5-15-1995

Organic Versus Sustainable Fed Cattle Production: A South Dakota Case Study

Donald Taylor
South Dakota State University

Dillion Feuz
South Dakota State University

Ming Guan
South Dakota State University

ORGANIC VERSUS SUSTAINABLE FED CATTLE PRODUCTION: A SOUTH DAKOTA CASE STUDY[1]

by

Donald C. Taylor, Dillon M. Feuz, and Ming Guan[2]

Economics Staff Paper 95-2[3]

May 1995

---

[1]A revised version of this paper has been submitted to **Amer J Alternative Agric** for possible publishing.

[2]Taylor and Feuz are Agricultural Economists; Guan is a former Graduate Research Assistant; Economics Department, South Dakota State University, Box 504A, Brookings, S.D. 57007-0895.

[3]Papers in this series are reproduced and distributed to encourage discussion of research, extension, teaching, and public policy issues. Although available to anyone on request, Economics Department Staff papers are intended primarily for peers and policy makers. Papers are normally critiqued by some colleagues prior to publication in this series. However, they are not subject to the formal review requirements of SDSU's Agricultural Experiment Station and Cooperative Extension Service publications.

ORGANIC VERSUS SUSTAINABLE FED CATTLE PRODUCTION: A SOUTH DAKOTA CASE STUDY

TABLE OF CONTENTS

LIST OF TABLES

ABSTRACT

This is an exploratory study of "organic" versus "sustainable" agriculture applied to fed cattle production. Two interrelated premises underlie the study. The paramount factors considered in current certification standards for organic beef production, in our judgment, are (1) protection of animal health and welfare and (2) production of a differentiated product intended to be conducive to consumer health and which, therefore, will command a price premium in the market. Second, we believe the concept of sustainability embraces concerns extending beyond those currently embodied in organic production standards.

The theme of organic versus sustainable fed cattle production is examined through development and verification of two production indices: a Producer Organic Index (POI) and a Producer Sustainability Index (PSI). The POI reflects current production standards for organically certified beef. The PSI reflects a broader range of concerns, including long-term natural resource conservation and economic staying-power of cattle producers.

Results of the study show there may be only a loose connection between current certification standards for organic beef production and conditions for sustainable beef production. Factors conducive to production of organic and sustainable beef production are identified. The methodology embodied in development of the producer indices can be used to provide insights to beef cattle extension specialists and individual cattle producers on strengths and weaknesses in current feedlot management practices.

ORGANIC VERSUS SUSTAINABLE FED CATTLE PRODUCTION: A SOUTH DAKOTA CASE STUDY

Donald C. Taylor, Dillon M. Feuz, and Ming Guan

INTRODUCTION

In this article, results of an exploratory study on "organic" versus "sustainable" fed cattle production in South Dakota are presented. The study involves development and empirical verification of two separate indices: one designed to reflect organic dimensions of fed cattle production and the other broader sustainable dimensions of fed cattle production.

A key inspiration for this study was the cover story of the Winter 1993 issue of **Organic Farmer: The Digest of Sustainable Agriculture** which bore the title, "Organic and sustainable: Debate or dialogue?" In that cover story, attention was drawn to "changing self-definitions of a changing constituency" concerning the terms "organic" and "sustainable" (Gershuny, 1993, p 7). To convey the diversity of thinking among farmers and "activists" in the country, several people were asked to respond to three questions: "What is the difference between organic agriculture and sustainable agriculture?" "Which do you feel more comfortable with?" "What negative associations do you have with either one?" A sampling of responses follows (OFDSA, 1993, pp 14-21).

> The transformative power of these developments (regarding sustainable agriculture) has been limited by corralling organic agriculture into a narrow arena of specialized production and niche marketing, while sustainable agriculture has broadened to include any new initiative in agricultural development, research, and policy (Forster).
>
> Organic is used to describe a production system that largely excludes the use of synthetic chemicals... Sustainable agriculture (is) inclusive of other factors .. pivotal to the long-term success of agriculture (Wonnacott).
>
> Organic agriculture is merely one model of sustainability... The producer who qualifies as organic simply because he does not use any "unacceptable" materials to produce his crops, but who does nothing to recycle nutrients or to create a healthy, diverse growing environment to naturally control pests, will find himself mining the soil and wasting resources in a manner that cannot be sustained. Organic agriculture that only seeks to avoid using "unacceptable" materials to qualify for the safe food market cannot be sustained over the long term and does not deserve the label "organic" (Kirschenmann).
>
> The more organic agriculture focuses on the marketing aspect, the more it looses relevance for the wider challenges for sustainability in agriculture as a whole... I have little comfort with either term since one is too narrow, the other too broad (Wollan).

Our own view is that current standards governing organic beef production are aimed most directly at insuring the health and welfare of animals and producing a differentiated product believed by organic certifying authorities to be conducive to the health of consumers. We believe that sustainable beef production involves not only these concerns, but also efforts aimed at conserving natural resources and ecological balances and helping ensure the economic survival of food producers.[1]

HISTORICAL BACKGROUND

The U.S. government's traditional "free-market" posture toward possible regulated cattle production has contrasted strongly with that in Europe. In 1990, however, the U.S. took an initial step toward developing regulations covering cattle production.

Europe

As early as 1911, Great Britain passed The Protection of Animals Act in which various acts of cruelty toward domestic and captive animals were delineated. The Agriculture (Miscellaneous Provisions) Act of 1968 is the principal piece of legislation applying today to the welfare of animals in Great Britain. Among other things, this act (Ewbank, 1988, p 6):

> (1) Makes it an offense to cause unnecessary pain or unnecessary distress to livestock being kept for farming purposes on agricultural land; (2) gives authority for veterinary officers ... to inspect, on welfare grounds, farms where livestock are being kept; and (3) empowers the appropriate minister to introduce regulations to improve the welfare of livestock.

In 1976, the Council of Europe passed the European Convention for the Protection of Animals Kept for Farming Purposes. Through this convention, livestock producers are required to meet the "physiological and ethological (behavioral) needs" of farm animals. Physiological needs are expressed in terms of dietary and exercise requirements. Behavioral needs are expressed, among other ways, in terms of five freedoms: "An animal should at least have sufficient freedom of movement to be able without difficulty, to turn round, groom itself, get up, lie down, and stretch its limbs" (Ewbank, 1988, pp 3-4).

A special case of regulated cattle production involves "organic" production certification standards. For years, several European countries have had their own individual "organic" certification standards (e.g., Skal, 1991). In 1992, European Union Regulation 2091/92 was passed in which broad organic standards for commodities sold in the European community are delineated (Manley, 1994, p 12). Based on the broad outline of EU Reg 2091/92, detailed animal production standards are now being developed (NFG, 1994, p 7).

---

[1]Social, family, community, and other institutional dimensions of sustainability do not receive attention in this article.

United States

Until very recently in the United States, the U.S. Department of Agriculture has exercised no regulatory control over cattle production practices. Its primary roles have been to provide (1) inspection services over slaughter of cattle and (2) inspection and grading services for carcasses and finished meat products (Wilder, 1991, p 128).

In 1990, however, the U.S. Congress passed the Food, Agriculture, Conservation, and Trade Act which directs the U.S. Department of Agriculture to exert more authority in the area of cattle production. The Act provides voluntary programs designed to create a more environmentally and economically sustainable livestock production system. The programs include the Integrated Farm Management Option, Integrated Management Systems research, and portions of the Conservation Reserve Program (Wilder, 1991, pp 3-4).

The Food, Agriculture, Conservation, and Trade Act also contains--for the first time in U.S. history--an Organic Certification title. The purposes of this title are to (1) establish national standards governing the marketing of organically produced commodities, (2) assure consumers that organically produced commodities meet a consistent standard, and (3) facilitate interstate commerce in organic products (OFPA, 1990, p 3935). The title called for establishment of a National Organic Standards Board (NOSB) to "assist in the development of standards for substances to be used in organic production and to advise the Secretary on any other aspects of the implementation of the title" (OFPA, 1990, p 3947). The NOSB is making progress in fulfilling its mandate, but is yet to finalize its recommendations (USDA, 1995).

In the initial conception of the research reported in this article, our research team gained especially useful insights from Francis Blake, one of the primary architects of Europe's organic agricultural production and marketing certification standards, and from the European literature on organic agricultural production. Early on, we also decided to develop not only a fed cattle organic index reflecting standards of various organic certifying organizations, but also a sustainability index based on a broader set of criteria. The research reported herein is intended to support the NOSB effort in developing U.S. certification standards for organic beef production.

CONCEPTUAL DEVELOPMENT: FED CATTLE ORGANIC AND SUSTAINABILITY INDICES

In this section, common approaches in the conceptual development of the organic and sustainability indices for fed cattle production are first indicated. The nature and rationale for the procedures used in creating unique organic and sustainability indices for fed cattle production are then explained. Finally, the nature and significance of contrasting weights for various practices in the organic and sustainability indices are discussed.[2]

Common approaches with two indices

The general philosophy and approach followed in developing the fed cattle producer organic and sustainable indices (POI and PSI) reported in this article are patterned after the philosophy and approach that Taylor et al. (1993) used in developing the Farmer Sustainability Index (FSI) for cabbage production in Malaysia. A basic presupposition in both studies is that organic and sustainable production practices are multifaceted and, therefore, the organic or sustainable dimensions of producers' practices must be measured on a continuum rather than in a discrete "0-1" format.

With both studies, scores were first assigned to individual production practices, then grouped according to substantive production and natural resource subject areas, and finally combined into composite individual producer scores. The composite scores are intended to reflect the degree to which the various producers follow organic and sustainable practices.

As with the FSI, the fed cattle POI and PSI were developed prior to attention being given to the empirical data-set covering producers' management practices.[3] Various management practices were scored according to an appraisal of their inherent organic and sustainable content, with:

* Plus scores being assigned to individual practices believed to contribute to organic or sustainable production, zero scores to practices neutral to organic or sustainable production, and minus scores to practices detracting from organic or sustainable production; and

* Higher scores being assigned to individual practices and different types of practices contributing relatively more to (or detracting relatively more from) the "ideal standards" of organic or sustainable production.

---

[2]For a more complete development of the issues covered in this section and a complete delineation of the nature and rationale for each component included in the fed cattle POI and PSI, see Taylor and Feuz (1993).

[3]However, as explained later, the management practices included in the fed cattle POI and PSI were based on questions included in the winter 1991-92 questionnaire in which information on management practices being followed by South Dakota cattle feeders was solicited (Taylor and Feuz, 1993, pp 64-67).

With the FSI for cabbage producers, attention was given to management practices for achieving insect control, disease control, weed control, soil fertility maintenance and enhancement, and soil erosion control. With the POI and PSI for fed cattle producers, attention was given to four types of production practices: feeding, health management, manure management, and drinking water access and quality. With the PSI, attention was also given to overall farm and ranch management.

Fed cattle producer organic index (POI)

Since the U.S. does not yet have official national organic beef certification standards, the fed cattle POI was based on a joint consideration of standards in effect as of June 1993 for the following eight organic certification sources:

* California Certified Organic Farmers, as reflected in their 1993 Certification Handbook (CCOF, 1993);

* International Federation of Organic Agriculture Movements, (a) "1989 standards" (IFOAM, 1989) and (b) minutes from January 30-February 2, 1991 Animal Standards Sub-Committee, chaired by Francis Blake, Technical Director, Soil Association, Bristol, U.K. (IFOAM, 1991);

* National Organic Standards Board Livestock Committee, as reflected in a March 1992 report to the National Organic Standards Board (NOSB) of the results of a mail survey of 252 organic livestock producers (NOSBLC, 1992);

* NOSB Livestock Committee, as reflected in a statement covering "national standards for organic production" distributed on March 17, 1993 for response by the public (NOSBLC, 1993);

* Northern Plains Sustainable Agriculture Society, as reflected in NPSAS's "guiding philosophy" for organic livestock production (NPSAS, 1992);

* Organic Crop Improvement Association, as reflected in their 1993 certification standards (OCIA, 1993);

* Organic Food Production Act of 1990, broad organic certification guidelines (OFPA, 1990); and

* Organic Food Producers Association of North America, as reflected in draft statements "written by committees of OFPANA and Organic Farmers Association Council (OFAC) members," which bear the date of June 1, 1992 (OFPANA, 1992).

In general, the practices covered by these organic certification sources have rather direct implications to animal health and welfare and human health, and involve natural rather than synthetic inputs. Many of the production practices covered in organic standards are intended to result in production of differentiated "organically certified beef" which some consumers will perceive to be healthier and tastier and for which they, therefore, will be willing to pay a premium.

In scoring the individual fed cattle management practices comprising the POI, primary attention was given to whether (1) all eight (rather than only some) of the referenced organic certification sources had established standards for the practice and (2) the standards from the various sources for the practice were pointed clearly in one common direction. To the extent that both conditions prevailed, higher scores were given. Plus scores were assigned to required and recommended practices and minus scores to prohibited practices.

To illustrate, since all eight sources require the exclusive feeding of organically produced feedstuffs, a large weight was given to this practice in the POI. Since only four of the eight sources have explicit standards on drinking water, practices concerning drinking water access and quality received a lesser weight in the POI. Seven of the eight sources recommend cautious use of parasiticides. However, since some organizations provide greater latitude than others on possible use of parasiticides, producers who "regularly" use parasiticides received a negative but only relatively modest score in the POI.

Fed cattle producer sustainability index (PSI)

Two main underlying principles were involved in development of the fed cattle PSI. Attention was given to joint short- and long-term implications of various production practices to productivity, profitability (both average level and year-to-year variability), environmental quality (water and soil resources), animal health and welfare, and human health and safety. Second, high plus scores were assigned to practices strongly recommended to producers by animal and range scientists, veterinarians, and agricultural engineers. At the other end of the continuum, high negative scores were assigned to practices which generally are not recommended to producers.

While these principles governed development of the indices, two factors constrained simple, full application of the principles. First, research resource limitations precluded simultaneous development of (1) the substantive content of the indices and (2) questions that could later be asked of producers for real-world verification of the indices. Rather, the practices that could be included in the indices and later be used in verifying the indices were limited to those which had been included in a questionnaire administered prior to development of the indices (Taylor and Feuz, 1993, pp 64-67). If the substantive detail provided in the questionnaire on certain aspects of sustainability was only limited, the weight assigned to that aspect in the index was less than would have been merited if "full" information on the aspect had been available.

Second, the judgment of different natural and social scientists and farm producers sometimes differed on the production, profit, environmental, animal health and welfare, and human health and safety implications of certain production practices. Contrasting views were particularly evident for practices which had implications that, from one standpoint, contradicted those from another standpoint. An example is whether producers with low debt-to-asset ratios should be "rewarded" with plus scores because of their lesser vulnerability to debt default, or should be "punished" with minus scores because of their failing to take advantage of possibilities for lower per-unit production costs sometimes derived through economies-of-scale.

In other instances, the judgment of one or more well-qualified resource personnel contradicted that of other apparently well-qualified resource personnel. For example, concerning parasiticide use, two commentators indicated the following:

> Don't even think about a minus value for a rancher who regularly worms and "pours" his cows! It has been shown in trial after trial that regular worming and lice control is a very good and profitable practice. Give a + 2 for regular use, a 0 for sometimes, and a - 2 for never.

> Use of parasiticides is an important indicator of the balance and sustainability of a system. The best run operations will be using none--as their rotation system, health promotion program, and general management will be so well-honed that they do not need them. Regular use indicates that there is a breakdown in the system, i.e., it is not sustainable "biologically..." So although many operations may use some, particularly as their systems settle down and achieve balance, I would suggest that regular use should be accorded a high negative score and no use a high positive score.

For practices in which the judgments of various resource personnel did not converge, either modest scores were assigned or the practices were assumed to be neutral in their impact to sustainability.

POI and PSI scores assigned to different practices

In this section, we first illustrate the scoring of selected fed cattle managerial practices comprising the POI and PSI. We then present an overview of the weights given to all practices comprising each of the POI and PSI.

Scoring selected feeding practices. Producers providing fed cattle with diets in which the importance of grains relative to roughages exceeded the threshold levels shown in Table 1 were assigned negative scores. Various types of feeding systems--defined in terms of the relative importance of grazing versus confinement feeding--were scored either negatively or positively, as shown in Table 1. The rationale for the scoring of these feeding practices is as follows.

For the POI, only one of the eight organic certification sources takes a position on the grain-roughage mix in fed cattle rations. IFOAM (1989, pp 26, 38) states that "For ruminants, forage should constitute no less than 60% of the total daily dry matter intake" ... "High energy, low fiber rations and those with more than 40% dry matter concentrate feeds" are prohibited. The negative scoring and single threshold level for percentage of grain to total dry matter intake

Table 1. Scores assigned to selected feeding practices in fed cattle production, POI and PSI.

Feeding practice	Score POI	Score PSI
Percentage grain to total dry matter intake fed to cattle[a]		
Backgrounded steers (500-750 lb): > 40%	- 8	- 8
Early finishing steers (750-950 lb):		
> 40%	- 6	n/a
> 70%	- 6	- 8
Late finishing steers (950+ lb)		
> 40%	- 4	n/a
> 80%	- 4	- 8
Feeding system		
Confinement feeding during entire feeding period	- 4	- 2
Grazing during part of backgrounding period, confinement feeding thereafter	- 2	0
Grazing during all the backgrounding period, confinement feeding thereafter	+ 2	0
Grazing, followed by a period of confinement feeding for < 100 days	+ 4	0

[a]Zero scores were assigned in instances in which the feeding conditions stipulated below were not met.

for the three different stages of feeding shown for the POI in Table 1 reflect this requirement. Results of animal nutrition research underlie the negative scores being smaller during later feeding stages.

Five organic certification sources take the following positions regarding the role of confinement feeding versus grazing in fed cattle production. CCOF (1993, p 20) states that "CCOF livestock producers are encouraged to provide all animals with access to pasture or outside runs..." IFOAM (1989, p 25) states that "all stock should have access to pasture during the grazing season unless ..." NOSBLC (1993, p 14) states that "year-round confinement of livestock to an outdoor drylot without seasonal access to pasture or grazing land shall be prohibited." NPSAS (1992, p 1) states that "stock should have access to outdoor range." OFPANA (1992, p 3) states that organic livestock shall have "access to pasture and sunshine when seasonally and ecologically sound." Based on these statements, we assigned the POI scores for feeding systems shown in Table 1.

The rationale for assigning the indicated scores to the two feeding practices for the PSI is as follows. Beef cattle, as ruminants, are uniquely designed to make effective use of roughages. In many areas, beef cattle can make more effective use of rangeland and forages in crop rotations than other livestock species. From this standpoint, feeding beef cattle high proportions of concentrates can conflict with effective and efficient natural resource use. Including "excessively" high proportions of concentrates in finishing cattle diets can, in some instances, also detract from cattle health and welfare and/or result in production of meat with levels of fat which may be harmful to human health. On the other hand, the positive potential of some top-quality, fast-growth genetic feeder calves today can be more fully realized--without penalty of excessive fat--if the calves are placed on heavy concentrate rations from weaning to little more than a year of age when they are ready for slaughter.

Scoring use of growth promotants and antibiotics. POI scores for growth promotants shown in Table 2 are based on a strong consensus among the eight organic certification sources that "organic" producers should not use growth promotants and hormones. Because single component animal production research shows cattle receiving growth promotants to have improved daily weight gain, feed conversion efficiency, and lean meat development, PSI scores for growth promotants differ substantially from those for the POI. The magnitude of plus scores for growth promotants in the PSI is relatively modest, however, because of some question on whether continued reliance on growth promotants over time is commensurate with long-term sustainable cattle production.

Table 2. Scores assigned to use of growth promotants and antibiotics in fed cattle production, POI and PSI.

Type of use	Score POI	Score PSI
Growth promotant use		
No cattle	0	- 1
Some cattle	- 8	+ 1
All cattle	-16	+ 2
Antibiotic use		
Treat specific sicknesses/injuries	+ 8	+ 4
Subtherapeutic	- 8	- 2
Newly purchased cattle upon arrival at feedlot	- 4	+ 2
Never used	- 4	- 4

The following positions on antibiotic use with fed cattle are taken by the eight organic certification sources.

* CCOF (1993, pp 20-21, 29) states that (1) "subtherapeutic feeding" and "routine" use of antibiotics are prohibited and (2) "livestock producers must never deny treatment to an ill animal so that its products may be labeled 'organic'."

* IFOAM (1989, pp 28-29) says that "the aim should be to reduce the use of antibiotics to a minimum or, if possible, eliminate their use altogether... For conditions requiring treatment and where effective alternative treatments are not available, conventional drugs should be used, in particular to save life, to prevent unnecessary suffering, or to provide the only way to restore the animal to full health. Treatment should never be withheld where an animal is suffering. Withdrawal periods must be observed. Treatment of healthy animals and the routine use of prophylactic drugs is prohibited, except in cases of a known farm disease problem."

* NOSBLC (1992) reports controversy around whether animals treated with antibiotics "should be removed from the certified herd or if some extended withdrawal time is acceptable." Of all respondents, 32% supported prohibition of all antibiotic use; 65% of them supported allowing restricted use of antibiotics with extended withdrawal periods.

* NOSBLC (1993, pp 8, 13) states that "antibiotics--systemic and topical" are excluded from the National List of exempted synthetics... "The action of a producer to withhold treatment to maintain the organic status of an individual livestock animal which results in the otherwise avoidable suffering or death of the animal shall be grounds for decertification." The position of OFPANA (1992, pp 1, 3-4) is essentially the same.

* OFPA (1990, p 21-6) states that producers shall not "use subtherapeutic doses of antibiotics." The positions of NPSAS (1992, p 1) and OCIA (1993, p 5) are essentially the same.

Based on these statements, we assigned the POI scores for antibiotics shown in Table 2.

The rationale for the PSI scoring of antibiotic use shown in Table 2 is as follows. It is conceivable that some cattle feeders would follow such finely-tuned management practices that no animals would become sick or injured and, therefore, they would be well-advised to never use antibiotics. Because some types of sickness and/or injury are likely with the vast majority of feedlots, however, we chose to assign (1) positive scores to producers who use antibiotics to treat specific sicknesses/injuries and (2) negative scores to those who never use antibiotics. Animal productivity and welfare are almost certain to be sacrificed on occasion, if producers follow a "blanket" policy of never using antibiotics.

From the standpoints of cattle developing resistance over time and prospective benefits likely being less than costs from continuous use of antibiotics, we assigned a negative score to producers who regularly include subtherapeutic doses of antibiotics in their feed. On the other hand, producers who use antibiotics with newly purchased feeder cattle were assigned mildly positive scores. A practice of using antibiotics prophylactically with calves just placed in the feedlot, particularly for calves from different sources, is likely to result in healthier calves that will earn higher profits.

Comprehensive overview of weights assigned to management practices. Table 3 shows the relative weights assigned to all management practices covered in the POI and PSI. For the above discussed practices, the weights in Table 3 reflect the indicated scores as percentages of the respective total absolute scores of 219 for the POI and 214.5 for the PSI (Taylor and Feuz, 1993, pp 39, 48). For example, a producer feeding more than 40% grain-to-total-dry-matter-intake during each of the three feeding stages would earn a maximum POI score of - 18, which is 8.2% of 219. Similarly, the maximum possible PSI score for the grain-to-total-dry-matter-intake practice would be - 24 or 11.2% of 214.5.

In seeking to identify major contrasts between the POI and PSI, we note management practices unique to each index. Those unique to the POI are feeding "organically" produced feedstuffs, prohibiting "alternative" feeds, and maintaining health records on individual animals (to provide an "audit trail"). Organic certification authorities believe that these practices--plus the absence of antibiotics (except in cases of extreme sickness or injury) and growth promotants--contribute to sounder health and welfare of animals and help insure meat products for consumers that are free of possible harmful chemical residues.

Table 3. Relative weights assigned to management practices covered in POI and PSI.

Management practice	Weight in total index (%) POI	PSI
Feeding		
Feeding "organically" produced feedstuffs	15.1	0
"Alternative" feeds prohibited, e.g., plastic pellets for roughage, recycled manure, urea, anhydrous ammonia, sawdust and other non-food ingredients	12.3	0
Percentage grain to total dry matter intake in cattle rations	8.2	11.2
Feeding system: Confinement during entire feeding period	3.7	0.9
Percentages of various feedstuffs that are home-raised	0	5.6
Selected feed management practices followed (viz., feedstuff nutrient composition tested at least once a year, feed records kept for separate pens of cattle, feed scales used)	0	5.6
Sub-total	39.3	23.3
Health management		
Nature of use of production tools, viz., antibiotics, growth promotants, inophores, coccidiosis control, parasiticides, insecticides/fumigants, vaccinations	25.5[a]	12.8
Selected features of cattle finishing operation (e.g., mounds, bedding shelterbelt windbreaks, feedlots partially paved with concrete)	7.8	8.4
Facilities available and used for segregating sick or injured animals	1.8	1.9
Records maintained on amounts and sources of medications administered to individual animals	1.8	0
Sub-total	36.9	23.1
Drinking water access/quality		
Drinking water quantity problems experienced	2.7	10.0
Drinking water quality problems experienced	3.7	6.4
If problems, actions taken to overcome the problems	3.7	6.4
Sub-total	10.1	22.8
Manure management		
Manure composted	5.5	3.7
Intensity of manure application	8.2	8.4
Sub-total	13.7	12.1
Overall farm/ranch and cattle management		
Farm/ranch debt-to-asset ratio	0	4.7
Percentage family labor used in feeding cattle	0	4.7
Percentage feedlot utilization	0	3.7
Percentage total cattle place on feed that are home-raised	0	2.8
Cattle weights monitored	0	1.9
Have grain storage facilities to take advantage of price drops in purchased feed grains	0	0.9
Sub-total	0	18.7
TOTAL	100.0	100.0

[a]Attention is given in the POI to only the following production tools: antibiotics, growth promotants, parasiticides, and vaccinations.

Practices unique to the PSI concern a variety of farm and ranch, feeding, and cattle management practices and the home-raising of feedstuffs. Evidence is rather strong that attention to management practices like those included in the PSI will contribute to improved physical and economic performance of cattle and more efficient and less risky long-term use of producers' limited financial resources.

Home-raising of feedstuffs is included in the PSI because, the greater the proportion of a producer's total feedstuffs that is home-raised, (1) the less fossil fuel energy and out-of-pocket expenditure required for transporting feedstuffs and (2) the less the exposure of the producer to possible difficulties in having to purchase high-priced feedstuffs in short supply. Thus, other things the same, producers who home-raise large proportions of feedstuffs are likely to have greater long-term "staying power" than those who routinely depend heavily on purchased feedstuffs. Home-raising, rather than purchasing, feedstuffs can also give producers greater assurance that their cattle will be fed uniformly high quality feedstuffs. On the other hand, it is conceivable that some otherwise sustainable producers might find the prices of certain purchased feedstuffs to be less than their own costs of producing the feedstuffs.

Finally, we wish to comment on manure management practices. Only three of the eight organic certification sources take a position on manure management. CCOF (1993, pp 25, 32) and OCIA (1993, p 2) both recommend composting manure and applying manure to land in particular ways. OFPA (1990, p 21-9) is the only source that places explicit emphasis on limiting land manure applications to levels that will not contaminate soil and water. We believe that a major challenge to sustainable beef cattle production is insuring that soil and water resources are not damaged by possible point source and non-point sources of pollution associated with animal wastes (Batie, 1993; Taylor and Rickerl, 1995). Although information limitations did not permit much attention to this issue in the PSI reported in this article, we would advocate greater attention to practices related to possible soil and water degradation in future efforts to improve the PSI and, more importantly, by authorities in establishing standards for organic beef production.

EMPIRICAL ESTIMATION: SOUTH DAKOTA FED CATTLE POI AND PSI

Feedlots studied

Data for the empirical verification of the fed cattle POI and PSI were taken from the responses of 102 cattle feeders to a winter 1991-92 mail survey questionnaire in South Dakota.[4] The design capacity for the 102 feedlots covered in this study ranges from 11 to 6,665 head and averages 935 head. On average, these feedlots are 12.5 times larger than the state-wide average of 75 head (USDC, 1989, p 28).

Seventy-one percent of the studied cattle feeders have livestock enterprises other than cattle feeding. Sixty-four percent have beef cow herds, 15% sell feeder calves, and 9% sell stocker cattle. Eighteen percent of the cattle feeders market slaughter hogs; 14% have farrowing operations. Eleven percent have dairy herds; fewer than 5% have either supplemental sheep or poultry enterprises.

The average area of cropland operated by the 102 feedlot managers is 1,375 acres, which is 2.3 times the average of 605 acres for farms/ranches throughout the state (USDC, 1989, p 7). Slightly more than 42% of the feeders realize more than 75% of their annual gross farm income from the sale of livestock. At the other extreme, less than 5% of them realize less than 25% of gross income from livestock.

The average age of the 102 feedlot managers is 48 years, which is just under the average age of 50 years for farmers/ranchers throughout the state (USDC, 1989, p 1). About 12% of the feedlot managers indicate they own their farms/ranches debt free. At the other extreme, 30% report debt-to-asset ratios of 0.40 or greater.

Empirical estimation procedures

The procedures for estimating POI and PSI values for the 102 cattle feeders in South Dakota were generally similar to those used in developing the FSI for cabbage producers in Malaysia (Taylor et al., 1993). Procedures for imputing values for missing data and adjusting final fed cattle POI and PSI values to 0-100 scales were identical to those for the FSI.

However, the steps involving item selection, bivariate selection, and index validation through item analysis that resulted in dropping some practices from the final FSI were not followed with the fed cattle POI and PSI. This decision was based on a judgment that the practices included in the fed cattle indices should be based on an a priori assessment of the importance of particular practices, rather than on whether the practices included in the final indices met certain statistical criteria. Also, the external validation procedure with the fed cattle

---

[4]Thirty five of the respondents were from a 12% randomly selected sample of cattle feeders with < 500 head design capacity, 48 of the respondents were from a survey directed to all cattle feeders with a design capacity of > 500 head design capacity, and 4 respondents were identified in advance as likely to be following organic beef production practices. The managerial practices followed by the 98 respondents are reported in Taylor and Feuz (1994).

POI and PSI involved the research team communicating individually with 17 farm producers, organic certifying organization officials, and natural and social scientists at two different stages in development of the indices, rather than with two panels of 4-6 natural scientists as in the FSI study.

Estimated POI and PSI[5]

Composite POI values range among the 102 feedlot managers from 31 to 82 and average 49 (Table 4). The POI values among feedlot managers are somewhat positively skewed, with 10% of the values less than 40, about 70% in the range of 40-55, and 20% greater than 55.

Table 4. Estimated composite POI and PSI values, 102 cattle feeders.

POI		PSI	
Range	31.2-81.7	Range	49.2-80.6
Mean	49.4	Mean	65.8
Frequency distribution (%)		Frequency distribution (%)	
0.0 - 40.0	9.8	0.0 - 55.0	8.8
40.1 - 45.0	24.5	55.1 - 60.0	12.7
45.1 - 50.0	22.6	60.1 - 65.0	21.6
50.1 - 55.0	23.5	65.1 - 70.0	28.4
55.1 - 60.0	9.8	70.1 - 75.0	16.7
> 60.0	9.8	> 75.0	11.8

To assess the stability of the baseline POI results reported in Table 4, a sensitivity analysis was undertaken in which, one-at-a-time, the weight for each of the four type-of-practice groups (see type-of-practice sub-totals in Table 3) was adjusted up by 30%, while the weights for the other type-of-practice groups were adjusted down so that the total POI score in each sensitivity analysis was the same as in the baseline POI. Rankings of the 102 feedlots were determined under each sensitivity test. A Spearman's rank correlation analysis was then undertaken to determine if the POI ranking of the feedlots under each sensitivity test differed significantly from the baseline POI feedlot ranking. The rank differences were statistically insignificant ($P < 0.10$) for the four sensitivity tests, thereby indicating that the baseline POI is stable.

Attention was given to determining the relative average strength of the 102 feedlot operators in the areas of feeding, health management, manure management, versus drinking water. To do this, the score earned by each producer for each type-of-practice group was computed as a percentage of the total possible score that could have been earned for that type-of-

[5]Data for this section are taken from Guan (1994).

practice group. The means of the percentages for all producers for the various types-of-practices are displayed in the first panel of Table 5. This analysis shows that the feedlot operators studied are stronger in their drinking water (65%) and health management (61%) practices than in their manure management (39%) and feeding (37%) practices.

Table 5. Mean scores for various types of production practices, by POI category, 102 cattle feeders.

	Mean type-of-practice score			
POI	Feeding	Health management	Manure management	Drinking water access/quality
Overall mean	37.4	61.4	38.9	64.9
Range in POI values				
0.0 - 39.9	28.3	45.5	11.3	63.6
40.0 - 49.9	31.0	60.0	31.4	64.4
50.0 - 59.9	40.5	64.9	52.5	65.8
60.0 - 69.9	64.2	69.4	46.7	66.2
70.0 or more	72.8	79.7	91.7	63.6

Intuitive attention was also given to determining whether and, if so, the degree to which producers with higher POI values tend to also be relatively strong in one or more of the individual types of management practices. To do this, the 102 feedlots studied were segregated into five consecutive ranges of POI values, and mean percentages for each POI feedlot category for each type-of-practice group were computed. These means are displayed in the second panel of Table 5. This analysis shows generally consistent patterns between feedlot POI categories and the quality of each of feeding, health management, and manure management practices, but no pattern of relationship with drinking water. The degree of difference between feedlots with high POI values and those with low POI values is greater for manure management and feeding practices than for health management practices.

Composite PSI values range among the 102 feedlot managers from 49 to 81 and average 66 (Table 4). The PSI values among feedlot managers are somewhat negatively skewed, with 22% of the values less than 60, about 66% in the range of 60-75, and 12% greater than 75. A baseline PSI sensitivity analysis, similar to that described above for the baseline POI, showed the baseline PSI to be stable.

From the standpoint of sustainability, feedlot operators studied are strongest in health management (80%), followed by drinking water (72%), feeding (63%), overall farm/ranch management (53%), and manure management (46%) (Table 6). Patterns between feedlot PSI categories and the quality of each of type-of-management practice, except drinking water, are generally positive. The degree of difference between feedlots with high PSI values and those with low PSI values is greatest for manure management, followed by feeding, overall farm and ranch management, and health management practices.

Table 6. Mean scores for various types of production practices, by PSI category.

PSI	Mean type-of-practice score				
	Feeding	Health management	Manure management	Drinking water access/quality	Overall farm/ranch management
Overall mean	63.1	80.1	45.5	71.5	53.4
Range in PSI values					
0.0 - 54.9	32.7	75.9	15.9	70.9	43.3
55.0 - 59.9	48.7	78.4	15.4	69.7	46.3
60.0 - 64.9	57.8	78.6	35.2	69.3	45.8
65.0 - 69.9	66.8	78.0	52.6	72.3	57.1
70.0 - 74.9	75.3	86.1	60.2	71.2	59.7
75.0 or more	84.1	84.3	81.7	76.6	64.2

In the prior section, attention was drawn to substantive differences in the types of managerial practices included in the POI versus the PSI. To determine whether the POI rankings of the 102 feedlots differed significantly from the PSI rankings for the feedlots, a Spearman's rank correlation analysis of the respective POI and PSI feedlot rankings was undertaken. The estimated rank correlation coefficient of 0.46 differs significantly from zero ($P < 0.01$), indicating that the ranking of the feedlots via the POI is not significantly different from the ranking via the PSI. However, only 21% of the variation in the POI is associated with variation in the PSI. Thus, the organic certification standards for organic beef for the eight sources considered in this study appear to be only rather loosely related to sustainable beef production practices.

FACTORS ASSOCIATED WITH ADOPTION OF ORGANIC AND SUSTAINABLE PRACTICES

A multiple regression analysis was undertaken to determine factors associated with adoption of organic and sustainable practices. Two separate estimations were made: one with POI and the other with PSI as the dependent variable. The following types of independent variables were considered in this analysis: farm size, farm type, farm location, family characteristics, manager attitude-belief, and self-identification (organic versus mainstream).

The nature and hypothesized relationship to the POI and PSI for each of the 16 independent variables were as follows.

Farm size variables

FeedlCap = feedlot design capacity (head): Inverse relationship, since the managerial and labor requirements for organic and sustainable production may be greater than for mainstream production.

CropAcre = acres cropland: Inverse relationship, for same reason as **FeedlCap**.

Farm type variables

OtherLSt = livestock other than fed cattle on farm (yes = 1; no = 0): Direct relationship, since enterprise diversification can be a means for achieving organic and sustainable production.

LandOwn = percentage of total land operated that is owned: Direct relationship, since operators who own the land they operate may have greater incentive to protect their soil and water resources from long-term degradation.

LStIncom = percentage of gross farm income from livestock: Direct relationship for same reason as **OtherLSt**.

Farm location variables

WestReg = feedlots located west of the Missouri River (yes = 1, no = 0): Direct relationship, since research on crop production in South Dakota shows farmers in the west to generally follow production practices that are more sustainable than those in the east.

NoEaReg = feedlots located in the northeastern part of the state (yes = 1, no = 0): No hypothesized relationship.

SoEaReg = feedlots located in the southeastern part of the state (yes = 1, no = 0): No hypothesized relationship.

Family characteristic variables

FaOffFaE = farmer employed off-farm (yes = 1, no = 0): Uncertain, since off-farm income could help to make up for possibly less farm income for organic and sustainable producers than for mainstream producers, thereby leading to an hypothesized direct relationship; but the relationship could be inverse, since managerial and labor requirements for organic and sustainable production may be greater than for mainstream production.

FaCustWk = farmer does off-farm custom work (yes = 1, no = 0): Uncertain for same reason as **FaOffFaE**.

Married = farmer married (yes = 1, no = 0): Direct relationship, since a spouse can assist a farm manager in carrying out managerial and labor requirements that may be greater for organic and sustainable than mainstream production and/or earn off-farm income to supplement farm income.

SpOffFaE = farmer's spouse employed off-farm (yes = 1, no = 0): Uncertain, with same reasoning as for **FaOffFaE**.

Manager attitude-belief variable

IonoCost = farmer uses ionophores to reduce production costs (yes = 1, no = 0): Inverse relationship with POI, since organic farmers tend to use natural rather than synthetic inputs; positive relationship with PSI, since single component research shows ionophores to contribute to improved feed conversion and general animal health.

Self-identification variables

Organic = farmers consider themselves to follow organic production practices (yes = 1, no = 0): Direct relationship since the perceived nature of farmers' practices is expected to be consistent with their actual practices, as measured by POI and PSI.

Main-Org = farmers consider themselves to follow some organic and some mainstream production practices (yes = 1, no = 0): Direct relationship, with same reasoning as for **Organic**.

Mainstr = farmers consider themselves to follow mainstream/conventional production practices (yes = 1, no = 0): Inverse relationship, with same reasoning as for **Organic**.

Only two of the three self-identification variables were included in any one regression analysis, with the third condition being loaded in the intercept term. **Organic** and **Main-Org** were included in the first estimated regression model for both POI or PSI, with **Mainstr** = 0 (Model 1). Since the **Organic** variable was statistically significant in the PSI regression, the regression was rerun with **Organic** and **Mainstr** included in the model and with **Main-Org** = 0 (Model 2).

In the multiple regression analysis, the SAS (1988, Chpt 28) REG-MAXR procedure was followed. With this software package, the factor-variables were forward-selected to fit the best 1-variable model, best 2-variable model, ..., and best 15-variable model. Variables were switched at each step so that R^2 was maximized. Once the complete model was estimated, the statistical properties at each successive step were examined. In determining the subset of factor-variables to include in a reduced model regression, joint consideration was given--at each step in the MAXR procedure--to the R^2 change and the number of statistically significant factor-variables and the signs of each.

The results of the reduced model multiple regression analyses are displayed in Table 7. All three overall regressions are statistically significant ($P < 0.01$). The percentages of variation in POI and PSI explained by the factor-variables included in the respective regressions are rather modest, ranging from 15% to 25%.

Table 7. Socio-economic factors associated with organic and sustainable cattle feeding.[a]

Regression features	POI	PSI Model 1	PSI Model 2
Regression parameters			
F-ratio of regression	3.57***	3.88***	3.35***
Adjusted R^2	14.8	24.5	23.3
Number of feedlots	74	62	62
Production coefficients			
CropAcre	- 0.00001**	+ 0.00001*	+ 0.00001*
FeedlCap	n/a	- 0.00002**	- 0.00002**
WestReg	n/a	+ 0.064*	+ 0.065*
SoEaReg	- 0.023ns	n/a	n/a
OtherLSt	+ 0.036**	+ 0.025ns	+ 0.024ns
FaOffFaE	+ 0.033*	n/a	n/a
SpOffFaE	+ 0.015ns	+ 0.049***	+ 0.049***
LStIncom	n/a	+ 0.029ns	0.029ns
Organic	n/a	- 0.151***	- 0.164**
Mainstr	n/a	n/a	- 0.014ns

[a]Levels of significance for the overall regression and the various production coefficients in each estimated regression are denoted as follows: *** = $P < 0.01$; ** = $P < 0.05$; * = $P < 0.10$; and ** = not significant ($P < 0.10$).

The only variable to be statistically significant in all three regressions is **CropAcre**. In the POI regression, its sign is minus, consistent with the hypothesized relationship. In the two PSI regressions, however, feedlot managers with higher PSI values unexpectedly operate larger crop acreages.

In the PSI regressions, both **FeedlCap** and **WestReg** are statistically significant. The signs on these variables are as hypothesized, indicating that PSI values are higher for smaller feedlots and feedlots located in the western part of the state.

In the POI regression, **OtherLSt** and **FaOffFaE** are statistically significant. In the PSI regressions, **SpOffFaE** is statistically significant. These results show feedlots with higher POI values to have supplemental livestock enterprises, as hypothesized. In three of six situations in which off-farm employment variables are statistically significant, the signs are positive. Thus, there is some evidence supporting the notion that farmers with higher POIs and PSIs tend to seek off-farm employment to augment farm income, rather than to spend added time on-farm meeting the possible greater managerial and labor requirements of organic and sustainable production.

Only one of the three self-identification variables is statistically significant, namely, **Organic** in the two PSI regressions. Its sign is unexpectedly negative, indicating that farmers who perceive themselves to follow organic production practices have lower PSI scores. One explanation is the possible loose connection noted above between a producer following organic production practices and scoring high on the PSI.

CONCLUSION

This exploratory study deals with comparisons and contrasts between "organic" and "sustainable" agricultural production. A principle underlying motivation for the study is concern that current certification standards for organically produced commodities fail to adequately incorporate attention to certain critical dimensions of sustainability.

The theme of organic versus sustainable production is developed through an examination of production management practices for fed cattle. The examination is undertaken through development and verification of two production indices: a Producer Organic Index (POI) and a Producer Sustainability Index (PSI). The POI reflects current production standards for organically certified beef in which paramount issues of concern are animal health and welfare and consumer health. The PSI was designed to also cover issues of long-term natural resource conservation and economic staying-power of cattle producers.

While the authors recognize that the substantive content of the production indices developed in this research requires further refining, we believe that the methodology developed in the study has interesting promise for providing insights to (1) policy-makers in further refining certification standards for organic beef production and determining approaches that might be followed to encourage adoption of organic and sustainable practices by agricultural producers, (2) extension specialists in identifying strengths and weaknesses in producers' current feedlot management practices, and (3) individual producers in identifying strengths and weaknesses in their current feedlot management practices. Illustrations of such insights are provided throughout the article.

REFERENCES CITED

Batie, S.S. (Chair). 1993. Soil and water quality: An agenda for agriculture. Committee on Long-Range Soil and Water Conserv, Bd on Agric, National Research Council. Washington, D.C.: National Academy Press.

CCOF. 1993. California certified organic farmer handbook. Santa Cruz, CA: California Cert Organic Farmers.

Ewbank, R. 1988. Animal welfare. IN Management of welfare of farm animals. The UFAW Handbook. London: Bailliere Tindall. (3rd ed).

Gershuny, 1993. Editor's note: Organic and sustainable: Debate or dialogue? **Organic Farmer: Digest of Sust Agric** 4(1):7.

Guan, M. 1994. Sustainable production practices adopted by beef cattle producers in South Dakota. M.S. thesis. Brookings, SD: Econ Dept, So Dak St Univ.

IFOAM. 1989. General standards for livestock husbandry. Bristol, UK: Soil Assoc.

IFOAM. 1991. Minutes: Animal standards sub-committee meeting (chaired by Francis Blake). Bristol, UK: Soil Assoc. Jan 30-Feb 2.

Manley. R. 1994. Comment: A mess in the market. **New Farmer & Grower (Britain's Journal for Organic Food Production)** 44:12-13. Autumn.

NFG. 1994. Changes to organic regulations proposed. **New Farmer & Grower (Britain's Journal for Organic Food Production)** 44:7. Spring.

NOSBLC. 1993. National standards for organic production. Washington, D.C.: National Organic Standards Bd Livestock Com. Mar 17.

NOSBLC. 1992. Report of the National Organic Standards Board of results of a mail survey of 252 organic producers. Washington, D.C.: National Organic Livestock Com. Mar.

NPSAS. 1992. A guiding philosophy for sustainable agriculture: Organic production standards and principles. Maida, ND: No Plains Sustain Agric Soc.

OCIA. 1993. OCIA certification standards. Bellefontaine, OH: Organic Crop Improvement Assoc.

OFDSA. 1993. Organic and sustainable: Debate or dialogue? **Organic Farmer: Digest of Sust Agric** 4(1):14-21.

OFPA. 1990. Organic foods production act of 1990. IN Food, Agriculture, Conservation, and Trade Act of 1990, Public Law 101-624, 101st Congress. Nov 28, pp 3359-4078.

OFPANA. 1992. Draft livestock standards. Committees of Organic Food Producers Assoc of No Amer and Organic Farmers Assoc Council. June 1.

SAS. 1988. SAS/STAT user's guide, release 6.03 edition. Cary, NC: SAS Institute, Inc.

Skal. 1991. Eko standards: Standards for sustainable organic agriculture and for processing organic agricultural products. Zwolle, Netherlands: Skal (Inspection Organization for organic production methods).

Taylor, D.C. and D.M. Feuz. 1993. Beef cattle producer "sustainability" and "organic" indices. Econ Staff Pap 93-6. Brookings, SD: Econ Dept, So Dak St Univ. Sept.

Taylor, D.C. and D.M. Feuz. 1994. Cattle feedlot management in South Dakota. Econ Res Rpt 94-1. Brookings, SD: Econ Dept, So Dak St Univ. Mar.

Taylor, D.C., Z.A. Mohammed, N.N. Shamsudin, M.G. Mohayidin, and E.F.C. Chiew. 1993. Creating a farmer sustainability index: A Malaysian case study. **Amer J Alter Agric** 8(4):175-184.

Taylor, D.C. and D.H. Rickerl. 1995. Livestock manure nutrient loadings on farmland: South Dakota case study. Manuscript submitted to **J Soil Water Conserv.**

USDA. 1995. National Organic Standards Board documents. Washington, D.C.: Agric Mktg Serv, Transp and Mktg Div, U.S. Dept of Agric. Mar.

USDC. 1989. 1987 Census of agriculture; Vol 1, Geographic area series; Part 41, South Dakota and county data. Washington, D.C.: Bureau of the Census, U.S. Dept of Commerce.

Wilder, J.R. 1991. Sustainable agriculture and the U.S. cattle industry: An examination of laws, production practices, and research studies. Master of Laws thesis. Fayetteville: University of Arkansas.