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Balancing the egoistic and empathic tendencies while seeking agrobiodiversity: Testing metaeconomics theory

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METHODOLOGICAL AND IDEOLOGICAL OPTIONS

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Abstract

Metaeconomics theory offers an alternative way to frame the environmental economics problem. It builds on biological tendencies for humans to seek a dynamic balance in both egoistic and empathic motivations, and on thermodynamics that highlights the fundamental interdependence among people and environment, leading to the justice problem. A natural tension and conflict persists among the forces, with an individual seeking new ways to achieve balance in a unique state of existence. Metaeconomics thinking facilitates the meta-economic value decision called for by Söllner(1997). Intergenerational (and contemporary) justice is addressed through empathy. Macro-economic limits on micro-behaviors become largely unnecessary subsequent to balancing the motivations toward the empathic side. The theory is tested for a sample of western Corn Belt, USA, farmers regarding their intentions to move away from monocropping and bicropping toward higher crop diversity. The results lend support to the theory that empathic commitment to others and the norms they represent along with profit-seeking jointly motivates economic actions and plans. We propose a metaeconomics that incorporates both thermodynamic and empathic realities, and can potentially yield valuable new understandings and solutions to environmental problems.

Keywords: Moral dimension; Self-interest; Others-interest; Intergenerational justice

1. Introduction

Perhaps nothing is more clear in reading this Journal than the ongoing quest by most if not all contributors for an alternative environmental economics theory to that deemed the mainstream. The latter is best characterized as what is generally referred to as neoclassical economics with perhaps the Chicago School providing the most consistent rendition of it. This perspective, a particular kind of economic theology (see Nelson, 1991), dominates the field of environmental economics as it does all other fields of economics generally. It reflects a particular rendition of human biology that has individuals in the singular pursuit of the self-interest, with the moral dimension not made explicit but nevertheless in place, and that this version of the moral dimension is the one appropriate philosophy, or economic theology, by which the people are to live. It is in this sense that neoclassical economics is amoral, in contrast to immoral, in its preaching on environmental issues, with it not explicitly addressing the justice problem on either the contemporary or intergenerational fronts.

One important track in this Journal has been to seek a thermodynamic basis for a new environmental economics. While progress has been made, it has been met with limited success. As Söllner (1997) notes, thermodynamics provides only a partial basis for a macro-economic complement to micro-economic based environmental policy. While it can provide (Söllner, 1997, p. 196) the ". . . leitmotiv for maintaining biodiversity and dealing with new technologies. . . thermodynamics cannot replace genuinely economic and political decisions." It is also the case that neoclassical economics also cannot succeed due to it only addressing the economic and not the

political, at least the latter is not made explicit in the analysis but rather is hidden in the underlying philosophy inherent in microeconomics theory (see Lynne, 1999).

The problem is, in addition to economic theory lacking thermodynamic reality, we lack an economic theory that explicitly handles the moral dimension, and thus the political dimension. This also means we lack theory that explicitly addresses the micro-to-macro (and macro-to-micro) transition. As characterized by Schelling (1978), we continue to experience a "micromotives, macrobehavior" problem on the economic and political end of the spectrum. We lack a social theory to address this problem even though many attempts have been made to develop one, e.g., see Coleman (1990), for an impressive, but unconvincing proposal, due to limiting the theory to modeling only the pursuit of self-interest in another amoral version of human behavior not dissimilar from the neoclassical economics tradition.

This paper proposes an alternative starting point for a unified social economic theory by recognizing the biological and evolutionary basis for both egoistic (self-interest) and empathic (others-interest) tendencies in individuals, which carry over to the larger society. We are able to go beyond considering only the self-interest tendencies within the individual by building on foundations in neuroscience; on scientific findings in psychological and other social science; and on older themes in philosophy. The primary objective of this paper is to contribute to the development of a new environmental metaeconomics theory that integrates ideas from these sciences and philosophy, and then subjects said integration to a rigorous empirical test.

The subject of this test relates to the broad concept of agrobiodiversity, defined as the "variability among living organisms associated with cultivating crops and rearing animals and the

ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems (UNEP, 1996, p. 6)." The unique aspect of agrobiodiversity is human management. Although biodiversity management has focused on natural areas such as national parks that account for only 5% of the worlds' land area, agriculture accounts for over 50% (Pimentel et al., 1992). Agrobiodiversity has a pervasive impact on rural economies, human health, and ecological sustainability across the world.

Farmers have used crop rotations for centuries to diversify production. In general, crop rotations provide the benefits of breaking pest cycles through greater diversity over space and time; distributing labor demands more evenly throughout the year; spreading financial risks among enterprises, and using complementary farm resources such as crops and livestock to reduce input costs (Bezdicek and Granatstein, 1989). Diversified crop rotations are also believed to support more farm employees and businesses in rural towns than specialized crop production (Goldschmidt, 1978). However, farmers need to balance the needs of short-term profits with long-term productivity, and, thus, we immediately see the potential connection as between the self and others in the decision to use a certain crop mix.

Regardless of the perceived macro-benefits of crop rotations or other diversification strategy, the decisions of individual farmers determine the level of crop diversity and associated agrobiodiversity in a community, county, state, or other region (Vandermeer et al., 1998). Therefore, the focus of the empirical test is on better understanding the mix of factors in farmers' future crop diversity intentions at the farm level as related to commitment to others at larger scales, and thus also serving to test the new theory of metaeconomics.

2. Biological basics integrated with philosophy within metaeconomics

With good reason, most people involved in agriculture consider the profit motive to be the main motivation in farmers' decisions. Empirical evidence, however, has demonstrated the inadequacy of simple profit maximization models in explaining human behavior (as argued in Sen, 1977). In general, people have a tendency to choose what is "good enough" to satisfy a desire instead of maximizing (Simon, 1957). As noted later, *the will* may well be the ultimate force in deciding what is indeed good enough. Information may also not be readily available to make the most profitable or beneficial decision. For example, the profitability of a crop is difficult to determine at planting time. If information is available, it is usually processed through heuristics, or rules of thumb, that people use to make their decision-making process easier. Past experience often guides the formation of these decision rules and biases decisions toward familiar outcomes (Kaplan and Kaplan, 1982). As a result, the most profitable alternative may not even be considered. In short, the profit motive is one part of the behavioral puzzle, but not the only piece.

Sen (1977, p. 336) labeled the purely rational, economic man "as close to being a social moron" because economic theory ignores the influence of other people on decisions. According to Mead (1934), humans naturally seek out social acceptance of their actions. As a result, what others believe is important becomes important to us individually as we strive for social acceptance. Etzioni (1993) also suggests that people usually do not think much about choices and draw primarily on emotions and normative commitments in taking action. For example, we probably mow our lawns

partly to avoid peer pressure from our neighbors. The incorporation of social norms and relationships in the analysis could help expand and improve our understanding of farmers' diversity decisions.

Although farmers have been traditionally considered independent decision makers, structural change in agriculture has increasingly shifted the control over production decisions from the farm to off-farm firms (Welsh, 1997). Farming decisions often need to be made with the approval of lenders, landlords, family members, and others (Nowak, 1992). More recently, we see the increasing influence of input suppliers with integrative production and marketing systems becoming evermore the standard. The complexity of farming systems is also influenced by the management ability of farmers, available time, and government regulations. Decision-making control is an overlooked dimension of farmers' social and economic systems.

Importantly, this concern over the egoistic self-interest in profit; the empathic others-interest in doing-the-right-thing as in commitments to other communities of interest; and control over balancing the two interests an achieving unique state, can all be addressed by first recognizing basic brain biology. We draw upon Cory (1999) who elaborates the neuroscience research by MacLean (1990) and others that demonstrate the triune brain. The human brain has evolved over hundreds of millions of years into a three-level interconnected structure (Cory, 1999, p. 10, 33).

At the core is the earliest protoreptillian complex that holds the egoistic part of our tendencies and interest, i.e., the I- or self- interest. Fundamental drives for survival, material things, emerge in this part. The first overlay is the paleomammalian complex that embeds the empathic part, i.e., the We- or others-interest. Fundamental drives pertaining to identification with others, with nurture, with the moral

and the symbolic, emerge in this part. These two interdependent parts demonstrate tension, and naturally are in conflict, both internal to the individual and in relations with others in both human and environmental communities. As Etzioni (1988, p. 9) says, "people are like porcupines in the cold", needing each other to keep warm (empathy), and sticking each other in the process (egos get hurt). The tension between the "I" and the "We" is natural, with individuals simultaneously under the influence of both forces, and (Etzioni, 1988, p. 63) "important differences in the extent each of these sets of factors is operative" in any given context, individual or time.

It is in the interconnected overlayer. . . the neocortex, neomammallian complex. . . wherein the hope lies for relieving the tension, resolving the conflict among the egoistic, comfort seeking but yet empathic porcupines, and wherein the hope for both contemporary and intergenerational justice rests. It is also within this complex where the hope for a truly rational economic actor resides, an individual going beyond the protoreptillian core of self-interest, and acting with empathy. We arrive on a different plane as a distinct entity (Khalil, 1990, p. 266). We resolve and balance the two forces in a synergistic fashion, the whole being larger than the sum of the egoistic and empathic parts. This distinct entity is one with nature, ecosystemic as it were, while simultaneously being quite autonomous and separated from the environment, not only within self, but with other members of the (biotic) community. We also see the basis for a triune brain in psychology and social psychology. As Maslow (1954, p. 232) says, only the self-actualized manage to reduce the tension by fusing dichotomies, wherein the "most socially identified people are themselves also the most individualist," "the most ethical and moral people are also the lustiest and most animal." In transactional analysis, we see the idea of the Parent (empathy), Child (ego) and the Adult (the rational mediator) (see Lynne, 1999).

The triune brain idea also blends well with that of more philosophical renditions. Following Buber (1922, as translated by Smith, 1958), we can characterize the ultimate outcome of our evolution as that of a distinct entity achieving an *I-Thou* state, in contrast to an *I-He/She* or *I-It* state. One identifies with the tree, the biotic community: The tree is part of me and the me is part of the tree. So, distinct individuals are both socially and environmentally identified as well as still being individualists embedded within both the social and the natural environments, inextricably intertwined and interdependent. It is when we withdraw from the *I-Thou,* and treat the tree (and all other living creatures in the biotic community) as in *I-He/She* or *I-It*, including a failure to address one's own internal need to express empathy for self (or, from the other side, failing to address the internal need to express the ego), that the tension increases.

Intriguingly, this idea surfaces early on in philosophy going back at least to Adam Smith. We achieve the state of a distinct entity only by listening and observing carefully while standing in the station of the Impartial Spectator (drawing on Smith, 1790, as cited by Khalil, 1990, p. 266), the conscience that talks to each individual about ecological diversity, community, and intertemporal justice. In such a state, we go beyond the self-interest that is necessary to achieve material wealth as emphasized in Smith (1784). It is only with sympathy and empathy that we can achieve the true wealth of a nation represented in being satisfied, with the material and the moral in good balance, as emphasized in Smith (1790). The *I-Thou* understanding emerges from seeing the interdependency between Adam Smith's two books, while going beyond Smith (1784).

We, operating as a distinct entity, and from within our neomammallian complex, express our will, take command, and resolve the natural tendency to want to draw away from community, both

human and natural. Ideally, we would see the emergence of an *I-Thou*, a state that may be what distinguishes a person from other primates, and, in fact, from other humans, especially the wantons. Drawing on Frankfurt (1971), it is *the will* that distinguishes a person. Indeed, it is the will that distinguishes the *I-Thou* from the *I-He/She* and the *I-It*.

Perhaps it is natural to express ourselves as individuals, to seek independence, as in *I-He/She* and *I-It*, from family, class and the environment from which we cannot, in fact, be separated. Perhaps it is equally as natural, and necessary, to stay connected. In fact, it may well be that in order to achieve long term sustainability and true wealth at the macro-level, we need a world community of nations populated by individuals of the *I-Thou* persuasion. As Sen (1977, p. 318) argues, we must address the commitment to the "claims of a variety of groups" even in our most individualistic of economic actions. Perhaps we need to take individual action in all the legitimate forums . . . legislative, administrative, judicial, and market. . . as an *I-Thou* in order to solve the micro-to-macro and the justice problem.

3. Joint interests: The metaeconomics theory of I-thou

Consider a consumer having two distinct but yet joint and interdependent preferences represented with two overlapping sets of indifference curves in Figure 1, one set favoring more cornflakes (q_2, on the vertical axis) and the other favoring crop diversity on farms that produce corn (q_1, on the horizontal axis). We see the consumer as a satisficer within two fields of utility, one field behind each set of preferences, and operating within the elliptical region 0AZC0, with the will actively

finding a satisfactory balance between empathic and egoistic economic actions (see Lynne, 2000, for the mathematical formulation of the problem). The consumer searches for point BN, representing a satisfactory balancing on RRN while pursuing both self- and others-interest utility or, as Etzioni (1986, p. 160, 166) has referred to it, a pleasure utility and a moral utility; and, Khalil (1997), ordinary and integrity utility (p. 503), or substantive and symbolic utility(p. 504). As van den Berg (1998, p. 453) argues, people act with varying degrees of both purposive rationality and normative commitment. Satisfaction comes from balancing the two interests in the pursuit of the two incommensurable utilities. After reaching BN, this consumer sleeps-well-at-night from having done-the-right-thing.

Notice that losing control, not having the will, means acting as a maximizer and moving along either the egoistic (Eg) path OAZ focusing on more cornflakes and stopping at A°, or maximizing along the empathic (Em) path 0CZ while focusing on crop diversity and stopping at C°. Notice, too, that even for the maximizer, the two interests are jointly served at both A° and C°, in that a lessor Em indifference curve (not illustrated) passes through point A° and a lessor Eg curve passes through point C°.

We see this phenomenon even more clearly along the ego-empathy frontier of Figure 2, where the vertical axis represents the self-interest utility and the horizontal the others-interest. Moving from R to AN in both Figures 1 and 2, the outcome from maximizing the self-interest , buying relatively more cornflakes, is enhanced by also paying some attention to the others-interest, ensuring at least some crop diversity. Perhaps following family tradition (Allen and Bernhardt, 1995; Salamon et al., 1997) a farmer may feel compelled to ensure at least some crop diversity, and thus move at least to point AN which we see is in both interests (both within the individual farmer). When moving from RN to CN, the

outcome from maximizing the others-interest and ensuring relatively more crop diversity is enhanced by paying some attention to the self-interest, i.e., eating at least some cornflakes: We have to eat. We discover the individual N with $(J_{Em}/4_{Eg})^N$ has found a tangency point, i.e., has balanced the empathic and egoistic tendencies. We would recognize J_{Em} as a subjective expression of value the individual N places on the utility received from crop diversity and 4_{Eg} as the subjective value placed on the utility received from cornflakes. The particular ratio chosen at point BN also balances the utilitarian needs of the ego and the empathy, ultimately decided by *the will.*

Generally, with crop diversity on the horizontal axis of Figure 1 and U^O from crop diversity on the horizontal axis of Figure 2, the more negative the ratio $-(J_{Em}/4_{Eg})^N$, the more *the will* has moved the balance toward the empathic, toward crop diversity. We say the individual N has taken command over perhaps the more fundamental core of egoistic tendencies, albeit the scientific conversation rages over whether these forces are hierarchical or on the same plane, with Cory (1999, esp. pp. 7-11) convincingly making the case for the latter. We agree, and depict the Eg and Em as overlapping in Figure 1, with both the price ratio (p_1/p_2) and the $(J_{Em}/4_{Eg})^N$ determined simultaneously: We see no hierarchy, although we do see *the will* as the ultimate arbiter. George (1993) sees such matters as hierarchical and resolved by a metapreference. In contrast, metaeconomics does not see a metapreference but rather sees *the will* as moving an individual beyond the utilitarian dimension to a distinct state of being.

Yet, as in the metapreference idea, metaeconomics recognizes that Em may at times trump Eg, and Eg may at other times trump Em, seeing it as symmetric rather than the asymmetric view that Em always trumps Eg, the latter common in the moralistic perspective (as highlighted in critique by Khalil,

1997). A consumer may at times be concerned mainly with buying the corn flakes, moving along 0AZ (Figure 1), with Eg > Em, so $(J_{Em}/4_{Eg})^N$ –> 0 at AN (Figure 2). In extreme cases of ego, 0AZ may run along the vertical axis and characterize this individual as in "it doesn't matter how the corn is produced." At other times, the same individual may demonstrate equally invariant preferences along 0CZ, with Em > Eg, so $(J_{Em}/4_{Eg})^N$ –> - 4 at C, and may even demonstrate the extreme case of empathy with 0CZ running along the horizontal axis as in "corn needs to be integrated with other crops and enterprises the same as a tree or plant in a natural system no matter how high the cost," an empathic interest trumping an egoistic one.

As noted, both sets of tastes and preferences may well be invariant, with the individual perhaps vacillating back and forth as *the will* works to relieve the tension in the path to *I-Thou*. Such invariance may be reflected in habit, with each set perhaps having its genesis in an earlier set of reasoned actions (van den Berg, 1998, p. 446), or, perhaps uncertainty, a setting within which norms tend to dominate (p. 450). We can now also see the potential for a developing dynamic, or as van den Berg (1998, p. 446) refers to it, "dehabituation", among heretofore invariant preferences in both realms. With enough individuals holding a particular ratio $(J_{Em}/4_{Eg})^N$, we would see the emergence of a new price ratio (p_1/p_2) in the markets, and, perhaps some technological shock could determine (p_1/p_2), which would then drive $(J_{Em}/4_{Eg})^N$, in constant tension and feedback, perhaps settling onto path 0BZ (Figure 1) and point BN (Both figures). In fact, it is now even possible that over time the Eg (Em) set could converge onto the Em (Eg) set, such that both sets could lie on the 0CZ (OAZ) path. This might be used as a charitable description of the amoralist prescription from neoclassical microeconomics: Like Khalil (1997) says, it is "not that the neo-classical paradigm does not recognize moral sentiments, which

it clearly does." It just does not model them: So, the net effect is to presume both utilities lie identically on the same path.

Figure 1 could also represent Em and Eg isoquants at the farm level for corn monoculture and crop diversity. We now have farm inputs X_1 and X_2 on the axes. Figure 2 now represents the frontier of outputs from crop diversity q_1 (horizontal) and cornflakes q_2 (vertical) with the farmer's ratio (J_V/ 4_C)^F, and $4_C{}^F$ reflecting the farmer's reaction to $p_2°$, the corn price revealed in the market. For any given level of capital available to this farmer, represented in RRN, the farmer will produce less crop diversity with more corn at point AN, or more crop diversity with less corn at point CN, or perhaps somewhere inbetween, at BN. Notice that the relative prices of the inputs (r_1/r_2) do not completely determine which point is chosen in Figure 1. Rather, the farmers empathy toward crop diversity represented in J_V influences the point BN. It follows that the amount of corn supplied on the market is affected by the degree of environmental empathy, not only by prices. So, social institutions reflecting the moral dimension affect the market, and, in contrast to the neoclassical agenda to create a scientific economics independent of social institutions (see Söllner, 1997, p. 178), metaeconomics posits a scientific economics that includes said institutions.

4. Testing the metaeconomics model: statistical model, measurement methods, and data

We chose Saunders County, Nebraska, USA, due to its wide range of landscape types and farm sizes representing the U.S. Corn Belt; available geographical information system data; and convenient access. This area is located on the western fringe of the rainfed western U.S. Corn Belt in

eastern Nebraska within 30 miles of Lincoln and Omaha, Nebraska. Corn and soybeans are the main cropping enterprises. Saunders County is approximately 28 miles wide and 32 miles long with a total area of 753 square miles (1951 square kilometers) or 481,792 acres (195,057 hectares). The average precipitation for Saunders County is 69 cm/yr. Approximately 74% of the precipitation falls during the growing season from April through September. The growing season in Saunders County lasts approximately 161 days (Elder et al., 1965).

As described later, four ecodistricts were defined by a cluster analysis of slope, cation exchange capacity, and organic matter content. The northern and eastern boundaries of the county are either bordered or within the flood plain of the Platte River. The Platte River Valley ecodistrict represents this area and is characterized by imperfectly drained alluvial soils, good irrigation potential, and some alkaline soil spots. The Todd Valley is a loess-capped terrace of the Platte River with good irrigation potential and deep, dark moderately clayey to clayey soils in the Sharpsburg-Fillmore soil association. A transitional ecodistrict, labeled Rolling Hills, is located to the east and west of the Todd Valley. The Rolling Hills ecodistrict is characterized by deep, dark, well-drained, moderately clayey soils in the Sharpsburg soil association formed in Peoria loess. The mean slope percent for the Rolling Hills ecodistrict is 7.3. On the western edge of the county, the Dissected Hills ecodistrict is characterized by steeper slopes (11% mean) and similar soils as the Rolling Hills ecodistrict. Backslope soils in the Dissected Hills formed in less fertile glacial till due to erosion of the loess surface layer. The predominant soil family in Saunders County is a fine montmorillonitic mesic Typic Argiudoll (Elder et al., 1965).

The total population of the county has remained near 18,000 for the past 20 years. Of the

10,859 people in the workforce in the county, over a third commute to work in Lincoln, Omaha, or Fremont. The main ethnic groups in the county are German, Czechoslovokian, Swedish, and English (Saunders County, NE Economic Profile, 1999). The county has a population of 1,176 farms, with 785 farm heads of household listing their primary occupation as farmers (NASS, 1998).

4.1 Model

We use crop rotations as an indicator of behavioral action toward crop diversity. Overall, crop diversity is a prominent component of agrobiodiversity. We focus on measuring the intent to change crop rotations during the next 5-years, and what motivates such intent. The main task is to construct indices that serve as proxies for the two unobservable, latent fields of utility represented by the preferences in Figure 1. We conceptualize the farmer as being jointly a consumer and a producer, having both utility (indifference) and quantity (isoquant) isocurves, and seeking two expected utilities, E(U), in contrast to the unobservable, actual utilities, U. To test for the possible role of each latent expected utility, the model becomes, with the dependent variable the "Intention to diversify crop rotations:"

Intention = f[self-interest(G, ego), others-interest(M, empathy), control (T, ability, will-power); control (C, capital); past crop diversity behavior(B, habit); ecodistrict(D_i, location)] (1)

or, forming the statistical model in the order of the item list in equation (1)

$$I = \$_0 + \$_1 G + \$_2 M + \$_3 T + \$_5 C + \$_4 B + \$_6 D_1 + \$_7 D_2 + \$_8 D_3 + \,, \qquad (2)$$

where the two variables of primary interest are defined as G – E (U^S) and M – E(U^O), and the key parameters (from Figure 2), $\$_1 - 4$ and $\$_2 - J$, due to the focus on the ratio $(J/4) - (\$_2/\$_1)$. The error term , is assumed independent and normally distributed. To operationalize, we use attitude measure G and norm measure M as proxies of the unobservable utility variables. By working with the expectations, we go beyond the static, perfect information world of Figures 1 and 2 toward the reality of risk and probability. We focus attention on the ratio, especially within the range $-4 < (J/4) < 0$ If the ratio is close to 0, we have found farmers pursuing mainly the self-interest, and moving toward monoculture cropping. If the ratio is in the direction of -4, we have found farmers pursuing the others-interest and moving toward crop diversity. An intermediate value suggests the farmer is operating as a distinct entity, achieving balance, and is either approaching or already in an *I-Thou* state. This is to say, this metaeconomics model goes beyond a too narrow, exclusive focus on only the economic, as in only the *I-part* or the *We-part* of the *I-Thou*, and thus recognizes, as Söllner (1997, p. 195) notes, "an intimate relation between the normative position and the integration of thermodynamic concepts," in this case to explain farmer behavior regarding future crop diversity in the U.S. Corn Belt.

4.2 Questionnaire development and measurement methods

Intention (I) toward expanding the use of crop rotations was measured by aggregating two questions on a 1 to 5 unlikely-likely scale: 1) " I plan to include more types of crops in my rotation in the next five years" and 2) "I plan to use rotations on more of my existing acres on my farm in the next five years."

Both the egoistic (G) self-interest and the empathic (M) others-interest are measured by multiplying the response on a 5-point unlikely-likely probability scale by the score on the 5-p joint unimportant-important scale to estimate expected utility. All statements were phrased in relation to the use of crop rotations as an indicator action toward crop diversity. For example, one of the dimensions of G is measured with (expectations scale):

	Unlikely	Slightly Unlikely	Neither	Slightly likely	Likely
Using a crop rotation results in reducing pounds of fertilizer applied per acre	1	2	3	4	5

with an associated statement (valuation scale):

	Unimportant to me	Slightly unimportant	Neither	Slightly Important	Important to me
Reducing chemical fertilizer use is:	1	2	3	4	5

Multiplying the responses on each scale gives one component of the $E(U^s)$. Other G statements included whether using a crop rotation results in increasing profit, reducing risk, spreading out labor demands, and controlling weeds among other commonly perceived benefits. Cronbach's " = 0.76 indicates all nine components of G are measuring the same general tendency.

The empathic (M) others-interest statements were measured with the statement "These people

or organizations believe that I should include more types of crops in rotation and/or use them on more of my existing acres," followed by the statement, “In general, what these groups think I should do is . . .” measured on the unimportant to important scale. Multiplying the responses gives one component of the $E(U^{o})$. A total of 12 different communities (and the norms in said communities) to whom the farmer might be committed were evaluated, including spouse, family, commodity group, lender, other farmers in the area, family landlords, county extension, crop consultant, non-family landlords, Farm Service Agency, seed supplier, and Natural Resources Conservation Service. Cronbach’s " = 0.93 indicates the components are measuring the same phenomenon.

The will-power and control factors (T) included the possible constraints of available time for managing rotation, property taxes, perceived difficulty of using rotations, and market prices for livestock and rotation crops. The control scale was calculated by the summation of these individual factors as measured on a 1-to-5 true-false scale. Cronbach’s " = 0.78. Another variable related to will and control is the capital (C) available for actually taking the action. We used a proxy in annual household income, reasoning that more income implies control over more capital of various kinds, including natural capital. We used eight income groups, e.g., grouping number three was “$30,000 - $39,999" which was recorded in the data set as $35,000/1000 = 35.

Previous diversity behavior (B) represents habit in human decision making. We might reasonably expect habit (see van den Berg, 1998, esp. p. 433), represented in past farming practices to be a force and quite resilient to change. We used the Shannon diversity index (Shannon and Weaver, 1949) to represent current (recently habitual) agrobiodiversity, defined by:

$$B = -\sum n_i \log n_i$$

where n_i = proportion of the farm area in the i^{th} species. A corn and soybean rotation of equal proportion gives a Shannon index of 0.70, representing the most common crop mix among farmers in Saunders County in 1998. This result is not surprising because Olson (1998) found corn and soybeans to have the highest gross income with the lowest variability in net returns in the study area, suggesting that such bi-cropping will occur when the egoistic drive for profits is a main force. Yet, we found the crop diversity to range from 0 to 1.83 with a median of 0.95 and mean of 0.98, implying something is at work beyond the egoistic drive for profit. A diversity value of 1.0 is a crop mix of two predominant crops with two or three minor crops. At 1.50 or higher, the crop mix is more evenly proportioned with generally five or more crop types, including forage crops such as alfalfa, hay, and pasture crops.

4.3 Ecodistricts

Following the general characterization of ecodistricts (Ecological Stratification Working Group, 1995), soil and topographic factors were selected from available geographic information systems for the county. The U.S. Natural Resources Conservation Service digital soil survey geographical information system data provided soil properties and interpretations at a scale of 1:12,000. Mapping unit attribute information for soil parameters was obtained from the accompanying Mapping Unit Interpretation Records database. Cation exchange capacity (CEC), soil pH, clay content, organic matter content, and prime farmland classification were derived from the soils database at the lowest estimated value for each mapping unit polygon. Each individual data layer was summarized by zones

defined by the cadastral land survey sections within the county. Mean statistics were derived for 801 sections using ArcView 3.0 (ESRI, 1997).

Next, principal components analysis was applied to reduce the number of variables. The first two components explained 74% of the total variation. Based on this analysis, we chose slope, CEC, and organic matter content to define regions of physiographic similarity within the county

A K-means cluster analysis of CEC, slope, and organic matter using statistical distance was applied to define four regions, represented by the Todd Valley (base dummy D_0); Platte River Valley (D_1); Rolling Hills (D_2), and Dissected Hills (D_3). This method partitions all observations into K initial clusters and obtains the means of these clusters. Then, observations are reassigned to the cluster with the nearest mean. After the observations have been moved to the appropriate clusters, new cluster means are computed. Observations are reassigned until none of the observations are assigned to new clusters.

4.4 Data

Salient G, M, and T questions and statements were developed from 16 in-person interviews and a pilot mail survey sample of 120 farmers with 30 respondents. After refining the instrument, data were gathered in mid-1999 from a mail survey of 700 out of a population of 1,176 less the 120 farmers in the test survey. The population list was obtained from the U.S. Farm Service Agency. Following the Dillman (1978) Total Design Method, we sent an introductory cover letter followed a week later by the survey with a personalized cover letter. Non-respondents received a reminder post

card after one week and another survey after three weeks, for a total of four mailings. Of the 346 returned questionnaires (about 50%), 145 were excluded because they were not farming, did not fully complete the survey, or operated a farm less than 80 acres in size.

5. Results and Discussion

The full regression was significant at $P < 0.01$, explaining 24% of the total variance of intention to expand the use of crop rotations. The parameters on the self-interest, others-interest, financial capital, and past-behavior variables are statistically significant (Table 1).

5.1 Egoistic pursuit of the self-interest (G)

The statistically significant ($P < 0.05$, Table 1) positive parameter on G suggests farmers see the use of rotations in the future as in their self-interest. Therefore, the intention to expand the use of crop rotations during the next 5-years is in part motivated by the self-interest. We found consistently low variation in G across the sample.

5.2 Empathic pursuit of the others-interest (M)

The results support the alternative hypothesis that M is positively related to intentions to expand the use of crop rotations within the next five years. A positive empathic, normative environment for using rotations significantly relates to higher intentions to expand the use of crop rotations in Saunders County ($P < 0.01$, Table 1). In the sample, farmers with the highest intentions had over double the average M measure of farmers in the lowest intentions category. As one farmer stated,

> Adopting a change in a farming practice involves risk – financial and personal. The financial risk, though real and important, can be overcome with cost-share programs and grants. The greatest hurdle to adoption is peer review. To most family farms, especially those handed down for generations, a farm is much more than property. It is a farmer's identity, her or his reputation and status in the community.

The results for M reflect the tone of this statement, that the claims of others affect economic action. The results also support the contention that farmers derive their views from society (Stickel, 1990), e.g., society sending indirect signals for farmers to specialize and develop larger operations, and perhaps not being overly supportive of diversified farmers who are viewed as laggards and traditionalists. As Söllner (1997, p. 196) notes, "valuation and decision coordination cannot be separated from their social context."

Diversified farming systems have been observed in many studies to increase family stress because they generally require more complex management, more information, and labor than specialized systems (Allen and Bernhardt, 1995; Salamon et al., 1997; Pfeffer, 1992). For many farmers, off-farm work responsibilities also result in less family time and more stress, especially if their cropping system is more labor intensive. As a result, family concerns may be a significant barrier to expanding the use of crop rotations. Allison (1992, p. 297) adds that, "It is incontrovertible that people

are much more willing to sacrifice their own interests for those who are similar to them, who live near them, who share the same position, etc."

5.3 Interaction between G and M

Liska (1984) recommends the use of interactions (G*M), which generally have been found significant in previous studies (e.g., see Lynne et al., 1995; Lynne and Casey, 1998). For this case, including (G*M) resulted in an intolerable level of collinearity with the main M effect, R = 0.948 such that we could not reliably estimate the parameters on M and (G*M). We dropped the (G*M) term.

5.4 Control (T) representing abilities and the will

The effect of control on intentions is relatively weak ($P < 0.10$, Table 1). Thus, the results do not support the alternative hypothesis that control is significant (i.e., direction of control is not tested). Livestock prices, property taxes, available time, and management ability do not appear to constrain the use of crop rotations. Yet, Devore (1997) relates that "Dropping six decades of promoting the production of a handful of crops won't change the processing, marketing, and transportation conditions those crops were raised under." The structure of agricultural markets and investment in equipment and land constrain cropping system changes after the 1995 Freedom to Farm Act. By using older equipment and carrying a lower debt load, diversified farmers may have more flexibility to diversify their rotations than other farmers do. The control construct did not account for these factors.

Ajzen (1991) suggests that control is most strongly influenced by the perceived ability to perform an action. At a general level, farmers probably believe that they have the ability to manage rotations.

5.5 Capital (C)

As hypothesized, the proxy for capital has a negative and significant relationship with intentions ($P < 0.05$, Table 1) to expand the use of crop rotations within the next five years. Farmers with higher incomes are more specialized, and less diversified, everything else equal. The significance of this variable demonstrates the importance of financial capability on intentions. As expected based on past research, farmers with lower incomes have higher intentions to expand the use of crop rotations, perhaps to reduce risk (Helmers et al., 1986).

5.6 Past crop (agro)diversity behavior (B)

The results support the alternative hypothesis that intentions to expand the use of crop rotations within the next five years and past behavior will have a positive relationship ($P < 0.01$, Table 1). Farmers' past crop diversity provides an important measure of the disposition of farmers to expand their use of crop rotations in the next five years.

The tendency of people to simplify decisions by using heuristics also increases the importance of past experience. Simon (1957) relates that people have a tendency to choose what is "good

enough" using simplified decision rules instead of pursuing optimization, which seems consistent with the path 0BZ idea, and the point BN choice. As van den Berg (1998, esp. pp. 430-433) suggests, information gathering and deliberation is costly, sometimes leading to mindless behavior. According to Mazzota and Opaluch (1995), past behavior or experience affects the ability of decision-makers to optimize their mix of enterprises by limiting information processing. The implication is that farmers who have been growing corn and soybeans for years are unlikely to change even with fewer regulatory cropping restrictions due to past habitual behavior.

According to Ajzen (1991), if the determinants remain stable between intention and behavior, past behavior should not be a significant factor. When past behavior is significant under these conditions, other variables may be affecting behavior. Thus, past behavior may be used as an indicator of behavioral reliability. For this case, a great deal of change in agriculture, including the new Freedom to Farm act in 1995, is apparently giving the instability between intention and behavior. A change in cropping system design would also require many intervening steps that may produce a change in intention (Fishbein and Ajzen, 1975).

Ecodistricts (D). Intentions were not found significantly different among the ecodistricts. Yet, diversity is higher in the Dissected Hills ecodistrict than the relatively flat Todd Valley. The availability of irrigation in the Todd Valley probably facilitates more specialization than the other predominately dryland regions of the county. While not statistically significant, mean intention by ecodistrict suggests that intentions are higher in the Rolling Hills and Dissected Hills ecodistricts.

5.7 Balancing and synergism: The distinct state in the self- and others-interest

Perhaps the most substantive result is the estimated $-(\lambda/\mu) = -(\$_2/\$_1) = -(0.009/0.011) = -0.82$ suggesting that farmers in this western U.S. Corn Belt area in Nebraska operate mainly in the self-interest. Yet, this shows greater empathy than that calculated for the tomato industry(2.13) and less than that calculated for the strawberry industry (-36.84), both industries in Florida (Lynne, 2000). The greater empathy toward others may be due to Nebraska farmers being far less specialized (and less industrialized) than is the tomato industry. The lessor empathy as compared to the strawberry industry may be due to the close knit community represented in that strawberry industry, producing only one crop, and even living near or in a small city named after the strawberry plant, i.e, Plant City, Florida. Also, a value of -0.82 is very close to -1.00, the latter describing a slope of a 45^{o} line orthogonal to a line bisecting the origin, appearing quite close to that depicted at point BN in Figure 2. In fact, a value of $(\lambda/\mu) = -1.00$ represents a turning point, where balancing places the two utilities largely on par. The Nebraska farmers are still on the self-interested side of this turning point, i.e., $-0.82 > -1.00$, although we might argue the two interests are quite well balanced due to being so close to -1.00.

6. Conclusions

As Söllner (1997, p. 196) notes, in calling for a new economics, "it is doubtful whether things will change for the better unless a new social value theory is postulated which is indispensable as the

centerpiece. . .” of that economics. We are offering such a new value theory, and provide empirical support for it: Farmers in this Nebraska, U.S.A., county pursue two incommensurable utilities reflecting egoistic and empathic tendencies. Further, these farmers are operating as distinct entities in an *I-Thou* state, i.e., being simultaneously one with others, including nature, and with self, albeit the balance is toward the self-interest side even though near -1.00. Evidence for an *I-Thou* state suggests the path a “social reconstruction (Söllner, 1997, p. 196)” of economics might take. Rights and duties, both to contemporaries, and to future generations, are now handled through commitment to others in an others-interest, in the move to the *I-Thou* state, and to justice.

Interestingly, the reality of (J/4) = -0.82, far closer to 0 than to -4, means strong egoistic forces are at work, and suggests we perhaps can still draw much from standard microeconomics, too. With (J/4) close to 0, we need to look to market mechanisms and financial incentives to achieve substantive changes in crop diversity. Also, however, due to empathy being a significant force, with (J/4) < 0, agrobiodiversity through increased crop diversity can be increased in the Nebraska portion of the western U.S. Corn Belt by further appeal to the empathic. As Leopold (1949) said,

> A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise . . . We abuse the land because we regard it as a community belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect.

The more negative (J/4), the more likely we will be in an *I-Thou* state with the land, and will use land with love and respect. Yet, metaeconomics also clarifies that there is no one, immutable, always right in contrast to always wrong ratio (J/4). The environmental ethic. . . the moral dimension of the empathic

tendency. . . also needs to coevolve along with the egoistic self-interest, with one influencing the other, with the focus on achieving the synergistic distinct state.

This conclusion is consistent with the major theme in Nelson (1991, esp. p. 267), that economics is a kind of theology, and that no one philosophy underlying a particular theology (with all its embedded ethical and moral norms) is necessarily superior. Fortunately, metaeconomics makes explicit the need to ask the questions about what theology and philosophy, and what ethical system, moral dimension is embedded in the equations, figures and rhetorical stories being told about environmental economy. Ironically and paradoxically, the more the moral dimension is considered directly and made explicit, the more objective the economic analysis becomes: This is the main feature of metaeconomics as a new kind of environmental economics.

Yet, consumers, all individuals, perhaps need to be continually encouraged to express more negative ($J/4$) ratios, and translate same into price ratios favoring corn(flakes) produced on diverse farms, as well as supporting laws, rules, regulations. . . and administrative and judicial processes, especially in the common law . . . that reflect their individual preferences for food crops being produced on said farms. We perhaps are a bit too close to $(J/4) = 0$ on environmental matters generally and with respect to the food system specifically. Perhaps most importantly, metaeconomics shows relative prices and costs to be subjective, due to containing moral sentiments represented in J and in $(J/4)$. It shows, also, that the moral sentiments embed relative prices and perhaps also need to be subjected to rational benefit-cost calculation.

Consumers can express moral sentiments with their willingness-to-pay for certain kinds of production on farms. The challenge identified by metaeconomics is to evolve and then balance an

others-interest with the individuals self-interest that is consistent with building agrobiodiversity, and diversity generally, and then to develop and encourage the will to act on it. It is in this light that the micro-to-macro transition problem evaporates. This is to say, an others-interest, a set of others-indifference or isoquant curves (and, we might say, an environmental economic theology and philosophy underlying the curves) always exists. It is the character of said curves, and the will to modify self-interested paths reflecting commitment to what is represented in the others-set, that determines the meta-economic value decision and resolves the meta-economic problem.

So, the challenge for gaining crop diversity, specifically, and agrobiodiversity and diversity more generally, becomes one of encouraging $(J/4)$ sufficiently less than 0 such that micro-behaviors will lead to the appropriate macro-behavior. It is only by changing the ratio $(J/4)$ for sufficient numbers of individuals in society that the kind of meta-outcomes Söllner (1997) highlights can be achieved, i.e., agrobiodiversity and material throughput consistent with a thermodynamic and moral understanding of the world. We need to find that common ground of environmental values among all individuals on which commitment can evolve, and justice served.

We see the change in the $(J/4)$ ratio in individuals over time in terms similar to Norgaard (1995); i.e., economy (ego) and the natural system (empathy toward) need to coevolve. This would be helped by education about thermodynamics, so that we see how empathy necessarily interacts with economy in the most fundamental of ways. It will be helped by public discourse, and reasoning. The insight added here is that even with such education and reasoning, that it still ultimately takes the will, a disciplined will, to forego material wealth, and, going the other direction, it also takes a disciplined will to forego empathy in order to produce sufficient wealth. Both the others- and self-interest need to be

jointly encouraged. Each individual needs to be educated, jointly motivated, and in command of self. So, in effect, it is the evolution and coevolution of *both understanding and the will* at stake here. It is in the expression of balancing by *the will* leading to the *I-Thou* state that we achieve, simultaneously, both economic and social efficiency as well as sustainability. With ($\partial J/\partial 4$) sufficiently negative, i.e., with sufficient empathy, and with ways for the individual to express this value system in appropriate forums of many types, the problem in the micro-to-macro (and macro-to-micro) transition to justice vanishes.

Finding that J ...0 for even one population, in this case, a population of U.S. Corn Belt farmers, suggests it may well be time to start phasing in metaeconomics, perhaps eventually subsuming microeconomics as a special case when $J = 0$, which now becomes an empirical question rather than a presumption. Importantly, this does not mean setting aside the large body of knowledge that has been accumulated using microeconomics. Rather, it suggests that this scientific base of knowledge can be adapted, i.e., use a blend of the old microeconomics and the new metaeconomics to rewrite the textbooks, and to reframe the foundation for environmental economic policy. Metaeconomics suggests that the moral dimension, and asking about the ultimate ends, needs to be made explicit in the scientific analysis forming the basis for such policy. It suggests we need to recognize the role of *the will*. Importantly, teaching metaeconomics in the elementary and secondary schools through the universities, by itself may well lead to a more negative ($\partial J/\partial 4$) over time as students learn that the environmental economic problem is in large part one of seeking the synergistic balance of ego and empathy. The fundamental environmental problem is perhaps the lack of discipline of *the will* to find this unique state. At least, with metaeconomics, we can now clearly see the problem, even if finding solutions will still be

challenging. It seems that a metaeconomics focused on the environmental question could indeed form the basis for the new environmental economics so sorely needed.

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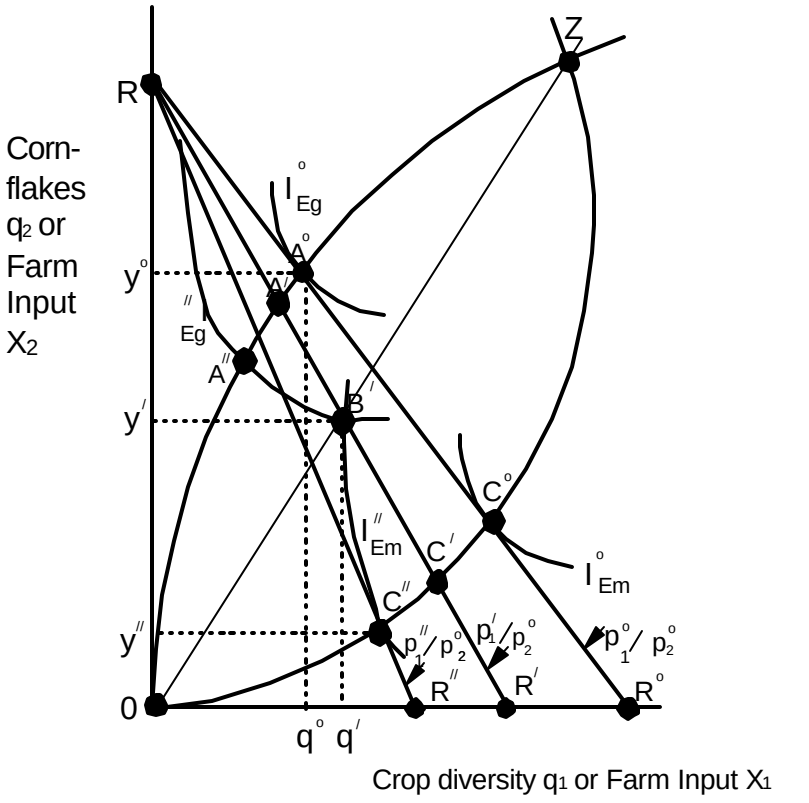
Table 1
Regression results for farmers in Saunders county, Nebraska, western Corn Belt, U.S.A., 1999

Variables	**Mean**	**SD**	**$**	**SE**	**t**	***P***
Intention	4.64	2.72	–	–	–	–
Constant, $\$_0$	–	–	1.677	1.312	1.278	0.203
Self-Interest, $\$_1$	161.60	35.32	0.011	0.006	1.733	0.042
Others-Interest, $\$_2$	86.89	59.21	0.009	0.004	2.521	0.005
Control/Ability, $\$_3$	18.65	4.88	-0.078	0.043	-1.824	0.070
Control/Capital, $\$_4$	37.00	21.90	-0.015	0.009	-1.656	0.050
Past Behavior, $\$_5$	0.98	0.30	2.331	0.703	3.317	0.001
Ecodistricts:						
Platte River Valley, $\$_6$	0.03	–	-0.990	1.167	-0.848	0.398
Rolling Hills, $\$_7$	0.22	–	0.741	0.501	1.478	0.141
Dissected Hills, $\$_8$	0.38	–	-0.287	0.565	-0.508	0.612

Dependent variable is intention to diversify crop rotations during the next five years. The equation R^2 = 0.24 with an overall significance of $P < 0.001$.



(Note: The p may be an r, or a "resource price," when the axes are for inputs)

Figure 1. Joint self-interest (Eg) and other-interest (Em) isoquant or indifference iso-curves for farm inputs X_i, goods q_i

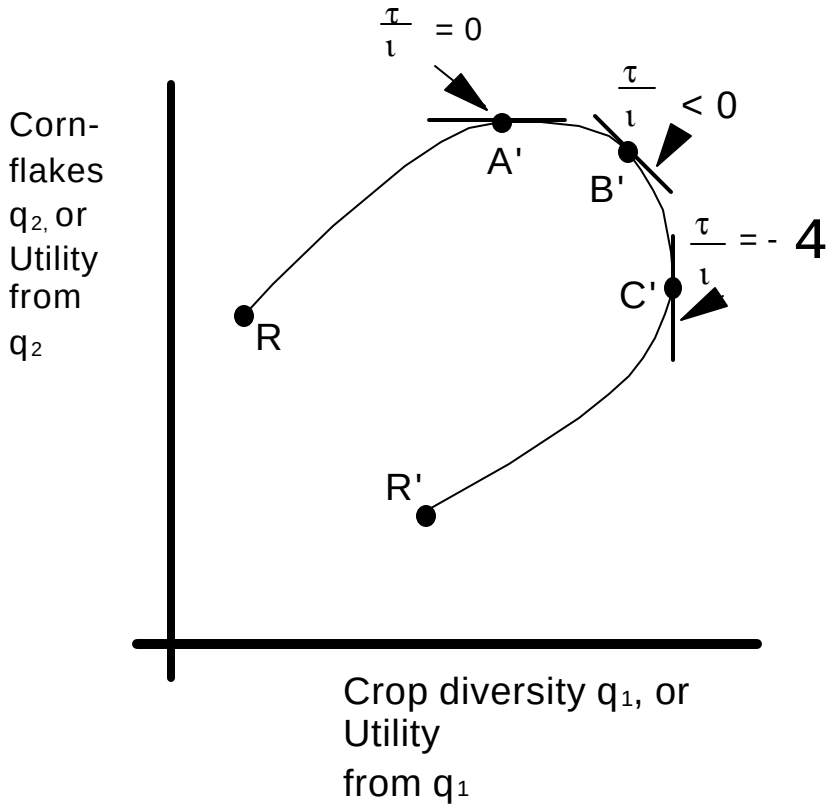


Figure 2. Ego-empathy frontier for two goods (or bads) q or for two sources of utility U.

References

Ajzen, I., 1991. The theory of planned behavior. Organizational Behavior and Human Decision Processes, 50, 179-211.

Allen, J.C., Bernhardt, K., 1995. Farming practices and adherence to an alternative conventional agricultural paradigm. Rur. Sociol., 60 (2), 297-309.

Allison, P.D., 1992. The cultural evolution of beneficent norms. Social Forces, 7(2), 279-301.

Bagozzi, R.P., Yi, Y., 1989. The degree of intention formation as a moderator of the attitude-behavior relationship. Social Psychology Quarterly, 52 (4), 266-279.

Bezdicek, D.F., Granatstein, D., 1989. Crop rotation efficiencies and biological diversity in farming systems. Journal of Alternative Agriculture, 4(3), 111-118.

Buber, M., 1922. Ich and Du (I and thou, Translated in 1958 by R.G. Smith). Charles Scribner's Sons, New York.

Coleman, J. S., 1990 (2nd printing 1994). Foundations of Social Theory. The Belknap Press of Harvard University Press, Cambridge, MA.

Cory, G. A., 1999. The Reciprocal Modular Brain in Economics and Politics. Kluwer Academic/Plenum Publishers, New York.

DeVore, B., 1997. Freedom to Farm, Freedom to .....? The Land Stewardship Newsletter. 15 (3).

Dillman, D., 1978. Mail and Telephone Surveys: The Total Design Method. John Wiley, NewYork.

Ecological Stratification Working Group, 1995. A National Ecological Framework for Canada and Agri-Food Canada. Centre for Land and Biological Resources Research and Environment Canada. Ottawa.

Elder, J.A., Beesley, T.E., and McKinzie, W.E., 1965. Soil Survey of Saunders County, Nebraska. USDA and University of Nebraska-Lincoln Conservation and Survey Division.

ESRI, 1997. ArcView Version 3.0. Redlands, CA.

Etzioni, A., 1986. The case for the multiple-utility conception. Econ. and Philos., 2, 159-183.

Etzioni, A., 1988. The Moral Dimension, Toward a New Economics. The Free Press, New York.

Etzioni, A. 1993. Normative-affective choices. Human Relations, 46 (9), 1053-1069.

Fishbein, M., Ajzen, I., 1975. Belief, Intention and Behavior: An Introduction to Theory and Research. Addison-Wesley, Reading, MA.

Frankfurt, Harry G., 1971. Freedom of the will and the concept of a person. The J. of Philos., 58, 5-21.

George, D., 1993. Does the market create preferred preferences? Rev. Soc. Econ., 51, 323 - 346.

Goldschmidt, W., 1978. As You Sow. Allanheld, Osmun and Co. Publishers. Montclair, New Jersey.

Helmers, G.A., Atwood, M.R., and Atwood, J., 1986. An economic analysis of alternative cropping systems for east-central Nebraska. American Journal of Alternative Agriculture. 1 (4), 153-158.

Kaplan, S., Kaplan, R., 1982. Cognition and Environment: Functioning in an Uncertain World. Praeger Scientific, New York.

Khalil, E. L., 1990. Beyond self-interest and altruism. Econ. and Philos., 6, 255-273.

Khalil, E. L., 1997. Etzioni *Versus* Becker: Do Moral Sentiments Differ from Ordinary Tastes. De Economist, 145, 491-520.

Liska, A.E., 1984. A critical examination of the causal structure of the Fishbein/Ajzen attitude-behavior model. Soc. Psych. Quart., 47, 61-74.

Leopold, A., 1949. A Sand County Almanac and Sketches Here and There. Oxford University Press, New York.

Lynne, G. D., Casey, C.F., Hodges, A., Rahmani, M., 1995. Conservation technology adoption decisions and the theory of planned behavior. Journal of Economic Psychology, 16, 581-598.

Lynne, G.D., Casey, C.F., 1998. Regulatory control of technology adoption by individuals pursuing multiple utility. J.Socio-Econ., 27, 701-719.

Lynne, G.D., 1999. Divided self-models of the socioeconomic person: the metaeconomics approach. J. Socio-Economics, 28, 267-288.

Lynne, G. D., 2000. Land managers pursue multiple utility, not futility: Toward a metaeconomics theory. Mimeo, University of Nebraska, Lincoln, NE. (also available in Adobe format on the website: http://www.ianr.unl.edu/agecon/lynne/metapape.htm).

MacLean, P. D., 1990. The Triune Brain in Evolution: Role in Paleocerebral Functions. Plenum Press, New York.

Maslow, A.H., 1954. Motivation and Personality. Harper and Row, Publishers. New York.

Mazzota, M.J., Opaluch, J., 1995. Decision making when choices are complex: a test of Heiner's hypothesis. Land Econ., 71, 500-516.

Mead, G.H., 1934. Mind, Self, and Society. University of Chicago Press, Chicago.

NASS, 1998. Nebraska Agricultural Statistics 1997-1998. Nebraska Agricultural Statistics Service. Lincoln, NE.

Nelson, R. H. 1991. Reaching for Heaven on Earth: The Theological Meaning of Economics. Rowman and Littlefield Publishers, Inc., Maryland.

Nowak, P., 1992. Why farmers adopt production technology. J. Soil and Wat. Conserv., 47, 14-16.

Norgaard, R.B., 1995. Beyond materialism: a coevolutionary reinterpretation of the environmental crisis. Rev. Soc. Econ., 53, 475-492.

Olson, R.K., 1998. Procedures for Evaluating Alternative Farming Systems: A Case Study for Eastern Nebraska. Vol. 8. North Central Region Sustainable Agriculture Research and Education Program, Lincoln, NE.

Pfeffer, M.J., 1992. Labor and production barriers to the reduction of agricultural chemical inputs. Rur. Sociol., 57, 347-362.

Pimentel, D., Stachow, U., Takacs, D., Brubaker, H.W., Dumas, A.R., Meaner, J.J., O'Neil, J., Onsi, D.E., Corzilius, D. B., 1992. Conserving biological diversity in agricultural/ forestry systems. BioScience, 42, 354-362.

Salamon, S., Farnsworth, R.L., Bullock, D.G., and Yusuf, R., 1997. Family factors affecting adoption of sustainable farming systems. J. Soil and Wat. Cons., 52, 265-271.

Saunders County, Nebraska Economic Profile. 1999. Available: http://www.co.saunder.ne.us/sauecon.htm.

Schelling, T.C., 1978. Micromotives and Macrobehavior. W.W. Norton and Company, New York.

Sen, A.K., 1977. Rational fools: a critique of the behavioral foundations of economic theory. Philos. and Public Affairs, 6, 317-344.

Shannon, C. E., Weaver, W. 1949. The Mathematical Theory of Communication. Unviversity of Illinois Press, Urbana, IL.

Simon, H.A., 1957. Models of Man: Social and Rational. John Wiley, New York.

Smith, A., 1784. An Inquiry into the Nature and Causes of the Wealth of Nations, edited by E. Cannan. The Modern Library (including the 3rd edition, copyright date 1937), New York.

Smith, A., 1790. The Theory of Moral Sentiments, edited by D. D. Raphael and A. L. Macfie. Liberty Classics (including the 6th edition), Indianapolis, IA

Söllner, F., 1997. A reexamination of the role of thermodynamics for environmental economics. Ecol. Econ., 22, 175-201.

Stickel, G. W., 1990. The land as a social being: ethical implications from societal expectations. Agric. and Hum. Values, 7, 33- 38

United Nations Environmental Program, 1996. Convention on Biological Diversity: Consideration of Agricultural Biological Diversity Under theConvention on Biological Diversity. UNEP/CBD/COP/3/14. Conference of the parties on the convention on biological diversity. Buenos Aires.

Van den Berg, A., 1998. Notes toward a general theory of deliberative action. Amsterdams Sociologisch Tijdschrift, 25, 429- 463.

Vandermeer, J., van Noordwijk, M., Anderson, J., Ong, C., Perfecto, I., 1998. Global change and multi-species agroecosystems: concepts and issues. Agriculture, Ecosystems, and Environment, 67, 1-22.

Welsh, R. 1997. Vertical coordination, producer response, and the locus of control over agricultural production decisions. Rur. Sociol. 62, 491-507.

Figure Captions

Figure 1. Joint self-interest (Eg) and other-interest (Em) isoquant and indifference iso-curves for inputs X_i, goods q_i.

Figure 2. Ego-empathy frontier for two goods q or for two sources of utility U.