The Ecological Footprint of Dairy Production

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Introduction

Humans are the only mammals that consume milk long after being weaned, and the only species that consumes milk from other species (Oster, 1984). Consequently, dairy products make up a large percentage of world food consumption. In today's global free-market economy, almost nothing has escaped industrialization, including milk production. Pressures from industry to expand have left a profound impact on both environmental and social spheres (See Appendix 1). In the developed world health hazards of milk are on the rise and small farmers are being pushed out of the market. Moreover, developing countries trying to industrialize are losing their food security due to loss of grain now designated for livestock feed. The environmental impacts of forest clearing, air and water pollution, landfills and soil erosion are part of the combined impact that human activities have had on the earth, whereby cattle raising of all types play a large role. Industrialization has also turned milking cows into machines of mass production, and inhumane treatment of dairy animals is commonplace. All of these factors have contributed in part to the cumulative ecological footprint of dairy production.

Globalization of the Dairy industry

Once upon a time dairy farming was practiced only on a small-scale and milk was considered a simple by-product of owning cows. It was not until after the Industrial Revolution, when the world started to function on a free-market capitalist economy, that dairying evolved into the industry it is today. In the 1999-2000 period, a total of 47.4 million hectolitres of industrial milk and cream were produced in Canada alone (Canadian Dairy Association, 2000). As herds become larger, so does the demand for their basic requirements. Because dairy cattle require a protein rich diet that cannot always be met by simple grazing, their feed needs to be supplemented with grains. Consequently farmers have been under increased pressure from the market to produce cash crops and become more specialized, and have given way to mass industrialized farming (Durning, 1991).

Currently only a few firms control the modern industrial livestock production, and small producers are being driven out of the market (Durning, 1991). Between March 1998 and March 2001 alone, there were 496 mergers or acquisitions in the dairy industry worldwide (Australian Dairy, 2001) (See Appendix 2). According to the World Bank (2002) "costs of production must be competitive with border milk prices and high capacity utilization is important given relatively high capital costs." Thus, the effect of globalization on small family producers in the developed world has been destabilizing.

> "The turn away from the farm for essentials coincided with the general cultural reorientation outward, away from the farm, for cultural ties, market opportunities, and employment. As the farm enterprise itself dissolved into loosely connected pieces, so did the household itself…" (McMurry, 1995)

According to the United Nations Food and Agriculture Organization, world dairy production nears 6 billion tonnes of milk every year (World Bank, 2002). The industry continues to consolidate and globalize rapidly "as major players grow through acquisition and expansion into emerging markets" (World Bank, 2002).

Prior to 1850, factorization in the dairy industry was virtually unheard of in North America. In fact, the first modern cheese factory in the United States was erected in 1851 (McMurry, 1995). Preceding the industrialization of the process, dairy-related jobs were performed mainly by women, who, in so doing, controlled this small sector of the economy. Though some

> "see factory consolidation as a positive event for women, alleviating burdensome labor, … [m]ore recent historians … are more critical. They see in dairy factory centralization a loss for women, since men both took over control of production and claimed the income… In Canadian dairying … the increased importance of capital in dairying, combined with patriarchal household structure, allowed men to assert control" (McMurry, 1995).

Widening the Gap Between Rich and Poor and the Issue of Food Security

There is a definite gap between rich and poor countries in terms of milk production. As countries become more affluent they engage in more energy intense food production, while consuming foods higher up the food chain. Though India is the largest producer of milk in the world (Indian Dairy, 2002), developed countries still account for three quarters of the world's milk production (Durning, 1991). Total world output of dairy products doubled between 1950 and 1990, just keeping up with population growth (Durning, 1991). Furthermore, while wealthy nations use the most shares of domestic grain to feed livestock, poorer regions use the least. For example, the United States uses 70 percent of its grain for animals while the world average is only 38 percent (Durning, 1991) (See Appendix 4).

Though the dairy industry is primarily located in the developed countries of Europe, North America and Russia, milk production and consumption is on the rise in developing countries as well. As countries industrialize and sections of the population become more affluent, they too begin to enrich their diet with more protein from animal sources. Furthermore, the switch to using grain to feed animals from feeding people, increases the demand of grain needed per capita, and countries trying to industrialize are now having a hard time keeping up with feed demands (Durning, 1991) (See Appendix 3). This trend further widens the gap between the rich and the poor, because it is mainly the elite who can afford products such as beef and milk. As more land is being used to supply the feed market, less land is used to grow the variety of staple grains that the poor rely on for food security (Durning, 1991).

This trend in developing nations is not just an isolated phenomenon. International development agencies, like the World Bank, have often provided funding to promote livestock raising, such as deep-well drilling in Africa, in areas previously inaccessible to cattle (Durning, 1991). This in turn has caused increased desertification, among other environmental problems associated with cattle, with which poorer nations are the least able to cope.

Health and the Food Pyramid

Toward the end of the last century, health associations and nutritionists also began to realize that there was a mistaken belief among developed nations that a person needed enormous quantities of protein to stay healthy.

> "This myth, propagated as much as a century ago by health officials and governmental dietary guidelines, has resulted in … members of industrialized societies ingesting twice as much protein as needed" (Durning, 1991).

Furthermore, milk is high in saturated fats, which accompany the concentrated protein found in milk. Saturated fat is associated with "diseases of affluence," (i.e. heart disease, strokes and cancer) which are the leading causes of death in developed nations (Durning, 1991). As a reaction to this, people in Western nations became more concerned with their fat intake. In

catching on to health guidelines, advising people to eat fewer animal products and more fruits and vegetables, they cut back on milk consumption (Durning, 1991) (See Appendix 5). At this time, new scientific evidence of milk's other adverse affects on health also became more apparent.

Other than diseases of affluence, there are a number of adverse health risks associated with milk consumption. The most frequent are chemical contaminants (Silverstone, 1984), milkborn infectious diseases (Galbraith et al, 1984), allergies, and intolerance causing respiratory, skin and gastrointestinal diseases (Brown, 1984).

Principally speaking, whatever is fed to a cow will end up being secreted in her milk. Chemical contamination of milk has a wide variety of sources, from the rubber components of milking machines to pesticides used on the feed (Silverstone, 1984) (See Appendix 6). The most common contaminants are antibiotics (i.e. penicillin), pesticides and fertilizers, sterols (i.e. progesterone), trace metals and radioactivity, and arsenic (Silverstone, 1984). There has been much concern with regards to antibiotic use in livestock and its implications with resistant organisms. Close to 70 percent of global production of antibiotics is used for livestock production, of which 80 percent is used to promote growth (Sierra Club, 2002). There is also "direct evidence that antibiotic use in food-producing animals results in resistant salmonella infections in humans…" (WHO, 1997).

It is true that evolutionary speaking, Europeans and their descendents have developed a tolerance to milk, which enables them to digest it. However, per capita consumption has near doubled in the last few centuries, and cases of intolerance and allergies have been on the rise (Brown, 1985). In this regard, the substituting of cow's milk for breast milk has also been associated with sudden infant death syndrome (Brown, 1985). Respiratory, skin and gastrointestinal diseases have also been directly linked to milk intolerance. Examples of these are rhinitis, exema and chronic constipation (Brown, 1984).

Pressures from the Dairy Industry

Despite the rise in health concerns related to milk, health organizations have been under constant pressure from the dairy industry to continue to promote its consumption. When the U.S. Department of Agriculture (USDA) first attempted to draft a new "food pyramid," (See Appendix 7) which emphasized fruits, vegetables and grains rather than animal foods, they were forced to retract the draft when livestock producers complained (Durning, 1991). Currently, the average North American diet consists of 40 percent dairy products (VegSource, 2002), a dietary pattern which has turned the current USDA food pyramid upside-down (VegSource, 2002) (See Appendices 7 & 8). Furthermore, agricultural programs continue to subsidize livestock and feed growers much more than fruit and vegetable producers (Durning, 1991).

North American dairy associations have also embarked on intense ad campaigns during the last two decades, in response to a recent decline in milk consumption. Such slogans as "Milk, it does a body good," and "Got Milk?" have pervaded television ads (Got Milk?, n.d.) (See Appendix 9). In trying to convince people that milk leads to a healthy lifestyle, the industry has portrayed images of celebrities and sports professionals drinking (and loving) milk. Due to this constant pressure from industry, it is difficult for the average citizen to know what is or isn't good for one's health.

> "Perhaps the apparent difficulties of the medical profession in accepting milk as a possible cause of disease are due to intensive and constant promotion of milk as a

> dietary essential and as a healthy food. Milk marketing organizations equate fitness and health with the consumption of milk and milk products. As a result public and profession have become convinced that milk is always good for you and find it difficult to accept the idea that milk can cause disease. Yet, as cow's milk was meant for baby cows, not baby humans, it should be no surprise that hypersensitivity can occur to the relatively enormous quantities of … milk products consumed by us all" (Brown, 1984).

Land Use

The land use process involved in dairy production leaves a definite imprint on the earth, especially considering that in the 1998-99 period, there were about 21,500 dairy farms in Canada containing approximately 1.2 million cows in total (Canadian Dairy Commission, 1999) (See Appendix 2). In British Columbia alone there are around 850 dairy farms with an average dairy herd size of 80 cows, not including replacement heifers and calves (Government of British Columbia, 1996).

Farms, regardless of their dairy or crop function, are intensive operations that impact the environment. Additionally, dairy cows themselves are a large part of a general 'cattle problem'. To create a farm, land must be cleared of much or most of its vegetation in order to allow for crop planting or animal grazing. Land clearing thus "...requires the removal of native cover, including trees, bushes and boulders from the land surface...[to facilitate] seedbed[s] into which an agricultural crop can be seeded" (Government of B.C., 1996). The B.C. Ministry of Agriculture, Food and Fisheries does, however, advise farmers to retain natural vegetation cover where possible along creeks and gullies to help minimize soil erosion and damage to river banks (Government of B.C., 1996). In terms of global trends, land conversion for agricultural use is a leading factor in forest destruction and it is estimated that one-fifth of the world's remaining forested areas may well become cropland or pasture in the near future (Roberts, 1998) (See Appendix 10).

Soil degradation, of which soil erosion is a part, helped contribute to the damage of 38 percent of the roughly 1.5 billion hectares of cropland worldwide (Roberts, 1998). The United Nations Environment Programme remarks that "[m]any of the adverse environmental impacts resulting from agriculture are connected either to the loss of natural habitat [from land conversion]...or to the use (or misuse) of pesticides and fertilizers" (Roberts, 1998:156).

In discussing land clearing for agriculture and the relationship between crops and dairying, one must bear in mind that in many areas, including B.C., farmers grow up to two-thirds of the food a cow eats (Government of B.C., 1996). Milking cows can eat up to 40 kilograms of grass, forage, and hay per day (Government of B.C., 1996). Legislation such as the Canadian Feed Act, along with additional government guidelines, outlines several types of feed for dairy and beef cattle; the most common feed types are hay (dry, baled grass), silage (fermented grain and corn), mixed rations (various crops for use on dairy farms and feedlots), and grain (Government of B.C., 1996). They are commonly produced on dairy farms themselves or purchased elsewhere (Government of B.C., 1996).

It is important to note that the collection and preparation of feed for cattle utilizes energy and fuel intensive equipment, such as mowers, trucks, tractors, combines, augers, balers, and mixers (Government of B.C., 1996). Government provisions are such that mechanized collection and preparation of animal feedstock may take place 24 hours a day (Government of B.C., 1996). In world terms, approximately "...38 percent of the world's grain – especially corn, barley, sorghum, and oats – is fed to livestock, up from 35 percent in 1960" (Durning, 1991:14).

Pesticide

Pesticides are often used on or near dairy farm crops, and come in several forms. They are strictly regulated by Canada's federal and provincial governments due to the associated risks they pose to the environment, animals, and humans. According to B.C.'s Pesticide Control Act, pests are defined as insects, disease organisms, weeds, rodents, birds, or wildlife for which the prescribed human responses may include insecticides, fungicides, herbicides, or rodenticides (Government of B.C., 1996). Farmers are encouraged to use more environmentally friendly integrated pest management techniques and are also directed to contain their use of pesticides within the farm boundaries, in order to prevent the spread of chemical agents to non-target areas (Government of B.C., 1996).

Cow Manure

Manure is also used on farm crops as a fertilizer. The manure that cows produce is usually recycled back into the fields where cattle feed is grown (Government of B.C., 1996). Environment Canada believes that many farmers regard manure as a waste-disposal issue and thus overlook manure as a source of nutrients and organic matter for crop growth (Broersma, 1995). It was found that in an average sample of dairy cow manure, total nutrient value was comprised of 85 percent water, 0.5 percent nitrogen, 0.06 percent phosphorus, 0.31 percent potassium, 0.13 percent magnesium and 0.08 percent sulphur (Brady 1990, In: Broersma, 1995). Studies also concluded that an average of 5.5 to 6.8 kilograms of dry matter manure is produced daily per cow weighing 500 kilograms (Chang 1995, In: Broersma, 1995).

While there are certainly benefits associated using manure as fertilizer, it can also have serious environmental implications. If used in excess, manure and other fertilizers can release too many of their nutrients into soil, thus reducing crop yields and toxifying plant species (Government of B.C., 1993). This can also lead to eutrophication of water bodies (Roberts, 1998). Furthermore, manure releases greenhouse gases such as methane, carbon dioxide, and nitrogen oxide into the atmosphere (Government of B.C., 1993).

Nitrate contamination of water supplies is a widespread problem due to the fact that nitrates from fertilizers and manure can pollute groundwater via irrigation courses and rainfall. Reports from numerous countries indicate that nitrates are some of the most common chemical contaminants found in drinking water, with the United States and European nations recording significant levels in their water supplies (Roberts, 1998). The Worldwatch Institute perhaps sums it up best by stating that the most immediate impacts of nitrogen contamination, retreating grasses, loss of species and climate change, mean that “current methods of rearing animals around the world take a large toll on nature” (Durning, 1991:27).

Livestock flatulence and belching is also an important contributor of methane gas. It has been estimated that globally, "[r]uminant (cud chewing) animals release perhaps 80 million tons of the gas each year in belches and flatulence, while animal wastes at feedlots and factory-style farms emit another 35 million tons" (Durning, 1991:27). The harm that stems from manure is most often found on factory-style farms and feedlots where waste is collected in oxygen-short environments, such as sewage lagoons and manure piles, that foster methane production by means of decomposition (Durning, 1991).

Transportation (See Appendices 11 & 12)

The dairy production process involves a great deal of transportation, which, by implication, involves fuel driven, motorized vehicles. According to the B.C. Ministry of Agriculture, Food and Fisheries, the most common form of transportation for farm produce and equipment is surface transportation. The latter consists mainly of road or rail vehicles (Government of B.C., 1996).

While enormously beneficial in ensuring that dairy produce reaches its various destinations without spoiling, refrigerated trucks, with their internal combustion devices, are also contributors of greenhouse gases and nitrogen (Roberts, 1998). Greenhouse gases include methane, ozone, carbon monoxide, nitrous oxide, and most importantly, carbon dioxide. Today, the transport sector uses around half of the world's oil, most of which comes in the form of motor fuel supplied to cars, trucks, buses, and scooters (Roberts, 1998). Where agricultural use and fossil fuel coincide, nitrogen becomes a by-product of human activity. This nitrogen glut alters the natural nitrogen cycle, thus leaving the earth's normal nitrogen absorption capacities overwhelmed (Roberts, 1998).

The refrigeration units aboard milk trucks that transport the products to the processing plants and the marketplace are additional causes for concern. It is critically important that dairy products are kept at temperatures that prevent bacterial growth (Government of B.C., 1996). The mechanical refrigeration units are usually comprised of four separate parts: an evaporator, a compressor, a condenser, and a refrigerant flow control known as an expansion valve (University of Guelph, 2002). The energy required to keep the refrigeration units functioning and the vehicle operating are factors directly involved in air pollution and fuel consumption. As with most other greenhouse gas emissions, global warming is the likely outcome of excess gas emissions, as gases linger in the atmosphere and trap radiation below.

Processing

There are four major steps to dairy processing in North America. They include milking, pasteurization, separation and homogenization, and packaging. The milking process typically takes place in a milking barn, where the udders are cleaned and the teats attached to rubber-lined suction cups (Government of B.C., 1996). The milk produced is collected in a holding tank via hoses and pipes that are attached to the suction cup (Government of B.C., 1996). Milk in the holding tank is quickly cooled in order to ensure its freshness (Government of B.C., 1996). Before and after the milking process, which occurs three times per day, all milking equipment is thoroughly cleaned and sanitized (Government of B.C., 1996). Milking machines alone requires huge amounts of energy and water for sanitization.

The next step, pasteurization, requires high temperatures in order to kill off disease-causing pathogens and bacteria, and to improve the shelf life of the final product (India Infoline, 2002). During this process, raw milk is heated to 63°C (145°F) for 30 minutes, or 72°C (161°F) for less than 16 seconds. Although this kills most harmful bacteria and pathogens, it is possible that some spore-forming bacteria still survive. Therefore, to prevent spoilage, pasteurized milk must be kept refrigerated at around 4°C (40°F), where bacteria growth is inhibited (Cole, 1974). Other than high energy input, pasteurization also produces large quantities of warm water waste.

The third step in dairy processing, separation or homogenization, is carried out depending on the desired end product. A centrifuge is used to separate and remove the cream from the milk. They are then recombined in different ratios to produce one percent, two percent, homo

and skim milk products. The extra cream is further concentrated to form various by-products, such as butter and ice cream (Cole, 1974). Fluid dairy products are also put through homogenization, which thoroughly mixes the two components and prevents separation (Cooke, 1999). Although the separation and homogenization of diary products are less energy intensive than the first two steps, they still require large amounts of energy.

Milk can be further manufactured into a variety of dairy products, such as cheese or yoghurt. In 1999-2000, Canadian provinces used 501,785 hectolitres of milk to produce new products for the market, “representing one percent of all milk produced Canada” (Canadian Dairy Commission, 2000). While cheese is made by adding an enzyme called rennet to harden the milk (Cole, 1974), yoghurt is made by adding a bacterial starter culture that carries out fermentation (Getty, 1999).

The last step in dairy processing is packaging, and, from a solid resource perspective, it demands the most material. Common filler materials are cartons, jugs, bottles and pouches (for fluid products), and drums, paper bags, and foil (for non-fluid products) (Gay Lea Foods Co-operative Limited, 2002, Cooke, 1999). All dairy product packaging requires either recyclable or non-recyclable plastics, paper, metal or glass, and large amounts of energy are needed for the production of fillers as well as the actual packaging of the final product.

Recycling

Dairy product packages are recyclable in some areas but not others, depending on the individual product. Milk jugs, dairy drums and pouches can most often be recycled in Canada. Milk cartons of all sizes, although possible to recyclable, are not accepted in every Canadian province, including British Columbia (Capital Regional District, 2002).

Beverage cartons are mainly classified into two different material-types, gable-top carton and aseptic bricks. Gable-top cartons consist of one layer of cardboard and two layers of plastic, while aseptic bricks consist of three layers of plastic, one layer of foil and one layer of cardboard. The difference between the two types of carton lies in the fact that gable-top cartons need to be refrigerated while aseptic bricks cartons do not, having been sterilized before packaging. Although they require different storage environments, it is possible to recycle both types (Ecorecycle Victoria, n.d.). Provinces that do not accept milk cartons in their recycling programs are British Columbia, New Brunswick and Saskatchewan (Encorp Pacific (Canada), 2001, Government of New Brunswick, 2002, Saskatchewan Environment and Resource Management, 2001). Ones that do include Alberta, Nova Scotia, Ontario, and Quebec (Alberta Diary Council, United States Environmental Protection Agency, 2001, City of Toronto, 2002).

The reason that cartons are not included under most provincial legislation is due to political pressure from dairy associations. If milk containers were included, there would have to be an additional deposit fee added to the price of milk, placing the cost onto the consumer (Alberta Diary Council, n.d.). Because a rise in price may discourage consumers from buying the product, most cartons are eventually sent to landfills.

Animal Treatment (See Appendix 13)

Animal treatment in the dairy industry has long been criticized by animal welfare organizations. The three main criticisms on dairy farms include the treatment of dairy cows, calves, and injured or ‘downed’ animals. On small traditional farms, where a healthy environment is provided, dairy cows will only produce milk when they give birth, and can live

more than 25 years (Factory Farming, 2002). In contrast, on modern industrialized farms, cows are forced to give birth every year in order to produce milk year-round, and live much shorter lives (Durning, 1991). They are usually slaughtered only four years after birth (Factory Farming, 2002). A cow's gestation period is nine months long, and giving birth annually is physically demanding (Factory Farming, 2002).

When calves are born, they are immediately separated from their mothers (Milk Sucks, n.d.). The majority of female calves are raised to replace the milking herd while the remainder are slaughtered at an early age for the rennet in their stomachs, which is the coagulating ingredient in cheese (Cole, 1974). During the first few months of their lives, they are kept in tiny crates or stalls. When mature enough to produce milk, they are forced to produce 100 pounds of milk per day (Milk Sucks, n.d.). This is ten times more than they would produce naturally, and is due primarily to intense milking, selective breeding and energy rich feed grain (Factory Farming, 2002). Dairy cows' bodies, subject to constant stress, often suffer severe health problems, such as mastitis, Bovine Leukemia Virus, and Johne's disease. Furthermore, their abnormal diet can also cause metabolic disorders (Factory Farming, 2002). Because disease is commonplace on dairy farms, due to unsanitary conditions, it is estimated that the mortality rate is one to two percent of the herd (Bagley, 1999). Bovine Growth Hormones (BGH), are also used to increase milk production largely in the name of increased profit (Cohen, 1998). This treatment will often cause dairy cows' udders to drag on the ground, causing infections and overuse of antibiotics to treat the infections (Milk Sucks, n.d.). Current industrialized treatment of dairy cows is turning them from animals into machines.

Male calves, on the other hand, are considered by-products of the dairy industry, and are therefore subject to inhumane treatment. They are useless for milk production and are usually raised for beef and veal products. Male calves are separated from their mothers and confined to small crates where their necks are tightly chained. Unable to turn around or even lie down, they are kept in these crates until slaughtered. This confinement is meant to disable the development of the animal's muscles in order to produce "tender" meat (PETA, n.d.). They are fed a milk substitute laced with hormones, but are deprived of iron because anaemia not only keeps the flesh pale and tender, but also weakens the calf (Factory Farming, 2002, PETA, n.d.). Scientific research has shown that crate-raised calves experience "chronic stress" and need five times more medication than normal calves (PETA, n.d.). Veal is therefore the most likely of meat types to contain illegal drug residues, which may further threaten human health (Say No to Veal, n.d.). Dr. Hurnick (2002) believes that all these severe abuses to calves could be altered within the reach of modern agricultural production systems, without causing serious impact on the productivity of animals or the efficiency of the system.

Controversy also surrounds the treatment of 'downed' animals on modern dairy farms. Downed animal are sick, injured or diseased animals, which are commonly left to suffer for extended periods of time without food, water, or veterinary care, before being slaughtered (No Downers, 2002). Because downed animals can sometimes barely walk, they are often dragged or pushed onto trucks with chains or forklifts, in order to transfer them to the slaughter site (Murphy, 2002). Such treatment causes injuries, from bruises and abrasions to broken bones and torn ligaments. The meat from these sick, diseased, or injured animals is quite often sold for human consumption (No Downers, 2002).

Conclusion

In conclusion, globalization of the dairy industry has left a substantial impact on the earth due to all the inputs required to turn grain into milk products. From land use and transportation, to processing and animal treatment, dairy farming is no longer what it used to be, both in the developed and developing world. Perhaps Sally McMurry sums it all up best with her own conclusions on North American dairying:

> "As the twentieth century draws to a close, [North] American dairying is in crisis. Its astonishing productivity has been achieved at considerable cost to rural society and the environment. Heavy reliance upon purchased feed, fertilizer, pesticides, balers, silos, milking parlors, and computerized feeding systems results in an escalating cycle of indebtedness. Dairy farming families live under constant pressure. They work long hours, year round. Many struggle to turn a profit in a market flooded with milk from ever more productive cows, even as consumer demand has slowed as other beverages replace milk for popular consumption. Government programs help some dairying families, but each year more people leave farming, and rural communities wither. Dairy farming practices also often lead, directly or indirectly, to serious ecological degradation. Waste from large herds can create runoff that pollutes water. Heavy equipment can cause erosion. Petroleum-based pesticides and fertilizers result in pollution both during manufacturing and after application… The seeds of these contemporary dilemmas were sown a century or more ago… Farmers continued the…'tradition' of ecological disruption by cutting down the forests, introducing the plow, insisting upon an inflexible notion of property, and aggressively attempting to control animals. Later, as dairy farmers began to buy supplies, to raise high-yielding cattle, and to grow cash crops, they embarked on the path to modern ecological and social problems" (McMurry, 1995).

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