))/2;

parameter cfrat(v) "calving rate, percent"
       /V1NORT = 74, V2SEMI = 64, V3TRAD = 56, V4CRIO = 45/;

parameter cfdl(v) "calf death loss, percent"
       /V1NORT = 4, V2SEMI = 5, V3TRAD = 8, V4CRIO = 10/;

parameter wean(v) "weaning percent";
       wean(v) = cfrat(v) - cfdl(v);

parameter aufact(v) "ranch AU factor/cow"
       /V1NORT = 1.25, V2SEMI = 1.18, V3TRAD = 1.12, V4CRIO = 1.05/;
$ontext
The ranch AU factor represents the AU's required per cow.  This value represents the
relative biological size of the different cow types plus an allowance for replacement
heifers and bulls that are required per cow.  These ranch AU factors are not calculated
internally in the model, thus signficant changes in assumptions about cow size, bull to
cow ratio, or culling percent should be accompanied by a revision in the ranch AU
factors.

Background assumptions for the four cow types are provided in the following table:

                 COW    MATURE
                  AU      WT
V1NORT          1.0      450
V2SEMI          0.96     435
```

```
V3TRAD        0.91         415
V4CRIO        0.85         400
$offtext

parameter vmat(v) "cow mature weight, kg"
       /V1NORT = 450, V2SEMI = 435, V3TRAD = 415, V4CRIO = 400/;

parameter vculwt(v) "cow cull weight, kg";
            vculwt(v) = vmat(v) * 0.9;

scalar dres "cull cow dressing percent" /56/;

parameter vcarc(v) "cull cow carcass weight, kg";
             vcarc(v) = vculwt(v) * (dres/100);

parameter vcul(v) "cow culling percent"
       /V1NORT = 10.0, V2SEMI = 10.0, V3TRAD = 8.0, V4CRIO = 7.0/;

parameter vdl(v) "cow death loss"
       /V1NORT = 2.0, V2SEMI = 2.0, V3TRAD = 4.0, V4CRIO = 5.0/;

parameter vrep(v) "net culling or replacement rate";
       vrep(v) =  (vcul(v) + vdl(v))/100

parameter m4vq(v) "per cow cull cow meat, kg";
       m4vq(v) = vcarc(v) * (vcul(v)/100);

scalar trat "cow:bull ratio" /20/;

scalar tcul "bull culling percent" /20.0/;

parameter twt(v) "bull weight";
       twt(v) =  vmat(v) * 1.25;

parameter m4tq(v) "per cow cull bull meat, kg";
       m4tq(v) = ((twt(v) * (dres/100))*(tcul/100))/trat;

parameter m4q(v) "per cow cull meat (M4DES), kg";
       m4q(v) = m4vq(v) + m4tq(v);

parameter vqm(v) "net quantity of machos per cow, kg";
       vqm(v) = (wtm(v) * 0.5) * (wean(v)/100);

parameter vqh(v) "net quantity of hembras per cow, net of replacements,kg";
       vqh(v) = (wth(v) * 0.5) * (wean(v)/100)- (wth(v)*vrep(v));
```

```
parameter vqb(v) "net quantity of calf per cow, net of replacements, kg";
       vqb(v) = vqm(v) + vqh(v);

****SECTION: REPASTO**************************************************

parameter rgain(v) "total weight gain in repasto, kg"
       /V1NORT = 100, V2SEMI = 100, V3TRAD = 120, V4CRIO = 120/;

parameter wtrnd(v) " repasto ending weight, kg";
       wtrnd(v) = wtav(v) + rgain(v);

****SUBSECTION: REPASTO INTENSIVO********

parameter r1adg(v) "intensive repasto adg, kg/day"
       /V1NORT = 1.1, V2SEMI = 1.0, V3TRAD = 0.85, V4CRIO = 0.8/;

parameter r1days(v) "intensive repasto days";
       r1days(v) = rgain(v)/r1adg(v);

parameter r1auf(v) "base au factor for intensive repasto"
       /V1NORT = 0.60, V2SEMI = 0.55, V3TRAD = 0.55, V4CRIO = 0.50/;

parameter r1au(v) "intensive repasto AU requirement per head";
       r1au(v) = r1auf(v)*(r1days(v)/365.0);

parameter r1dl(v) "intensive repasto death loss, percent"
       /V1NORT = 2.0, V2SEMI = 2.0, V3TRAD = 2.0, V4CRIO = 2.0/;

parameter r1ndwt(v) "adjusted intensive repasto end weight";
       r1ndwt(v) =  wtrnd(v) * (1 - (r1dl(v)/100));

****SUBSECTION:  REPASTO EXTENSIVO*********

parameter r2adg(v) "extensive repasto adg, kg/day"
       /V1NORT = 0.31, V2SEMI = 0.30, V3TRAD = 0.29, V4CRIO = 0.285/;

parameter r2days(v) "extensive repasto days";
       r2days(v) = rgain(v)/r2adg(v);

parameter r2auf(v) "base au factor for extensive repasto"
       /V1NORT = 0.70, V2SEMI = 0.65, V3TRAD = 0.65, V4CRIO = 0.60/;

parameter r2au(v) "extensive repasto AU requirement per head";
       r2au(v) = r2auf(v)*(r2days(v)/365.0);

parameter r2dl(v) "extensive repasto death loss, percent"
```

```
        /V1NORT = 4.0, V2SEMI = 4.0, V3TRAD = 4.0, V4CRIO = 4.0/;

parameter r2ndwt(v) "adjusted extensive repasto end weight";
        r2ndwt(v) =  wtrnd(v) * (1 - (r2dl(v)/100));

****SECTION: FINALIZACION EN CORRALES*****************************

*****SUBSECTION: PRODUCCION DE CARNE ENGORDA (M2)******

parameter e2days(v) "days on feed for production of M2 meat"
        /V1NORT = 111, V2SEMI = 120, V3TRAD = 113, V4CRIO = 113/;

parameter e2adg(v) "adg for M2 production, kg/day"
        /V1NORT = 1.43, V2SEMI = 1.35, V3TRAD = 1.3, V4CRIO = 1.2/;

parameter e2dl(v) "feedlot death loss, percent"
        /V1NORT = 0.5, V2SEMI = 0.5, V3TRAD = 0.5, V4CRIO = 0.5/;

parameter e2finwt(v) "feedlot ending weight per head, kg";
        e2finwt(v) = wtrnd(v) + (e2days(v) * e2adg(v));

parameter e2dr(v) "dressing percent for M2 production"
        /V1NORT = 61.0, V2SEMI = 60.0, V3TRAD = 59.0, V4CRIO = 58.0/;

parameter e2raw(v) "carcass weight for M2 production, kg";
        e2raw(v) = e2finwt(v) * (e2dr(v)/100);

parameter e2carc(v) "adjusted carcass weight for M2 production, kg";
        e2carc(v) = e2raw(v) * (1 - (e2dl(v)/100));

****SUBSECTION: PRODUCCION DE CARNE NORTE (M1)************

set vn(v) "norte animals" /V1NORT/;

parameter e1days(vn) "days on feed for carne norte production (M1), kg/day" /V1NORT
            = 132/;

parameter e1finwt(vn) "feedlot ending weight for carne norte, kg";
        e1finwt(vn) = wtrnd(vn) + (e2adg(vn) * e1days(vn));

parameter e1dr(vn) "dressing percent for M1 production" /V1NORT = 63.0/;

parameter e1raw(vn) "carcass weight for M1 production, kg";
        e1raw(vn) = e1finwt(vn) * (e1dr(vn)/100);

parameter e1carc(vn) "adjusted carcass weight for M1 production, kg";
```

```
        e1carc(vn) = e1raw(vn) * (1 - (e2dl(vn)/100));

****SUBSECTION: PRODUCCION DE CARNE TRADICIONAL (M3)*******

set vm(v) "semi-intensive animals" /v2semi/;

parameter e3days(v) "days on feed for production of M3 meat"
        /V1NORT = 516, V2SEMI = 512, V3TRAD = 428, V4CRIO = 464/;

parameter e3adg(v) "adg for M3 production, kg/day"
        /V1NORT = 0.27, V2SEMI = 0.26, V3TRAD = 0.255, V4CRIO = 0.25/;

parameter e3dl(v) "potrero death loss, percent"
        /V1NORT = 4.0, V2SEMI = 4.0, V3TRAD = 4.0, V4CRIO = 4.0/;

parameter e3finwt(v) "potrero ending weight per head, kg";
        e3finwt(v) = wtrnd(v) + (e3days(v) * e3adg(v));

parameter e3dr(v) "dressing percent for M3 production"
        /V1NORT = 58.5, V2SEMI = 57.5, V3TRAD = 56.5, V4CRIO = 56.0/;

parameter e3raw(v) "carcass weight for M3 production, kg";
        e3raw(v) = e3finwt(v) * (e3dr(v)/100);

parameter e3carc(v) "adjusted carcass weight for M3 production, kg";
        e3carc(v) = e3raw(v) * (1 - (e3dl(v)/100));

parameter e3auf(v) "base au factor for potero"
        /V1NORT = 0.8, V2SEMI = 0.75, V3TRAD = 0.75, V4CRIO = 0.75/;

parameter e3au(v) "potrero AU requirement per head";
        e3au(v) = e3auf(v)*(e3days(v)/365.0);

****SUSBSECTION:  FINALIZACION EN POTRERO CON SUPLEMENTACION*

parameter e2sdays(v) "days on feed for semi-intensive production of M2 meat"
        /V1NORT = 100, V2SEMI = 105, V3TRAD = 113, V4CRIO = 120/;

parameter e2sadg(v) "adg for semi-intensive M2 production, kg/day"
        /V1NORT = 0.90, V2SEMI = 0.85, V3TRAD = 0.80, V4CRIO = 0.75/;

parameter e2sdl(v) "semi-intensive potrero death loss, percent"
        /V1NORT = 3.0, V2SEMI = 3.0, V3TRAD = 3.0, V4CRIO = 3.0/;

parameter e2sfinwt(v) "semi-intensive potrero ending weight per head, kg";
        e2sfinwt(v) = wtrnd(v) + (e2sdays(v) * e2sadg(v));
```

```
parameter e2sdr(v) "dressing percent for semi-intensive M2 production"
        /V1NORT = 59.0, V2SEMI = 58.5, V3TRAD = 58.0, V4CRIO = 57.5/;

parameter e2sraw(v) "carcass weight for semi-intensive M2 production, kg";
        e2sraw(v) = e2sfinwt(v) * (e2sdr(v)/100);

parameter e2scarc(v) "adjusted carcass weight for semi-intensive M2 production, kg";
        e2scarc(v) = e2sraw(v) * (1 - (e2sdl(v)/100));

parameter e2sauf(v) "base au factor for semi-intensive potero"
        /V1NORT = 0.75, V2SEMI = 0.7, V3TRAD = 0.7, V4CRIO = 0.7/;

parameter e2sau(v) "semi-intensive potrero AU requirement per head";
        e2sau(v) = e2sauf(v)*(e2sdays(v)/365.0);
```

Appendix III

```
****SECTION: TRANSPORTATION****************************************
$ontext
This section contains the tranportation matrices (distances in kilometers) for all
transportation activities.  This section also include transportation costs (pesos/km) for live
animal loads and meat and load sizes for live animals and meat (kgs).
$offtext

scalar piecost "cost of hauling live animals, pesos/loaded km" /15.0/;
scalar meatcost "cost of hauling meat, pesos/loaded km" /16.0/;
scalar pieload "live animal load size, kilgrams" /20000/;
scalar meatload "meat load size, kilograms" /20000/;

alias (p,pp)

table distpp(p,pp) "shipping distance between production regions, km"
        P1NO   P2NE   P3ME   P4CO   P5PA
P1NO     100    783    882   1177   1200
P2NE     783    100    469    786   1096
P3ME     882    469    100    320    839
P4CO    1177    786    320    100    715
P5PA    1200   1096    839    715    100
P6SS    1922   1359   1075   1000   1715
P7VE    1896   1023   1007    964   1679
P8SU    2241   1504   1373   1319   2034
P9YU    2800   2063   1937   1878   2599

+       P6SS   P7VE   P8SU   P9YU
P1NO    1922   1896   2241   2800
P2NE    1359   1023   1504   2063
P3ME    1075   1007   1373   1937
P4CO    1000    964   1319   1878
P5PA    1715   1679   2034   2599
P6SS     100    382    620   1179
P7VE     382    100    481   1040
P8SU     620    481    100    559
P9YU    1179   1040    559    100;

parameter piepun(p,pp) "per kg cost of shipping animals between prod regions";
```

```
piepun(p,pp) = (distpp(p,pp)*piecost)/pieload;

table distpf(p,f) "shipping distance from production regions to feedlots, km"
        F01NW   F02LA   F03NE   F04PA   F05CO
P1NO    1385    467     783     1200    1177
P2NE    2168    316     100     1096    786
P3ME    2278    407     469     839     320
P4CO    2098    714     786     715     100
P5PA    1391    780     1096    100     715
P6SS    3098    1450    1359    1715    1000
P7VE    3062    1414    1023    1679    964
P8SU    3417    1769    1504    2034    1319
P9YU    3976    2328    2063    2599    1878

+       F06HA   F07ME   F08VE   F09TB   F10YU
P1NO    1313    1045    1896    2241    2800
P2NE    530     517     1023    1504    2063
P3ME    591     190     1007    1373    1937
P4CO    742     336     964     1319    1878
P5PA    1438    1032    1679    2034    2599
P6SS    829     877     382     620     1179
P7VE    493     841     100     481     1040
P8SU    974     1196    481     100     559
P9YU    1533    1755    1040    559     100;

parameter   piefun(p,f) "per kg cost of shipping animals from prod to feedlot";

piefun(p,f) = (distpf(p,f) * piecost)/pieload;

table distpc(p,c) "shipping distance for meat from prod regions to consumption, km"
        C1NW    C2NC    C3NE    C4TP    C5CE    C6GO    C7YU
P1NO    690     100     783     1177    1468    1896    2800
P2NE    1473    783     100     786     925     1023    2063
P3ME    1576    882     469     320     605     1007    1937
P4CO    1403    1177    786     100     546     964     1878
P5PA    696     1200    1096    715     1261    1679    2599
P6SS    2403    1922    1359    1000    454     382     1179
P7VE    2367    1896    1023    964     418     100     1040
P8SU    2722    2241    1504    1319    773     481     559
P9YU    3281    2800    2063    1878    1332    1040    100;

parameter m34un(p,c) "per kg cost (carcass) of shipping meat from prod to
consumption";

m34un(p,c) = (distpc(p,c) * meatcost)/meatload;
```

```
table distfc(f,c) "shipping distance for meat from feedlot to consumption, km"
              C1NW    C2NC    C3NE    C4TP    C5CE    C6GO    C7YU
F01NW          170     1385    2168    2098    2644    3062    3976
F02LA         1157    467     316     714     996     1414    2328
F03NE         1473    783     100     786     925     1023    2063
F04PA         696     1200    1096    715     1261    1679    2599
F05CO         1403    1177    786     100     546     964     1878
F06HA         2003    1313    530     742     488     493     1533
F07ME         1720    1045    517     336     423     841     1755
F08VE         2367    1896    1023    964     418     100     1040
F09TB         2722    2241    1504    1319    773     481     559
F10YU         3281    2800    2063    1878    1332    1040    100;

parameter m12un(f,c) "per kg cost of shipping meat from feedlots to consumption";

       m12un(f,c) = (distfc(f,c) * meatcost)/meatload;

parameter xdistpie(p) "distance to export cattle to U.S., km"
       /P1NO = 373,P2NE = 224,P3ME = 741,P4CO = 1010,
       P5PA = 1320,P6SS = 1583,P7VE = 1247,P8SU = 1726,P9YU = 2287/;

parameter xcostpie(p) "per kg cost of exporting cattle to U.S.";

       xcostpie(p) = (xdistpie(p) * piecost)/pieload;

****NOTE: xcostpie is also the per unit cost of importing slaughter cows from the
U.S.**
****NOTE: xdistpie is also the distance used for cull beef exports to the U.S. as
below:**

parameter xcostm4(p) "per kg cost of exporting cull beef to the U.S.";

       xcostm4(p) = (xdistpie(p) * meatcost)/meatload;

parameter mdistmeat(c) "distance to import meat from U.S., km"
       /C1NW = 769,C2NC = 373,C3NE = 224,
       C4TP = 1010,C5CE = 1149,C6GO = 1247,C7YU = 2287/;

parameter mcostmeat(c) "per kg cost of importing meat from U.S.";

       mcostmeat(c) = (mdistmeat(c) * meatcost)/meatload;
```

Appendix IV

```
****SECTION: PRODUCTION AND SLAUGHTER COST PARAMETERS*********

scalar vcost "base annual variable cost per cow, pesos" /2000/;

table vcostin(p,v) "production cost index by region and cow type"
          V1NORT  V2SEMI  V3TRAD  V4CRIO
P1NO       1.00    0.71    0.35    .15
P2NE       1.00    0.69    0.35    .15
P3ME       1.00    0.68    0.35    .15
P4CO       1.02    0.67    0.28    .15
P5PA       1.10    0.64    0.28    .15
P6SS       1.10    0.64    0.28    .15
P7VE       1.10    0.64    0.28    .15
P8SU       1.10    0.64    0.28    .15
P9YU       1.10    0.64    0.28  .  15;

parameter vcst(p,v) "adjusted annual variable cost per cow, pesos per head";
     vcst(p,v) = vcostin(p,v)*vcost;

scalar r1cst "intensive repasto cost base, pesos per head" /150/;

parameter r1cstp(p) "intensive repasto cost per region, pesos per head";
     r1cstp(p) =  r1cst * vcostin(p,'V1NORT');

****intensive repasto uses the V1NORT cost index for each region**********

scalar r2cst "extensive repasto cost base, pesos per head" /50/;

parameter r2cstp(p,v) "extensive repasto cost per region, pesos per head";
     r2cstp(p,v) = r2cst * vcostin(p,v);

****extensive repasto uses the cow cost index for each region and cow type*****

scalar e3cst "potrero cost base, pesos per head" /150/;

parameter e3cstp(p,v) "potrero cost per region, pesos per head";
     e3cstp(p,v) = e3cst * vcostin(p,v);
```

```
****potrero uses cow cost index for each region and cow type*********

****SECTION: SLAUGHTER COSTS**************************************

scalar s1cst "TIF slaughter cost, pesos/kg" /1.3/;

scalar s2cst "local slaughter cost, pesos/kg" /0.7/;

****SECTION: FEEDLOT COSTS****************************************

scalar rat "base ration cost, pesos/kg" /1.25/;

scalar conv "base feedlot conversion" /7.45/;

scalar dia "feedlot daily cost base, pesos/day" /2.0/;

scalar med "base feedlot receiving cost, pesos/head" /80/;

parameter ratin(f) "regional feedlot ration cost index"
/F01NW = 1.0,F02LA = 1.0,F03NE = 0.98,F04PA = 1.02,F05CO = 1.02 F06HA =
        1.0,F07ME = 1.01, F08VE = 0.90,F09TB = 1.05,F10YU = 1.05/;

parameter convin(f) "regional feedlot conversion index"
/F01NW = .93,F02LA = 0.93,F03NE = 0.93,F04PA = 0.94,F05CO = 1.0 F06HA =
        1.04,F07ME = 1.00, F08VE = 1.0,F09TB = 1.1,F10YU = 1.1/;

parameter fdcste1(f,vn) "per head cost of feeding for Norte";
      fdcste1(f,vn) = rat*ratin(f)*conv*convin(f)*(e1finwt(vn)-wtrnd(vn)) +
        dia*e1days(vn)+ med;

parameter fdcste2(f,v) "per head cost of feeding for E2";
      fdcste2(f,v) = rat*ratin(f)*conv*convin(f)*(e2finwt(v)-wtrnd(v)) + dia*e2days(v) +
        med;

parameter fcap(f) "feedlot 1X capacity, head"
      /F01NW = 175000,
       F02LA = 60000,
       F03NE = 125000,
       F04PA = 130000,
       F05CO = 120000,
       F06HA = 35000,
       F07ME = 5500,
       F08VE = 10000,
       F09TB = 10000,
       F10YU = 5000/;
```

```
parameter fturn(f) "feedlot turnover rate"
 /F01NW = 2.5,F02LA = 2.5,F03NE = 2.5,F04PA = 2.5, F05CO = 2.5, F06HA =
     2.5,F07ME = 2.5, F08VE = 2.5, F09TB = 2.5,F10YU = 2.5/;

parameter fprod(f) "feedlot annual production capacity, head";
   fprod(f) = fcap(f) * fturn(f);

parameter e2slim(p) "semi-intensive potrero production limit, head"
   /P1NO = 100, P2NE = 100, P3ME = 100, P4CO = 100, P5PA = 100, P6SS =
     100,P7VE = 5000, P8SU = 15000, P9YU = 100/;

parameter e2scst(p) "semi-intensive potrero cost index"
   /P1NO = 1.5,P2NE = 1.5, P3ME = 1.5,P4CO = 1.5, P5PA = 1.5, P6SS = 1.5,P7VE
     = 1.5, P8SU = 1.5, P9YU = 1.5/;

parameter e2sconv(p) "semi-intensive potrero conversion index"
   /P1NO = 0.55, P2NE = 0.55, P3ME = 0.55, P4CO = 0.55, P5PA = 0.55, P6SS =
     0.55, P7VE = 0.55, P8SU = 0.55, P9YU = 0.55/;

parameter e2scost(p,v) "cost of semi-intensive potrero, pesos/head";
   e2scost(p,v) = (rat*e2scst(p)*0.0125*(wtrnd(v) +
     (0.5*e2sdays(v)*e2sadg(v))))*e2sdays(v) + (dia*e2sdays(v))+ med;
```

Appendix V

```
****SECTION: TRADE*****************************************************
$ontext
This section contains values for cattle and meat imports and exports.
$offtext

scalar camb "exchange rate, pesos/dollar" /10.9/;

****Steer and Heifer Calf Export Values*****************************************

scalar uspm "U.S. steer calf price, border, dlls/cwt, 300 pound basis" /159.00/;

scalar bslid "calf price slide, dlls/cwt" /14.0/;

parameter uspmadj(vn) "U.S. steer calf price, weight adjusted, border, dlls/cwt";
        uspmadj(vn) = uspm - (((wtm(vn)*2.2046) - 300)/100) * bslid;

parameter uspmsadj(vm) "U.S. s-i steer calf price, weight adjusted, border, dlls/cwt";
        uspmsadj(vm) = (.86*uspm) - (((wtm(vm)*2.2046) - 300)/100) * bslid;

scalar excstm "per head export cost for steers, dlls" /35/;

parameter expm(vn) "value of steer calf exports, pesos/head";
        expm(vn) = ((uspmadj(vn) * (wtm(vn)*2.2046)/100) - excstm)*camb;

parameter expsm(vm) "value of semi-intensive steer calf exports, pesos/head";
        expsm(vm) = ((uspmsadj(vm) * (wtm(vm)*2.2046)/100) - (excstm))*camb;

scalar pricdif "heifer to steer price difference, U.S. basis" /0.84/;

scalar usph "U.S. heifer calf price, border, dlls/cwt, 300 pound basis";
        usph = uspm * pricdif;

parameter  usphadj(vn) "U.S. heifer calf price, weight adjusted, border, dlls/cwt";
        usphadj(vn) = usph - (((wth(vn)*2.2046) - 300)/100) * bslid;

parameter  uspshadj(vm) "U.S. s-i heifer calf price, weight adjusted, border, dlls/cwt";
        uspshadj(vm) = (.86*usph) - (((wth(vm)*2.2046) - 300)/100) * bslid;
```

```
scalar excsth "per head export cost for heifers, dlls";
       excsth = excstm + 8.0;

parameter exph(vn) "value of heifer calf exports, pesos/head";
       exph(vn) = ((usphadj(vn) * (wth(vn)*2.2046)/100) - excsth)*camb;

parameter expsh(vm) "value of s-i heifer calf exports, pesos/head";
       expsh(vm) = ((uspshadj(vm) * (wth(vm)*2.2046)/100) - (excsth))*camb;

****Feeder Steer and Heifer Export Values******************

scalar bndif "calf to feeder price differential" /0.755/;

scalar uspmn "U.S. feeder steer price, border, dlls/cwt, 500 pound basis";
       uspmn = uspm * bndif

scalar nslid "feeder price slide, dlls/cwt" /10.5/;

parameter  uspmnad(vn) "U.S. feeder steer price, weight adjusted, border, dlls/cwt";
       uspmnad(vn) = uspmn-(((wtrnd(vn)*(2/(1 + wtfact))*2.2046) - 500)/100) * nslid;

parameter expmn(vn) "value of feeder steer exports, pesos/head";
       expmn(vn) =(((uspmnad(vn)*(wtrnd(vn)*2/(1+wtfact))*2.2046)/100) -
          excstm)*camb;

scalar usphn "U.S. feeder heifer price, border, dlls/cwt, 500 pound basis";
       usphn = uspmn * pricdif;

parameter  usphnad(vn) "U.S. feeder heifer price, weight adjusted, border, dlls/cwt";
       usphnad(vn) = usphn - (((wtrnd(vn)*((1 + wtfact)/2)*2.2046) - 500)/100) * nslid;

parameter exphn(vn) "value of heifer calf exports, pesos/head";
       exphn(vn) = (usphnad(vn) * ((wtrnd(vn)*((1 + wtfact)/2) *2.2046)/100) -
          excsth)*camb;

****Meat Import Values****************************

scalar impm1p   "import price of M1 meat, dlls/cwt" /138.00/;

$ontext
The M1 meat import price is roughly the price of Select or No-Roll type middle meats,
adjusted to a carcass basis. (The majority of this meat is imported in boneless form.)
Boneless meat is equal to a carcass quantity about 30 percent larger. This is the type of
product used for "cortes", e.g., for norte style steaks, etc.  The M2 import price is
specified as a proportion or differential from the M1 price.  The M2 price corresponds to
```

Select or No-Roll end meats, mostly chucks and rounds (also boneless). M2 meat is used in addition to or in place of Mexican Fed beef for traditional meat cuts.
$offtext

```
scalar m1m2dif "import M1 to M2 price differential" /0.86/;

scalar impm2p "import price of M2 meat, dlls/cwt";
       impm2p = impm1p * m1m2dif

scalar pm1imp "import price of M1 meat, pesos/kg";
       pm1imp = ((impm1p/100)* 2.2046)*camb;

scalar pm2imp "import price of m2 meat, pesos/kg";
       pm2imp = ((impm2p /100)*2.2046)*camb;

****Cull Cow and Meat Trade********************************

scalar vacawt "live weight of imported slaughter cows, pounds" /900/;

scalar vacap "price of imported slaughter cows, dlls/cwt" /54.00/;

scalar imcstv "per head cost of importing slaughter cows, dlls" /10.00/;

scalar imvacp "per head cost of imported slaughter cows, pesos";
       imvacp = (((vacawt/100) * vacap) - imcstv) * camb;

scalar impvcarc "carcass weight of imported slaughter cows, kg";
       impvcarc = (vacawt/2.2046) * (dres/100);

scalar exm4p "carcass price of exported cull cow beef, dlls/cwt";
       exm4p =  vacap / (dres /100);

scalar m4pex "export price of cull cow beef, pesos/kg";
       m4pex = (exm4p/100)*2.2046*camb;

scalar vacalim "maximum slaughter cow imports, head" /0/;

****Exported Rodeo Calves**********************************

scalar rodeop "price per head of exported rodeo calves, dlls" /625/;

scalar prodeo "net price per head of exported rodeo calves, pesos";
       prodeo = (rodeop - excstm) * camb ;

set rp(p) "rodeo calf region" /P1NO, P3ME/;
```

```
parameter rodlim(rp) "maximum quantity of rodeo cattle exports, head"
        /P1NO = 15000, P3ME = 0/;

set rv(v) "rodeo calf type" /V4CRIO/;

****Imported Central American Cattle**********************

scalar capb "price of imported Central American calves, pesos/kg" /13.5/;

scalar capn "price of imported Central American feeders, pesos/kg" /13.5/;

scalar cabwt "weight of imported Central American calves, kg";
        cabwt = wtav('V3TRAD');

scalar canwt "weight of imported Central American feeders, kg";
        canwt = wtrnd('V3TRAD');

set ip(p) "Central American calf imports" /P6SS, P8SU/;

set ir(f) "Central American feeder imports"
        /F01NW, F04PA, F06HA, F08VE/;

scalar cabmax "maximum Central American calf imports, head/year" /30000/;

scalar canmax "maximum Central American feeder imports, head/year" /20000/;
```

Appendix VI

```
***SECTION: FORAGES************************************************
set z "Forrajes" /pastizal, esquilmas, praderas/;

table zlim(p,z) "hectares of forage available in each production region"
            pastizal      esquilmas      praderas
P1NO    53105000      2571700          27730
P2NE       9170000      2085584          49662
P3ME     15380000       3174187          11781
P4CO     11086300      6844708          36518
P5PA       3300000      1745767          14248
P6SS        5124000      2058244          12347
P7VE        3600000       1664157            7640
P8SU        4117000       1836982                0
P9YU        4900000       1180867           3014;

table zyndx(p,z) "index of forage yield in each production region"
            pastizal      esquilmas      praderas
P1NO       1.0             1.0              1.0
P2NE        1.0             1.0              1.0
P3ME       1.0             1.0              1.0
P4CO       1.0             1.0              1.0
P5PA        1.0             1.0              1.0
P6SS        1.0             1.0              1.0
P7VE        1.0             1.0              1.0
P8SU        1.0             1.0              1.0
P9YU        1.0             1.0              1.0;

parameter agost(p) "coefficient of agostadero (stocking rate, ha/au)"
      /P1NO = 23.93,P2NE = 15.01,P3ME = 12.95,P4CO = 8.24, P5PA = 8.62,P6SS =
         4.88, P7VE = 1.81,P8SU = 1.85,P9YU = 3.94/;

scalar esq "esquilmas yield, au/ha" /0.09/;
scalar prad "praderas yield, au/ha" /3.0/;

***NOTE: coefficient of agostadero is in ha/au but esquilmas and praderas are in au/ha*

parameter  agostadj(p) "adjusted coefficient of agostadero, (stocking rate, ha/au)";
```

```
        agostadj(p) = agost(p)* zyndx(p,"pastizal");

parameter esqadj(p) "adjusted esquilmas yield for each production region, au/ha";

        esqadj(p) = esq * zyndx(p,"esquilmas");

parameter pradadj(p) "adjusted praderas yield for each production region, au/ha";

        pradadj(p) = prad * zyndx(p,"praderas");

table zcndx(p,z) "index of forage cost in each production region"
            pastizal     esquilmas     praderas
P1NO        1.0          1.0           1.0
P2NE        1.0          1.0           1.0
P3ME        1.0          1.0           1.0
P4CO        1.0          1.0           1.0
P5PA        1.0          1.0           1.0
P6SS        1.0          1.0           1.0
P7VE        1.0          1.0           1.0
P8SU        1.0          1.0           1.0
P9YU        1.0          1.0           1.0;

scalar pricpast "price of pastizal, pesos/au" /300.0/;
parameter pastpric(p) "price of pastizal, pesos/ha";

        pastpric(p) = pricpast/agostadj(p);

scalar pricesq  "price of esquilmas, pesos/ha" /10.0/;
scalar pricprad "price of pradera, pesos/ha" /11750.00/;

parameter  ppast(p) "adjusted price of pastizal, pesos/au)";

        ppast(p) = pastpric(p) * zcndx(p,"pastizal");

parameter pesq(p) "adjusted esquilmas price for each production region, pesos/ha";

        pesq(p) = pricesq * zcndx(p,"esquilmas");

parameter pprad(p) "adjusted praderas price for each production region, pesos/ha";

        pprad(p) = pricprad * zcndx(p,"praderas");
```

Appendix VII

```
*****SECTION:  DAIRY**************************************************
$ontext
This file includes parameters for the exogenous dairy industry contribution to beef
production.
$offtext

parameter dyshar(p) "share of dairy herd in each production region"
       /P1NO = 0.335,P2NE = 0.005, P3ME = 0.068,P4CO = 0.439, P5PA = 0.015,P6SS =
       0.04,P7VE = 0.058,P8SU = 0.023,P9YU = 0.016/;

scalar dyherd "total dairy herd inventory" /1950000/;
scalar dywean "dairy net weaning percent" /65/;
***dywean is net of calf death loss and veal (ternero) slaughter***************
scalar dycull "dairy culling rate" /20/;
scalar dycarc "cull dairy cow carcass weight, kg" /325/;
scalar dyval "dairy calf value, pesos/cab" /1875/;
scalar dycalf "dairy calf weight per head, kg" /125/;

parameter dym4(p) "kg of dairy cull meat in each production region";

       dym4(p) = (dyherd * (dycull/100)* dycarc) * dyshar(p);

parameter dyfdr(p) "dairy calves available (vb3) in each production region, head";

       dyfdr(p) = (dyherd * (dywean/100)) * dyshar(p);

 set dc(v) "dairy calves" /'V3TRAD'/;
```

Appendix VIII

```
****SECTION:  CONSUMPTION*******************************************
$ontext
This section contains population data and consumption parameters.  Population values are
given for the year 2000 but can be indexed up or down from current levels.  By changing
the relative index values it is possible to represent regional differences in population
growth.

Meat consumption in GANMEX is indexed to a specified national level of total per capita
beef consumption.  From the national level, per capita consumption in each region is
determined by specifying the regional quantity index and the regional quality profile.
$offtext

parameter pop(c) "population by consumption region, 1,000"
      /C1NW = 7659.421,
      C2NC = 5058.281,
      C3NE = 8304.670,
      C4TP = 14733.170,
      C5CE = 45676.009,
      C6GO = 12710.993,
      C7YU = 3219.167/;

parameter popndx(c) "regional population index"
      /C1NW = 1.03, C2NC = 1.03, C3NE = 1.03, C4TP = 1.03, C5CE = 1.03, C6GO =
      1.03, C7YU = 1.03/;

parameter popnet(c) "adjusted regional population";

      popnet(c) = pop(c)* popndx(c);

scalar poptot "total national population, 1,000";
      poptot = sum(c,popnet(c));

scalar con "national average beef consumption, kg per capita" /16.75/;

parameter conqndx(c) "regional consumption quantity index"
      /C1NW = 1.20,C2NC = 1.15,C3NE = 1.25,C4TP = 1.05,
      C5CE = 1.0,C6GO = 0.70,C7YU = 0.80/;
```

```
conqndx("C5CE") = (1.00-conqndx("C1NW")*(popnet("C1NW")/poptot)-
conqndx("C2NC")*(popnet("C2NC")/poptot)-
conqndx("C3NE")*(popnet("C3NE")/poptot)-
conqndx("C4TP")*(popnet("C4TP")/poptot)-
conqndx("C6GO")*(popnet("C6GO")/poptot)-
conqndx("C7YU")*(popnet("C7YU")/poptot))/(popnet("C5CE")/poptot);

set m "meat types" /M1NOR, M2FED, M3TRA, M4DES/;

**NOTE: EACH ROW IN THE FOLLOWING TABLE SHOULD TOTAL TO 100***

table concndx(c,m) "regional meat consumption by meat quality, percent"
          M1NOR   M2FED   M3TRA   M4DES
C1NW       18.0    50.0    13.0    19.0
C2NC       27.0    48.0    10.0    15.0
C3NE       25.0    53.0    10.0    12.0
C4TP        5.0    27.0    47.0    21.0
C5CE       10.0    28.0    41.0    21.0
C6GO        5.0    19.0    53.0    23.0
C7YU       10.0    18.0    50.0    22.0;

parameter conctot(c,m) "regional quantity of meat demanded by quality, kg";

     conctot(c,m) = popnet(c)* con * conqndx(c) * (concndx(c,m)/100) * 1000;

set im "fed meat" /M1NOR, M2FED/;
```

VITA

Megan Elaine Cunningham

Candidate for the Degree of

Master of Science

Thesis: ESTIMATED IMPACTS OF MEXICAN REGIONAL TRADE RESTRICTIONS ASSOCIATED WITH BOVINE HEALTH CAMPAIGNS

Major Field: Agricultural Economics

Biographical:

Personal Data: Born in Fredricksburg, Texas, on January 26, 1981, the daughter of Jack Cunningham and Elaine Wendel Burkhoder.

Education: Graduated from Plainview High School, Ardmore, Oklahoma in May 1999; received Bachelor of Science degree in Agricultural Economics from Oklahoma State University, Stillwater, Oklahoma in May 2004. Completed the requirements for the Master of Science degree with a major in Agricultural Economics at Oklahoma State University in August, 2006.

Experience: Raised on a stocker ranch near Ardmore, Ok. Studied abroad for a semester in Chihuahua, Mexico. Worked for Stillwater Milling Company, Bank First, and interned at Supreme Cattle Feeders. Employed by Oklahoma State University, Department of Agricultural Economics as a graduate research assistant and a teaching assistant. Worked as an assistant to Dr. Peel in the Agricultural Economics Department for the FIPSI program from 2004 to present helping coordinate study abroad trips and receiving and sending student studying abroad through FIPSI.