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The Real cost of beef: A monetary assessment of the environmental degradation caused by beef production

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**THE REAL COST OF BEEF: A MONETARY
ASSESSMENT OF THE ENVIRONMENTAL
DEGRADATION CAUSED BY BEEF PRODUCTION**

A Thesis submitted in partial satisfaction
of the requirement for the degree of

Bachelor of Arts

in

Environmental Studies

UNIVERSITY OF NEVADA

Las Vegas

by

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Summer, 1996

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Abstract

The environmental degradation caused by beef production is severe. The current literature assesses the ecological damage, but falls short of assigning a per pound dollar amount to reflect the real cost of beef. In the United States, most of the environmental focus has been centered around the use of public lands for grazing and the grazing fee the government considers appropriate. The fee covers the maintenance of the grazing program, which includes maintenance of the actual land. This paper will concentrate on beef-related environmental degradation and select specific damage for monetary valuation.

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INTRODUCTION

The United States is a beef-centered culture. We produce approximately one-quarter of the world's beef ("Agriculture", 1996). McDonald's and other fast-food restaurants, with their hamburger-oriented menus, are a ubiquitous presence throughout the world. The production of beef required to satiate America's (and the world's) appetite is causing environmental destruction on a global scale.

A conflict exists when establishing a price for beef and beef products. Currently, McDonald's charges \$1.89 for their "Quarter-Pounder" (Las Vegas), ground beef is \$0.99 per pound (Smith's Food & Drug supermarket, Las Vegas) and beef is a commodity selling at \$0.60 per pound (Wall Street Journal, 6/17/96). But, these prices grossly understate the environmental cost of beef, which in reality, is at least ten times greater. Environmental organizations such as the Sierra Club and EarthSave are trying to raise public awareness as to the real cost of beef. The Sierra Club focuses on conserving the public lands of the western United States, where (over)grazing has literally destroyed ecosystems (Wuerthner, 1990), rather than advocating change through a dietary conversion to vegetarianism. EarthSave's sole purpose is to shift the world's diet from the current 66% plant-based to 100% plant-based.

The controversy over the effects of beef production has been felt in other areas besides environmental organizations. Scholarly journals have published papers assessing the environmental impact of cattle (Ward, Knox & Hobson, 1977; Fleischner, 1994). The United States Congress has heard countless arguments between environmentalists and ranchers who debate the costs of grazing, and what a fair and accurate grazing fee should be (Congress, 1991).

In the United States there has been a slow shift away from the consumption of beef due to the negative health effects (Dosti, 1989; Kline 1996). The beef industry has countered with public relations campaigns (e.g. the current media ads: "Beef. It's what's for dinner."). Some of the campaigns have been targeted at children (Hendrix, 1992). Environmentalist organizations, such as EarthSave, hope that increased public awareness regarding the negative ecological effects of beef will continue the dietary shift away from beef.

Purpose of Study

Much has been written about the deleterious effects of cattle grazing, and the problems associated with the mere presence of the cattle population. However, the real dollar per pound cost of beef has not been calculated. The purpose of this paper is to place a monetary value on the environmental degradation caused by beef production.

Research Questions

To ascertain the real cost of beef, the following research questions must be answered:

1. What is the extent of the negative environmental effects caused by beef production?
2. What specific effects can both represent the type of research being conducted and can yield formulae for calculations?
3. What are the limitations to the calculations and will these limitations be mathematically offset?

Definitions

The following terms were used in this research:

Grazing fee	" ... fees ranchers pay to graze livestock on public lands." ("Senate looking", 1996)
Overgrazing	"Destruction of vegetation when too many grazing animals feed too long and exceed the carrying capacity of a rangeland area." (Miller, 1993)
Ruminant (livestock)	"An animal, such as a cow or a sheep, with an elaborate, multicompartmentalized stomach specialized for an herbivorous diet." (Campbell, 1993)

REVIEW OF LITERATURE

Introduction

Approximately 250 million acres of public land is administered by the Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) (Lancaster, 1991; Wuerthner, 1990; Royte, 1990). Much of the public land lies west of the Mississippi River. Among the 11 western states, 70% of the land is utilized for cattle grazing (Fleischner, 1994). Both currently and historically, this land has been mismanaged, due in part to economic interests and lack of knowledge about the environment. An ongoing debate rages between the beef industry and environmentalists as to the effects of grazing and the proper stewardship of the public lands.

But the negative effects of beef production go far beyond the confines of public lands and grazing. Whether it is water pollution or greenhouse gases, the presence of cattle impacts our environment. The ranchers claim that the effects are both minor and correctable. Environmentalists claim that the ranchers do not understand the complex nature of ecospheres and the domino effect which can result from overextending our resources.

Beef Industry Perspective

From ranchers to restaurants, beef is a major part of Americana (Royte, 1990). Ranchers maintain that cattle have been a cornerstone of the Western environment for several centuries (Lancaster, 1991).

In 1991, Congress reviewed data and heard opposing points of view regarding grazing and its environmental and economic impacts (Congress, 1991). In an effort to neutralize environmentalist claims, Congressional Member Joe Skeen of New Mexico dissected the Washington Post article "Public land, private profit" (Lancaster, 1991). He vehemently argued the following points: 1) New Mexico receives more rain than most of the other Western grazing states and is, therefore, not climatically adverse to grazing; 2) Ranchers continually make improvements to the land which have resulted in better conditions for wildlife; 3) Ranchers cannot ranch if the land is severely damaged; 4) Grazing has been a part of the West since the 1500s; 5) There is no proof that cattle are the sole reason for environmental degradation; there may be other factors such as natural geologic evolution and foraging by wildlife (e.g. rabbits); 6) Forage consumption is regulated by the government to prevent overgrazing and abuse; 7) Total restoration of the land to its pre-1800s condition requires a significant amount of rainfall; 8) The majority of public rangelands is in stable to improving condition;

9) Large herds of buffalo, elk, etc. have been able to successfully graze for several centuries; 10) It cannot be ascertained what the condition of the land was prior to the last century; and 11) Grazing impacts must consider the ranch as a whole, not just the effects of the animals.

There is a recurring, emphatic claim made by the ranchers: Under the ranchers' care, the rangeland has enjoyed many improvements (Arrandale, 1994; Lancaster, 1991). These improvements benefit not only the rancher, but wildlife as well (Arrandale, 1994). In some cases, though, ranchers state that it is perfectly normal for environmental changes to occur where there is grazing (Royte, 1990).

Environmental Perspective

Soil suffers severely as a result of (over)grazing livestock. A major concern is the erosion of topsoil which results from the removal of vegetation by foraging cattle (Fleischner, 1994). There is speculation that as much as 35 pounds of topsoil are lost to every pound of beef produced (Teisler-Rice, 1996). In addition, cattle hooves are responsible for the compaction of the soil which interferes with biological nutrient cycles (Fleischner, 1994).

The runoff of topsoil ends up in surface waters where the sediment accumulates and interrupts the stream flows (Fleischner, 1994). Fecal waste from cattle pollute the

streams, which, in turn, changes the habitat of the riparian areas (Fleischner, 1994; "Grazing management", 1996; Royte, 1990). As cattle come to the streams, the stream banks are trampled, accounting for even more watershed destruction (Lancaster, 1991). Many of these riparian ecosystems have been seriously altered. Vegetative communities, in some cases have been substantially decreased, only becoming reestablished when cattle have been removed from the area ("Grazing management", 1996).

Beef production requires large quantities of water, and water supplies in the arid West and Southwest are significantly lower than regions in the Eastern U.S. (Wuerthner, 1990). The Sierra Club asserts that almost 90% of the water removed from the vital Colorado River basin is used in conjunction with livestock production, much of it for irrigation of feed-crops (Wuerthner, 1990).

The ecosystems of grazing lands are dramatically changed as grazing continues. Fleischner (1994) categorized the changes as follows: 1) alteration of species composition of communities, including decreases in density and biomass of individual species, reduction of species richness, and changing community organization; 2) disruption of ecosystem functioning, including interference in nutrient cycling and ecological succession; and 3) alteration of ecosystem structure, including changing

vegetation stratification, contributing to soil erosion, and decreasing availability of water to biotic communities. Consequently, the U.S. Forest Service has begun to require Environmental Assessments (including public participation) be completed before grazing permits are renewed, in order to minimize the effects of overgrazing ("Grazing effects", 1995).

The degradation caused by (over)grazing is not limited to the immediate environment of soil and water. Methane is a principal greenhouse gas, with cattle as a significant methane source (Miller, 1993; Hanley & Spash, 1993). The Environmental Protection Agency (EPA) has initiated a volunteer "Ruminant Livestock Methane Program" designed to reduce the quantity of cattle-emitted methane ("Ruminant livestock", 1996). According to the EPA, "The Ruminant Livestock Methane Program is a key component of President Clinton's Climate Change Action Plan, which promotes efficiency and American resourcefulness to avert the threat of global warming" from methane.

Beef production requires more energy than any other protein source (Ward, Knox & Hobson, 1977). Fuel is necessary to operate cattle ranches and to transport both cattle and feed, with feed production consuming the most energy (Ward et al, 1977).

Feed production uses acreage. The land needed to produce food for livestock is in direct competition with

land needed to produce food for the global population (Ward et al, 1977). The grain held in reserve to feed the world's people has been critically low (Brisbane, 1989). From 1992 to 1995, these grain stocks steadily decreased ("Agriculture", 1996). Yet, last year, "37% of the world's grain crop was fed to livestock" ("Agriculture", 1996). One pound of beef requires 11 pounds of grain, while one pound of pork or poultry requires 6 pounds and 3 pounds of grain, respectively ("Agriculture", 1996).

Lastly, endangered species are at risk in areas of grazing. Ranchers are permitted, by law, to kill any predator of their herds. Among these predators are wolves, which are considered endangered (Royte, 1990). Besides predators, other flora and fauna on the Sierra Club's grazing casualty list include: cottonwoods, game birds such as sage grouse, five native species of fish and three plant species (Wuerthner, 1990). Fleischner (1994) lists various birds and small mammals in the western U.S. whose numbers have been reduced due to (over)grazing but experience a resurgence when cattle have been reduced or removed from their habitat.

The Role of Government in the Dispute

The leverage being used by environmentalists to protect the land is the grazing fee: the cost set by the Federal government to the ranchers for the use of public lands. These fees fall short of the total budgetary

requirements for the administration of the grazing program by the U.S. Forest Service and the Bureau of Land Management (Egan, 1990; Arrandale, 1994; Hess, 1996).

Another shortcoming of the grazing fee is its inequity among the affected states. Since climate, topography and abundance of vegetation differ from state to state, the current uniform fee is considered incongruous (LaFrance & Watts, 1995). Fees to graze on private land do vary according to the land's characteristics (LaFrance & Watts, 1995). Therefore, it could be inferred that varying the fee according to the nature of the grazing site may reduce the Forest Service's and BLM's budget deficit.

Legislation recently approved by the Senate (and currently working its way through the House of Representatives) raises grazing fees by 37% (Coughlin, 1996). The fees are based upon "Animal Unit Month", or AUM, which is the cost of forage for one animal, for one month. While the bill does help to offset the cost of the grazing program, additional features of the bill grant the ranchers more control over the Federal lands (Coughlin, 1996).

The grazing fee structure has been under scrutiny for the last few years. In 1991, a Congressional committee heard input from both ranchers and environmentalists (see above section "Beef Industry Perspective") (Congress, 1991). Since the monies generated from the fees go to

other governmental agencies besides those administering the grazing program, it was suggested that the fees should cover the program's actual cost (Congress, 1991). Opposing viewpoints to raising the fees included: 1) Ranchers are not reimbursed for the improvements they have made to the public lands; 2) Grazing increases the actual value of public lands; 3) The costs of grazing on public lands is higher than on private lands because public lands are less productive; 4) Transportation costs are higher on public lands due to less accessibility, i.e. greater distances; 5) Costs increase during dry years when cattle must be moved off the lands; and 6) The needs of the ranchers are not understood by the general public (Congress, 1991).

The Sierra Club argues that many of the improvements are borne by the taxpayers. Among these are "stock ponds, cattle guards, 'open range' signs, herbicide spraying, seeding and even dragging chains across the land to eliminate trees and brush" (Wuerthner, 1990). In addition, many of the other "improvements" are necessary to permit grazing and not ones which would normally benefit the land (Wuerthner, 1990).

Other Costs

Grazing fees address, whether directly or indirectly, primarily soil-related issues. Ranchers claim that with good management, stress can be relieved from the riparian areas as well (Lancaster, 1991). However, many of the

other costs (see above section "Environmental Perspective") cannot be managed by grazing fees (e.g. competition for grain, methane emissions, species reduction/extinction). The Sierra Club concludes, "Judging by the condition of public lands in the West, ... a blizzard of questions is long overdue. It's not that livestock can't be raised with a minimum of environmental damage -- it's that the cost of doing so in the dry lands of the West is extremely high" (Wuerthner, 1990).

Assessing Specific Values

Environmental damage is difficult to appraise due to the interrelationship among the Earth's ecospheres. EarthSave (1996) has endeavored to assign both consumptive and monetary values to the resources employed for beef production. Some are: 1) Water = 2,500 gallons per pound of beef; 2) Soil erosion (direct and indirect costs) = \$44 billion; and 3) Soil use efficiency where one acre of prime land yields 250 pounds of beef versus 40,000 pounds of potatoes.

Land inefficiency is further illustrated by the productive difference between public and private ranges. BLM lands operate at approximately 42% of private land productivity and the U.S. Forest Service lands are still lower at 37% (Arrandale, 1994).

Overabundance of cattle can interrupt natural processes such as nitrogen cycling in plants. Nitrogen

replacement per hectare was estimated at \$5.50 in 1977 (Westman, 1977).

Beef production is energy-intensive (see above section "Environmental Perspective"). Ward et al. (1977) estimated that it takes approximately 20 to 50 gallons of gasoline to produce 129 pounds of beef. This averages to .27 gallons per pound.

Placing a value on the negative effects of global warming is an ambitious and complex task. Taking into account the resulting economic damage to areas such as agriculture, construction and finance (i.e. from very susceptible to not susceptible), a final figure of 2.5% of the world's gross income has been suggested (Hanley & Spash, 1993).

Solutions

The necessity to manage the environmental costs of grazing has generated recommendations and possible solutions. The following represent a rancher's, a Forest Service critic's and an environmentalist group's viewpoints, respectively.

Ranchers want grazing rights privatized instead of regulated by the government. They maintain that a precedent has been set by the war for water rights in the West which ultimately led to control of the lands. To solve the problems of environmental degradation which is currently causing another "war", privately owned grazing

rights would give ranchers a personal interest in the stewardship of the land. At present, the "bureaucratic micro-management" of the lands by different agencies is causing conflict and confusion. In addition, by making grazing rights and property rights synonymous, persons other than ranchers, such as environmental groups, could purchase land thought to be sensitive or endangered (Jackson, 1992).

Randal O'Toole of The Thoreau Institute proposes that Federal agencies which have a product to offer should be run as businesses, i.e. with a profit-motive. He maintains that the U.S. Forest Service, BLM and Park Service have valuable land which could be managed as a product. By "demanding a return on their investment", the agencies as land owners could realize a profit. This profit would, in turn, generate enough money to solve environmental as well as economic problems (O'Toole, 1996).

The mission of EarthSave is simple: reduce or remove domesticated cattle from the environment to relieve the stress which beef production has placed on the world's resources. This can be accomplished by reducing or removing beef from the human diet. Americans are one of the largest consumers of livestock and livestock-related feed (e.g. soy). To dramatically illustrate this point, EarthSave contends that if the rest of the world were to adopt an American-type diet, " ... 2½ times as much grain

as the world's farmers produce for all purposes" would be required (EarthSave, 1996).

The Future of Beef

As recently as 1973, beef was considered a dietary asset (Maidenberg, 1973). Within the last two decades, however, beef has become linked with heart disease, cancer and obesity. Consequently, beef consumption per capita has decreased (Dosti, 1989; Kline 1996)). It could be speculated that the same trend may continue as the public becomes environmentally aware.

To offset the mounting negativity against beef, the Beef Industry Council has enlisted the help of a public relations firm. Their objective: "To maintain beef's dominance in the food-service marketplace, ... to increase operator awareness that beef is suited to new, contemporary menu items" (Hendrix, 1991). The major thrust of the campaign is directed at children. The "Be a Star" promotion supplied creative, beef-oriented items designed to entertain children at restaurants while the family's order was being prepared (Hendrix, 1991). In addition, advertisements and recipes were featured in restaurant trade publications (Hendrix, 1991). Follow-up and evaluation indicated that the promotion had been successful, i.e. there was recipe utilization and/or recognition.

Conclusion

Cattle grazing is a major cause, if not the central cause, of environmental degradation in the U.S. western region. Across the United States, a primary agricultural use of the land is to produce food for livestock. In addition, beef production is a major consumer of our energy and water, uses the land inefficiently, disrupts ecosystems and contributes to the continuing increase of greenhouse gases.

Currently, the beef industry has a strong foothold in the minds and on the land of America. As a result, Americans are oblivious to the environmental price of beef. Historically, when the public became aware of the negative health effects of beef, it reduced its beef consumption. This paper will estimate the real cost of beef which, then, could be used to educate the public regarding beef production's severe environmental impact. Perhaps, as the public became aware, it would again, reduce its beef consumption.

METHOD

While beef production is a global issue, this research is limited solely to the negative impact on the environment created by agricultural practices in the United States. The environment, by definition, consists of many interrelated factions. Thus, the effects of negative impacts can be far-reaching. In order to narrow the scope of the research, only the following impacted areas are selected for monetary analysis: ecospheres, greenhouse gases, soil, competition for land, energy and water. Each area of impact is complex. Therefore, just one contributing factor within each area will be considered and analyzed.

Pounds of U.S. Beef Produced

In order to compute the environmental cost per pound of beef, the number of pounds of beef and veal produced in the United States has been calculated. This figure is determined through the following method:

- 1) Number of metric tons produced in the United States in 1995 = 11,540,000 ("Agriculture", 1996)
- 2) Conversion of metric tons to short tons (U.S. equivalent = 1.102311) (# short tons = 1 metric ton)
- 3) Conversion of short tons to pounds = 2,000 (# pounds = 1 ton)

- 4) Total pounds (Step 1 x 2 x 3) = 25,441,338,000
5) Total pounds rounded down and put in scientific notation = 2.5441×10^{10}

This final number appears in the cost calculations for ecospheres, greenhouse gases, soil and competition for land. The amount of energy and water used per pound of beef has been calculated in the cited literature.

Conversion of Dollars to Future Value

When a dollar amount is calculated in the literature and is based upon values prior to 1995, these figures have been converted into their present value. This is accomplished by using the following standard formula (Turner, Pearce, & Bateman, 1993) (Note: "r", the annual rate of inflation, is set at 4%):

$$\text{Future value} = \text{Present value} \times (1 + r)^{\text{time}}$$

Ecospheres

The ecosphere component selected for analysis is nitrogen replacement. This component is significant because: 1) the nitrogen cycle is an important biological process of vegetation (Westman, 1977); 2) the nitrogen cycle is seriously affected by the trampling of cattle hooves (Fleischner, 1994); and 3) an amount of \$5.50 was determined as the cost of nitrogen replacement per hectare (Westman, 1977).

The following calculation assesses the environmental cost of nitrogen replacement, per pound of beef (Note: farms include ranches/rangeland):

- 1) Number of farms in the United States = 2,073,000
("Comparative national statistics", 1996)
- 2) Average number of hectares per farm = 190
("Comparative national statistics", 1996)
- 3) Percentage of farms used for grazing = 43.5%
("Comparative national statistics", 1996)
- 4) Cost of nitrogen replacement = \$5.50 per year
(Westman, 1977)
Conversion to 1995 dollars = \$11.14 per year
- 5) Steps 1 x 2 x 3 x 4 = \$1.91 x 10⁹
- 6) Divide by total number of pounds of beef =
2.5441 x 10¹⁰
- 7) **Cost per pound = \$0.08** (\$0.075 rounded up)

The primary limitation to this calculation is the assumption that all nitrogen must be replaced on every hectare grazed. To offset this limitation, the use of nitrogen replacement represents all damage to the ecosphere. Not included in the damage estimate is Fleischner's (1994) summary of grazing effects: 1) alteration of species composition of communities; 2) disruption of ecosystem functioning; and 3) alteration of ecosystem structure.

Greenhouse Gases

There are several gases which contribute to the greenhouse effect. Among them are carbon dioxide, methane, chlorofluorocarbons, and nitrous oxide. Methane is used in this assessment for the following reasons: 1) methane is directly attributable to cattle as an emitted gas; and 2) the international cost of global warming is estimated at

2.5% of the world's gross national product (GNP) (Hanley & Spash, 1993).

The following calculation is used to determine the environmental cost of global warming, attributable to cattle, per pound of beef:

- 1) Gross world GNP in 1993 = \$24,299,220,000,000
("Comparative national statistics", 1996)
= 2.4299×10^{13} (rounded down and put in scientific notation)
- 2) Cost of global warming = 2.5% of world GNP
(Hanley & Spash, 1993)
- 3) Methane as a percentage of greenhouse gases = 18%
(Miller, 1993)
- 4) Percentage of methane from cattle = 33%
(Hanley & Spash, 1993)
- 5) Percentage of pounds of beef produced by the United States = 25% ("Comparative national statistics", 1996)
- 6) Steps 1 x 2 x 3 x 4 x 5 = 9.0210×10^9
- 7) Divide by total number of pounds of beef =
 2.5441×10^{10}
- 8) **Cost per pound = \$0.35** (\$0.3546 rounded down)

The limitations to this calculation are: 1) the percentage of methane from cattle (33%) is approximate and inferred as 1/3 of three anthropogenic methane sources (cattle, rice paddies and fossil fuels) (Hanley & Spash, 1993); and 2) the world GNP is a rough estimate of global income ("Comparative national statistics", 1996).

To offset these limitations, only methane is considered as a cattle-related greenhouse gas, although carbon dioxide emissions are generated from the production of beef. As

another offset, the GNP has not been converted from 1993 to 1995 dollars (a difference of an additional \$0.03 per pound).

Soil

The soil suffers severely from cattle grazing (see "Review of Literature" section). One of the more easily assessed effects is soil erosion. EarthSave (1996) values all direct and indirect erosion costs at $\$4.4 \times 10^{10}$. When those costs are divided by the number of pounds of beef produced in the U.S., 2.5441×10^{10} , the *cost per pound is \$1.73* (\$1.7295 rounded up).

The limitation to this calculation is the unknown composition of the erosion costs, although EarthSave cites a direct source (David Pimentel, 1989: "Waste in Agriculture and Food Sectors: Environmental and Social Costs"). Since this source is from 1989, the erosion costs have not been converted to 1995 dollars (a difference of an additional \$0.46 per pound), as a method of offset.

Competition for Land and Land Use Efficiency

As the Earth's human population continues to escalate, land use will become critical and require more efficient use. Non-beef food sources demand far less land for food production. For instance, one acre of prime land is needed to produce 250 pounds of beef. That same acre could generate thousands of pounds more of fruits and vegetables (e.g. 20,00 pounds of apples, 40,000 pounds of potatoes and

60,000 pounds of celery) (EarthSave, 1996). To calculate the inefficient land use, the dollar-yield of beef and potatoes, per acre, is compared. Potatoes have been selected as the comparative crop due to their low price per pound and their ability to be grown in arid western states, such as Idaho.

- 1) Number of farms in the United States = 2,073,000
("Comparative national statistics", 1996)
- 2) Average number of hectares per farm = 190
("Comparative national statistics", 1996)
- 3) Conversion of hectares to acres = 2.471 (# acres =
1 hectare)
- 4) Percentage of farms used for grazing = 43.5%
("Comparative national statistics", 1996)
- 5) Steps 1 x 2 x 3 x 4 = 423,365,000 acres
- 6) Less Bureau of Land Management (BLM) acres used for
grazing = 150,000,000 (Arrandale, 1994)
- 7) Add efficiency percentage, BLM versus private land =
150,000,000 x 42% = 63,000,000
- 8) Less U.S. Forest Service (USFS) acres used for
grazing = 117,000,000 (Arrandale, 1994)
- 9) Add efficiency percentage, USFS versus private land =
117,000,000 x 37% = 43,000,000
- 10) Steps 5 - 9 = Total number of acres available for
grazing = 262,365,000
- 11) Loss/inefficiency per acre =

40,000 pounds potatoes at \$0.20/lb.	=	\$8,000
250 pounds of beef at \$2.00/lb.	=	<u>500</u>
		\$7,500
- 12) Step 10 x 11 = Total loss = \$1.9677 x 10¹²
(\$1.9677375 x 10¹² rounded down)
- 13) Divide by total number of pounds of beef =
2.5441 x 10¹⁰
- 14) Loss/inefficiency cost per pound = \$77.34

15) Arbitrary percentage to account for limitations in calculation = 25%

16) Steps 14 x 15 = **Cost per pound = \$19.34**
(\$19.335 rounded up)

The limitations on this calculation include: 1) to simplify valuation, only potatoes were considered as a crop; and 2) it is assumed that all acres would produce potatoes. To offset these assumptions the following four measures are employed to intentionally reduce the final number: 1) BLM and USFS land efficiency is taken as a percentage of total land actually used for grazing; 2) the cost of beef per pound in Step 11 is artificially inflated to reduce loss per acre calculation; 3) the cost of potatoes is based on a 15-pound bag at \$3.00 (Smith's Food & Drug, Las Vegas, 6/96); and 4) an arbitrary fraction of the total cost is taken.

Energy

Ward, Knox & Hobson (1977) stated that beef is the most energy-intensive protein source. They concluded that the production of 129 pounds of grain-fed beef required the gasoline equivalent of 19.7 to 49.8 gallons. Therefore, one pound of beef would require .15 to .39 gallons of gas, or an average of .27 gallons. If the price of gasoline is \$1.00 per gallon, then the **cost per pound is \$0.27**. Since all beef is not grain-fed, this places a limitation on the accuracy of the gasoline assumption. In order to offset

this limitation, the price of gasoline is quoted low at \$1.00/gallon (versus the 6/96 pump price of \$1.40/gallon).

Water

Beef production requires large volumes of water. EarthSave (1996) estimates that it takes 2,500 gallons of water for one pound of beef. The Las Vegas Valley Water District charges approximately \$1.00 per 1,000 gallons (6/96) for residential use. Based upon that figure, the **cost per pound is \$2.50.**

The price of water in the Las Vegas Valley may not be consistent with other regions in the United States. To offset this inconsistency, no service charge was factored into the water charge. In addition, all costs associated with this water calculation reflect only delivery to the areas of demand. Types of environmental degradation not considered as part of the water costs include: 1) the cleanup of water pollution directly attributable to cattle fecal waste; 2) damaged riparian areas caused by cattle grazing on or near stream; and 3) the depletion of nonrenewable water sources (e.g. Ogallala Aquifer) which have been used for irrigation of feed crops.

Areas of Impact Not Included in Analysis

Ecospheres are interwoven among and within each other. Therefore, it is difficult to break down some areas of negative environmental effects. Two of these, pesticide effects and the loss of endangered species, present

complicated scenarios which inhibit a monetary assessment. For instance, a major use of agricultural land in the U.S. is for livestock-feed (e.g. corn and soy). This practice promotes the planting of single crops which encourages the need for pesticides (EarthSave, 1996). If the same land were used for agriculture for human consumption, the crops could be more varied. The loss of endangered species is immeasurable because the end result of this effect is still unknown.

Due to foreign trade, the effects of the American beef-centered diet goes beyond our national borders. These effects, however, are far too sweeping and involve too many components to be evaluated in this paper. Among these effects are the degradation of Central and South American rainforests and other fertile regions. The burning of the rainforests to create grazing pastures contributes to greenhouse gases, causes extensive soil erosion leading to desertification (EarthSave, 1996), and reduces a major oxygen source. By importing our beef from Central and South America, North Americans contribute to these effects.

RESULTS AND DISCUSSION

The REAL Cost of Beef

As of 6/30/96, the following prices were being charged for beef products:

Beef as a commodity	\$0.60/per pound
Ground Beef (Smith's)	0.99/per pound
McDonald's "Quarter-Pounder"	\$1.89

In contrast, the total cost from the six areas of negative environmental impacts is:

Ecospheres (nitrogen replacement)	\$.08
Greenhouse gases (methane)	.35
Soil (erosion)	1.73
Competition for land (efficiency)	19.34
Energy (gasoline)	.27
Water (delivery)	<u>2.50</u>
	\$24.27
Less: Wall St. Journal \$/lb.	<u>.60</u>

The real cost of beef, per pound \$23.67

In the final analysis, what is not added into the cost per pound is the individual supermarket's charge. This charge would reflect distribution, preparation and other steps required to move the beef from the source to the

supermarket, and may range between \$1.00 and \$2.00 per pound.

Who Pays the Difference?

In the western U.S., much of cost for ecosphere damage, soil erosion and water use is borne by the taxpayers through subsidies. Teisler-Rice (1996) claims that "Meat would cost \$35/lb. if all the water used by the meat industry was not subsidized by the U.S. government." (Teisler-Rice's figure is considerably higher than the \$2.50 computed in this paper, however, the \$2.50 covered water delivery only.) Hess (1996) is more direct. He states that subsidies are the equivalent of "cowboy socialism" because "... the combined grazing programs of the Bureau of Land Management and the Forest Service are running deep deficits, costing taxpayers up to \$200 million each year." In addition, he asserts that the government spends millions of dollars improving the land for grazing purposes. Wuerthner (1990), of the Sierra Club, argues, the improvements which the ranchers claim they make to the land are not ones which benefit the land or the environment, but rather are solely intended to maintain the range for grazing purposes. However, Hess and Wuerthner are discussing primarily the Western U.S. region., where the 270 million acres used for grazing on public lands generates only 2 - 3% of the meat consumed in the U.S.

Teisler-Rice's calculation of water usage seems to address the entire United States.

The impact from methane, i.e. the effect of greenhouse gases, is monetarily felt by people all over the world. Gradual changes in weather patterns (e.g. hurricanes and drought) were recently reported to be linked with global warming. In June, 1996, a Galveston, Texas resident said that insurance companies were no longer offering hurricane coverage in Texas and Florida. This means that property and casualty losses will be borne by the residents. Droughts result in increased crop prices to the consumer.

The competition for land is a monetary toll which will come due in the future. The sheer numbers of the Earth's burgeoning population will demand more and more from the Earth's resources. The loss of fertile cropland through inefficient land use will reduce the amount available for the future. At some point the land will not be able to respond to the food demand unless agricultural practices are changed.

Public Awareness

Americans have responded to environmental information. The trend is apparent on supermarket shelves. The product manufacturers mark their packages, "Made from recycled material", "Please recycle", "No phosphates", "Environmentally-friendly", etc. There are regular news shows, such as "Earth Matters" on Cable News Network (CNN),

which report on environmental issues. In the last five years there have been global summits on the environment and population growth. The interest is there, people need only to tap into it and create an awareness. To that end, copies of this thesis will be sent to the Sierra Club and EarthSave. In addition, the magazine Vegetarian Times frequently focuses articles and reports on the environmental damage created by livestock production. Therefore, a copy of this thesis will be sent to them, also.

The Sierra Club has concentrated its efforts on the use and misuse of the public lands in the western U.S. Yet, many of its members are unaware of the real cost of beef as illustrated in this paper. With its vast network of influence, the Sierra Club could explore this issue more fully and begin a campaign to inform its members, political decision-makers, and the general public.

EarthSave's primary goal is the conversion of the American population to a plant-based diet. It is hoped that this organization can use the information contained herein to pursue the implications of "the real cost of beef" (in dollars) and use it for continued education-awareness.

Vegetarian Times may also want to explore this issue as it is consistent with the publication. By getting this

information to its subscribers, the information could be passed along or acted upon.

The objective, to inform the public, will be met with resistance from the beef industry and the public themselves, who consider the "Quarter-Pounder" and the backyard barbecue to be "as American as apple pie". It will require the evidence to be so overwhelming that the choice to consume beef will be a guilt-laden one. A recent report (Kline, 1996) indicates that beef has experienced a "15% decline of the U.S. market share in a decade", mainly attributable to health concerns. This decline is the result of getting the information to the consumer regarding the negative health effects of beef. The task ahead is to get the information to the consumer regarding the negative environmental effects of beef.

Implications for Further Research

We now know that the public will respond to information regarding environmental issues and products, and beef and health. Future research can be centered on ways to get these two avenues of thought together.

The following research questions could be explored:

- 1) What is the limit people will be willing to pay per pound of beef?
- 2) What environmental issues does the public consider most important?
- 3) What would be the impetus to changing the public's mind

about beef? In other words, what would the public need to know to make the decision to remove beef from their diet?

4) What would be the most effective ad campaign to reach the general public (e.g. print ads, television ads, a multimedia campaign)?

5) What companies, industries or persons would be best able to conduct such a campaign? Should this campaign be generated by the potato industry, or the grain industry, or environmental organizations? To whom would the public best respond?

The study begun in this paper is in preparation for creating a media campaign designed to dissuade the public from consuming or purchasing beef. Such a media campaign will be the end product of a Master's thesis in Communications.

Conclusion

The negative environmental impacts of beef production are pervasive and extensive. Yet, the public is unaware of the sweeping and global effects. By establishing the real cost of beef in dollars, the devastation caused by beef production is clearly illustrated. The next step is to turn this academic knowledge into public knowledge, thus creating the basis for the necessary public action: ***reduce or eliminate beef from the American diet.***

References

Agriculture. (1996). Encyclopaedia Britannica 1996 book of the year (events of 1995). Chicago: Encyclopaedia Britannica, Inc.

Arrandale, T. (1994, June 17). Public land policy. CQ Researcher, 4, pp. 529-52.

Brisbane, A.S. (1989, September 26). World's grain reserves called dangerously low. The Washington Post, A3.

Campbell, N.A. (1993). Biology: third edition. Redwood City, CA: The Benjamin/Cummings Publishing Company, Inc.

Comparative national statistics. (1996). Encyclopaedia Britannica 1996 book of the year (events of 1995). Chicago: Encyclopaedia Britannica, Inc.

Congress. (1991). BLM reauthorization and grazing fees. (In 8/14: 102-2). Washington, DC: U.S. Government Printing Office, 1023-A.

Coughlin, B.G. (1996, March 22). Grazing fees up 37 percent. The Las Vegas Review-Journal, p. 9C.

Dosti, R. (1989, September 14). Whatever happened to hamburger? The Los Angeles Times, VIII.

EarthSave Foundation. (1996). Our food our world: the realities of an animal-based diet. Santa Cruz: EarthSave Foundation.

Egan, T. (1990, August 19). Ranchers vs. rangers over land use. The New York Times.

Fleischner, T.L. (1994, September). Ecological costs of livestock grazing in western North America. Conservation Biology, 8, pp. 629-44.

Grazing's effects to be assessed. (1995, March 27). The New York Times, B.

Grazing management. MMGI (Chapter 2). Environmental Protection Agency. Internet (5/10/96): <http://www.epa.gov/OWOW/MMGI/Chapter2/ch2-2e.html>, pp. 1-11.

Hanley, N. & Spash, C.L. (1993). Cost-benefit analysis and the environment. Brookfield, VT: Edward Elgar Publishing Company.

- Hendrix, J.A. (1992). Public relations cases. Belmont: Wadsworth Publishing Company, pp. 80-94.
- Hess, K. (1996). Range bill just cowboy socialism. Las Vegas Sun (reprinted from The Wall Street Journal).
- Jackson, J.M. (1992, Summer). Grazing rights: time for a new outlook. Natural Resources Journal, 32, pp. 623-31.
- Kline, S. (1996, July 10). Cattle industry beefs about prices. Las Vegas Review-Journal, D8-9.
- LaFrance, J.T. & Watts, M.J. (1995, August). Public grazing in the West and "Rangeland Reform '94". American Journal of Agricultural Economics, 77, p. 447-51.
- Lancaster, J. (1991, February 17). Public land, private profit. The Washington Post, A1, A8, A9.
- Maidenberg, H.J. (1973, July 1). The livestock population explosion. The New York Times, p. 1, 3.
- Miller, G.T. (1993). Environmental science/fourth edition. Belmont, CA: Wadsworth Publishing Company.
- O'Toole, R. Run them like businesses. Internet (4/3/96): <http://www.teleport.com/-rot/business.html>, pp. 1-15.
- Royte, E. (1990, December 16). Showdown in cattle country. New York Times Magazine, pp. 60, 62, 66, 68, 60.
- Ruminant livestock methane program. U.S. Environmental Protection Agency. Internet (3/15/96): <http://www.epa.gov/docs/GCDOAR/ruminant.html>, pp. 1-4.
- Senate looking at grazing reform bill. (1996, March 18). Las Vegas Review-Journal.
- Teisler-Rice, P. 101 reasons why I'm a vegetarian. Internet (3/15/96): <http://www.southwind.net/Orgs/VivaVeg/VV101reas.html>, pp. 1-11.
- Turner, R.K., Pearce, D., & Bateman, I. (1993) Environmental economics. Baltimore: The Johns Hopkins University Press.
- Ward, G.M., Knox, P.L. & Hobson, B.W. (1977, October 21). Beef production options and requirements for fossil fuel. Science, 198, pp. 265-71.

Westman, W.E. (1977, September 2). How much are nature's services worth? Science, 197, pp. 960-64.

Wuerthner, G. (1990, September/October). The price is wrong. Sierra, 75, pp. 38-43.