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**Analysis of a Re-Focused Agricultural Policy within a Farm-Household Framework  
Some Data Requirements**

By

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Paper Presented at  
Workshop on the Farm Household-Firm Unit:  
Its Importance in Agriculture and Implications for Statistics

12-13 April 2002

Wye Campus  
Imperial College, University of London

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## **Introduction**

Serious students of farm policy (even those who have had a hand in the formation and maintenance of current farm policy) now agree that policy reform to end the agricultural sector's longstanding reliance on traditional farm commodity programs is long overdue (e.g. Cochrane and Runge, 1992). Although there has been some progress toward this goal, it is unclear exactly how rapidly the substantial inertia surrounding current policy can be overcome, or exactly what form new policy initiatives will take. To many it seems obvious that policy reform must account for the increasing heterogeneity of the agricultural sector, particularly with respect to the variety of dimensions by which farm households and firms now differ (Kuhn and Offutt, 1999). From this perspective, farm policy might be reshaped to provide a safety net based on the economic circumstances of the farm household (Gundersen et al., 2000). Others make the case that a new policy paradigm must recognize explicitly the "multifunctional" nature of agriculture. In this event, the managers of land and natural resources would be remunerated for the non-commodity outputs valued by society, but penalized for those that impose social costs (Blandford and Boisvert, 2002).

The outcome of new policy initiatives is likely to reflect both of these views and others in some politically acceptable combination.<sup>1</sup> In anticipating the data requirements for effective policy evaluation, they must at a minimum be sufficient to measure:

- the effects of current agricultural policies/changes in policies on the behavior and well-being of farm households;
- the environmental implications of traditional agricultural policies, and the impacts of policies directed towards environmental outcomes; and
- the implications of changes in general economic conditions (e.g., due to technological change and shifts in consumer demand) for farm household behavior and well being.

Since the effects of domestic farm policy reform in many developed nations will likely resonate through international markets for agricultural products and have implications for global

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<sup>1</sup> While acknowledging that the level of support for particular policy objectives can differ, a recent AAEA Data Task Force lists five national policy priorities relating to agriculture and rural America. They include: "(1) achieving national and global food security; (2) improving domestic productivity and international trade, especially in the production of food and fiber; (3) preserving and improving good health and human capital through improved nutrition; (4) preserving environmental and natural resources; and (5) sustaining viable rural lifestyles and rural sectors" (AAEA, 1997).

environmental goals, it is imperative that countries can agree on the common data needed to effect international comparisons.

The overriding theme of this conference is to raise the awareness of the data needed to effect an evaluation of new policy initiatives from these diverse perspectives. To contribute to this goal, the purpose of this paper is to provide a conceptual overview of how we can analyze these issues at the farm household level, and then articulate the implications of this framework for the data that must be collected. To the extent possible, the conceptual framework should be generic—capable of encompassing a broad range of effects stemming from a variety of possible policy directions.<sup>2</sup> We might be able to visualize an ideal data set for this purpose, but if international comparisons are to be effected, our recommendations must be guided by considerable restraint, recognizing countries' differential capacities for assembling data, conceptual problems of measurement due to differences in social institutions, and realistic budgetary considerations. These issues should generate lively discussion throughout the conference.

In what follows, I begin with a brief review of agricultural economists' concerns over the adequacy of data that were evident more than a quarter century ago, particularly as they relate to farm households and rural economies more generally. Next, I describe briefly efforts in the United States by the USDA to collect farm household data on a continuing basis. Then, a framework by which these data can be used to inform the debate over new directions for farm policy is outlined, and the implications for data collection are articulated. A final section draws some conclusions for policy and poses some questions for more in-depth discussion throughout the conference.

### **Some Background on the State of Agricultural Data Systems**

In a review commissioned by the American Agricultural Economics Association (AAEA) over a quarter century ago, one former Administrator of the Economic Research Service (ERS) of the USDA wrote: "It would be hard to imagine the subject of agricultural economics without data" (Upchurch, 1977, p. 305). By lending substance to description, and when properly ordered, data can reveal problems and point to their solution.

No applied economist is ever confronted with an ideal set of data, but those engaged in the study of problems in agricultural economics, both public and private, arguably have had ready access to a storehouse of data unparalleled for any single sector of an economy. Beginning with the Census of Agriculture of 1839 and following the creation of USDA in 1862, steady improvements were made in the coverage, scope, and accuracy of U. S. agricultural data through the early 20<sup>th</sup> Century. The capacity for further improvement was given a substantial boost during the 1920's and '30's with the creation of the Bureau of Agricultural Economics. Demand for better data came from all quarters during this period as economists and policy makers sought solutions to the deep-seated economic problems brought about by an extended period of seriously depressed agricultural prices (Upchurch, 1977, p. 305). It was also against this

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<sup>2</sup> Because of public demands for accountability in agricultural research from economic, environmental, and health perspectives, Antle and Wagenet (1995) argue persuasively for the need for collaboration across the full spectrum of biological, physical, and social sciences in setting research priorities and addressing the impacts of agricultural technology. Major changes in agricultural policy could hardly be judged by any lesser standard.

backdrop of common problems facing a homogeneous agricultural sector in financial crisis that the foundations of present-day domestic agricultural policy were laid.

Agricultural economists have continued to demand better data, and throughout the ensuing three or four decades, improvements were made both in the quality and coverage of many types of data (Upchurch, 1977). Table 1 contains a list of the general categories of data available at that point in time.

It was not until the mid-1970's that agricultural economists began to raise some serious questions about data. A new research agenda was beginning to emerge to address the issues facing an agricultural industry forever changed through the adoption of technology, decisions in response to public policy, and the expansion of international markets. This clearly heightened the demand for data to measure a broader range of social and economic phenomena in agriculture and in rural areas. As consolidation and specialization in farming continued, data were also required for the rapidly expanding agribusiness industries both up-stream and down-stream from farming operations.

Much of the data used in agricultural economics research continues to be collected and reported by public agencies, particularly the USDA through its Economic Research Service and the National Agricultural Statistical Service (NAAS). There has also been tremendous growth in the data acquired through special surveys or studies, and other data are increasingly available through private sources such as commodity associations, private consultants, and Extension services (Just et al., 2002). Some special research efforts were to study issues that had heretofore not been identified, or that were anticipated to emerge in the future. Only when it becomes clear that an issue will persist for some period of time is it prudent to put in place procedures for the systematic collection and reporting of new data. Important examples include the more systematic maintenance of data on purchased nutrient and chemical inputs and energy use in response to a greater recognition of agro-environmental problems, fuel shortages, and higher fuel prices in the late 1970's.

But progress both in the quality of data and its coverage has also been uneven. For the study of some issues, data have never been adequate. In other cases, data have proven sufficient in the past, but the data systems may now be obsolete, or are in danger of becoming so.<sup>3</sup>

Despite the increasing interconnection between farm and non-farm rural economies, for example, efforts as of the mid-1970's to secure the data needed to study the broad range of rural economic problems had fallen well short of those to collect and maintain agricultural data (Bryant, 1977). Despite the mounting evidence since then that many farm families rely

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<sup>3</sup> According to Bonnen (1977) conceptual obsolescence "...can occur not only because of changes in the organization and nature of the food and fiber industry, ..., but also because the agenda of food and fiber policy (public and private) changes dramatically" (p. 388). When this happens, of course, the questions asked of the data change as well. As we move further into this electronic information age, there is also greater risk of obsolescence of a different kind if sufficient attention is not given to the packaging, dissemination, and accessibility of data to a variety of users. This issue was underscored in the report of the most recent AAEA (1997) data task force, particularly as it relates to availability of micro-level data.

increasingly on off-farm income, there has been no sustained effort to develop a data base to investigate the complexity and dynamics of these rural livelihood strategies.<sup>4</sup>

Bryant attributed the unevenness in data collection largely to the fact that the demand for agricultural data had historically been at the national and international levels. It was easy for the industry to lobby in favor of better data that could not only serve private interests, but also provide the foundation for the study of commodity farm policy. In contrast, the demand for rural economic data is primarily at the state and local level. There has been no effective lobby for rural economic data; these data are perhaps still often viewed as just part of the economic data for the larger economy that crosses all industries, regions, and people.

These difficult circumstances are continually compounded because “rural development” means different things to different groups. To some, rural development means jobs; to others it is access to services or a change in social institutions. Thus, as suggested by Upchurch (1977) in an earlier critique of rural data systems, we have failed to conceptualize rural socio-economic problems adequately,<sup>5</sup> and then match this effort with equal concern to design statistical systems to measure important social phenomena. Federal budgetary problems that plagued the 1970’s and ‘80’s and persist today have also worked against efforts to obtain rural economic data on a consistent and sustained basis.

This is not to say that the call for changes in our agricultural data systems has gone completely unheeded. In accordance with the Food and Agriculture Act of 1977 and subsequent legislation, the USDA now reports annually to the U. S. Congress on the status of family farms (Sommers, et al., 1998). Until the mid-1980s, the data in this report to Congress were collected as part of the USDA’s farm costs and returns survey (FCRS). In the mid-1980’s, the Agricultural Resource Management Study (ARMS) replaced the FCRS as the basis for this annual report. ARMS is a flexible tool for data collection that was clearly developed in order to expand the scope for analysis and respond to emerging policy concerns, such as those related to the farm sector’s greater reliance on off-farm income.<sup>6</sup> It is perhaps also the appropriate vehicle to collect some additional farm level data needed for an analysis of policies designed to recognize explicitly the environmental and other non-commodity outputs from a multifunctional agriculture.

A summary of the categories of information collected as part of the ARMS survey is in Table 2. Many of the sections assemble information on costs and returns of the farm business, as well as on land holding and other farm assets. To place the farm business into a broader context with the farm household, the information collected under Section K was added to the old costs and returns survey. The questions generally relate to the extent and type of off-farm employment,

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<sup>4</sup> On occasion, there have been some special studies to understand the nature of the participation of farm operations and farm family members in off-farm employment. See, for example, Gould and Saupe (1989) for an analysis from such a special survey.

<sup>5</sup> At that time, Upchurch (1977) pointed to a report of the AAEA Committee on Economic Statistics, which argued that the most critical needs were: better concepts of demographics; better measures of social well-being, whether in health, education, personal safety, housing, income and employment; income and asset distribution in rural areas; regional and local area development data; and data systems to do program evaluation.

<sup>6</sup> The ARMS survey form is modified from time to time for the purpose of collecting information about a special topic or policy concern.

the reasons of working off-farm, off-farm earnings, non-farm assets, and aggregate household consumption expenditures. Data are collected for both the farm operator and spouse.

The section on other farm income, including the variety of government program payments helps to complete the picture (Table 2). Items in this section, such as revenue for custom work, livestock grazing, and recreational services, can clearly be important components of farm family income, as are de-coupled production flexibility contract payments. In theory, these de-coupled payments should have no effect on farm production. Currently, the most important, environmentally-related programs make annual payments to farmers for land taken out of production and put into trees, filter strips or other conservation practices. The government also pays some share of the establishment costs for the individual conservation practices. These payments contribute to farm family income, but in contrast to the de-coupled payments, they are designed to affect production plans and are supposed to lead to land use changes that enhance the environment. No data are collected in ARMS to document the contribution of these program payments to important environmental goals. We return to this issue below.

These efforts in the United States and similar efforts elsewhere are a significant step forward in gathering improved farm household data for the analysis of critical issues as legislators and policy makers in developed countries redirect the focus of domestic agricultural policy. But it is only the beginning.<sup>7</sup> Rather than repeat the errors of the past, the adequacy of these data for expanded policy analysis can only be assessed within an appropriate framework to conceptualize rural socio-economic problems. The nature of this framework turns not only on and the interrelationship between farm households and the greater rural economies, but also on the types of policy changes anticipated in the near future.

I proceed in a series of steps. First, and perhaps foremost, this framework must inform policy makers of the implications in policy changes for the income distribution of farm households. Next, the framework is expanded to embrace the effects of policy redirections that recognize the multifunctionality of agriculture and compensate farmers more directly for their production of valuable non-commodity outputs or penalize them for the production of non-commodity outputs that impose costs on society. Finally, it is important to put these data needs into perspective with budget considerations, the needs of various users of the data, the form of data collection and distribution, and the potential need to link household and physical resource data through some GIS capacity.

### **A Framework for Understanding the Generation of Income by Farm Households and its Distribution**

In developing this conceptual framework, we must understand how income is generated and its distribution between farm and non-farm households and among groups of farm households. We can distinguish two separate, but very much interrelated processes. The first

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<sup>7</sup> Although the viability of rural areas is listed as one of the five national policy priorities listed by the most recent AAEA Data Task Force, just the tone of their final report, at least to this reader, would suggest any effective lobby for rural economic data is still absent. However, the heightened level of prominence given to resource and environmental concerns in the policy debate will require a much sharper focus on the spatial diversity of policy impacts, be they site-specific, local, area-specific, regional, or nationally differentiated. Those with a long standing interest in broader rural economic data may have found a significant ally also with a heightened demand for rural micro-economic data.

relates to how the income is generated initially. That is, the productive activity of any firm or sector of an economy generates sales revenue, as well as a stream of payments to various factors of production—intermediate inputs and several primary factors such as land, capital and labor. Our focus is on the total payments to these primary factors, which constitutes most of value added in the economy.

The distribution of total value added among land, labor and capital is sometimes called **the functional distribution of income**.<sup>8</sup> The proportions of total payments going to land, labor, and capital characterize the relative input intensities of the various economic sectors. This distribution clearly depends on the amount of each factor employed by sector and the wage rate relative to returns to land and capital. But the story doesn't end there; these payments to primary factors are in turn distributed geographically and among households in various income groups, depending on location of both the economic activity and the ownership of the productive factors. The final incidence of these primary factor payments to various household and income groups is often called **the size distribution of income**.

### *An Economy Wide View*

We can gain an important perspective on the relationship between these two concepts of the distribution of income through a social accounting matrix (SAM). The SAM, whose development is attributed to Richard Stone, explicitly includes institutions and their interactions into a general accounting framework (Miller et al., 1989). It has at its foundations the inter-industry transactions table (e.g. an I-O table) first used by Leontief over 60 years ago to characterize the structure of an economy.

One objective of a SAM is to organize information about the economic and social structure of an economy in a particular year. It is nothing more than a double entry booking system, where for each of a series of accounts, the incomings and outgoings (or income and expenditures in most cases) must balance. In this respect, the SAM resembles traditional national accounts, but embodies much more (King, 1985).

Perhaps the best way to understand a SAM is through an example with numbers. With the help of the hypothetical SAM in Table 3, we can establish the linkage between the functional and size distributions of income at this aggregate level. This SAM depicts the standard set of inter-industry accounts for a three sector economy, but also distributes primary factor payments (for two types of labor, capital, and land) among urban (URBAN), rural non-farm (RNFARM), and rural-farm (RFARM) residents and between low (Low) and high (High) income households.<sup>9</sup>

By convention, the individual elements of the SAM represent expenditures or distributions of funds from the sector in the column to the sector in the row. For example, the manufacturing sector purchases \$5,052 of intermediate inputs from the agricultural sector, while

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<sup>8</sup> The importance to farm-household well being of such things as consumption, environmental quality, and farm and non-farm assets is considered explicitly below.

<sup>9</sup> The three sectors are agriculture (AGR), manufacturing (Man) and services (Ser). The two types of labor (Lab1 and Lab2) might represent unskilled and skilled labor, respectively. Capital (Cap) and Land are the other two primary factors of production. There are also rows and columns to trace government expenditures and receipts (Govt) and transactions to and from the rest of the world (ROW).



low-income households purchase \$133 of agricultural output for final consumption. The portions of the table surrounded by the boxes are typically what one sees in the national I-O accounts.

To understand the income distribution (defined here as total payments to the four primary factors of production), we focus initially on the corresponding four rows of the table (e.g., total payments to Lab1 are \$17,446, while total payments to Land are \$322). Further, all land is employed in agriculture, but each of the three sectors employs some portion of the other three primary factors (e.g., manufacturing makes payments of \$2,032 to Lab1).

While it is often useful to know the proportion of payments to labor due to any productive sector, the **functional distribution of income** relates to how the total primary factor payments (value added) are distributed among its four components. Total value added in this economy is \$42,946 (e.g.  $17446 + 9286 + 15892 + 322$ ),<sup>10</sup> and the factor shares distributed to Lab1, Lab2, Cap, and Land, respectively, are 41%, 22%, 37%, and 1%.<sup>11</sup> From this exercise, it is clear that as long as the components of value added are reported individually (which by the way is not often the case), the national income accounts provide at any point in time a detailed snapshot of the functional distribution of income.

What distinguishes the SAM from the national I-O accounts is that total value added in the economy is additionally distributed to households in different income classes. And, this is the essence of **the size distribution of income**. In this example, there are two dimensions to this distribution—the distribution by location, and by income class.

To illustrate, of the \$17,446 payments to Lab1, we see from Table 3 that \$10,690 (or 61%) are paid to households in urban areas. From Table 4, we see that less than 1% goes to rural farm households, 28% goes to rural non-farm households, and 11% is paid to the government. In this economy, 75% of the payments to land go to rural farm households, while 9% go to urban households and 16% is paid to the government.

Nearly 29% of all value added in this economy (\$12,339) is paid to the government, while the remaining \$30,608 is distributed among low and high-income households in the rural and urban areas. Urban households receive nearly 2/3's of this amount, while rural non-farm households receive over 31%. The \$481 going to rural farm households is less than 1% of the total. As seen in Table 4, high-income households receive 57%, 63%, and 64% of the income going to urban, rural farm, and rural non-farm households, respectively.

The data over and above that found in traditional national accounts needed to populate the cells of a SAM are substantial indeed, but once the data have been organized, they present a powerful image that can reveal a great deal about the country's economic structure. We must be ever mindful, however, that this image is only a static, descriptive "snapshot" at a point in time.

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<sup>10</sup> The lion's share of payments to any component of value added comes from one of the three production sectors, but, there are also \$106 and \$56 payments to Lab1 and Lab2, respectively, from the rest of the world.

<sup>11</sup> We can likewise examine a similar functional distribution by production sector. That is, of the \$11,949 of total value added in agriculture (e.g.  $1646 + 3789 + 6192 + 322$ ), 14%, 32%, 52%, and 3% are paid to Lab1, Lab2, Cap, and Land, respectively. Similar calculations could be made for manufacturing and services as well.

A comparison of SAMs at two different points in time would embody the combined effects of general changes in the economy and policy interventions, but with little insight into the process through which the changes were effected. If major changes in farm policy were set in place in the intervening years, for example, the functional distribution of income may change, but so also might the distributive shares (e.g. Table 4) that characterize the size distribution of income.

A SAM does provide the statistical basis for the creation of a model of the economy that can be used to simulate the effects of policy interventions (King, 1986), most often through either SAM multiplier analysis or the construction of a Computable General Equilibrium Model. In manipulating these models, it is usually assumed that policy interventions have no effect on the distributional coefficients in the model. As we contemplate major revisions in farm policy in response to changed policy priorities, our singularly most important task is perhaps to discover how these distributional coefficients are likely to be altered.

For that purpose alone, we need access to comprehensive micro data about farm and non-farm activities of farm households. Only by bringing these data to micro-economic models that recognize the important interactions between farm and non-farm activities in these households, can we learn about how farm-households respond to new policy initiatives and how the income distribution changes in the process. As echoed by the recent AAEA Data Task Force, the complex processes of technology adoption, off-farm job participation, and participation in environmental programs can be understood only by appealing to these same micro-economic foundations (AAEA, 1997). As a by-product, such micro-level analyses may provide the basis for populating the cells of regional or national SAMs that document the size distribution of income in rural areas.

#### *The Micro-economics of the Farm Household (F-H)*

For many applied economists, the genesis of the agricultural household model lies in Becker's early investigations into the economics of time allocation within and outside the household. This time allocation model is the conceptual cornerstone of the now vast literature on labor supply. In turn, development economists were quick to expand the model to include farming activities for the study of diverse livelihood strategies of subsistence farms which depend critically on the allocation of time among household activities, off-farm work, and farm labor (Singh et al., 1986).

One curious fact in these further developments of Becker's model for time allocation is the absence of any reference to the earlier recognition by agricultural economists of the importance of firm-household interrelationships, as is seen in Heady's 1952 text entitled *Economics of Agricultural Production and Resource Use*. I mention Heady's work not because I believe his contribution to our understanding of these interrelationships has gone unnoticed. Quite to the contrary, his careful treatment of this issue undoubtedly shaped the thinking of countless students who studied production economics from this landmark text. Rather, I mention his work not only to emphasize that agricultural economists have long recognized the significance of these interrelationships, but also to focus attention on how our views of the interrelationships have evolved. I can think of no better way to contrast how our demands for data to effect policy analysis have changed.

The important ideas put forth on this subject by Heady a half-century ago can be summarized in the eight quotations found in Exhibit 1. Although some might quarrel with the emphasis and suggest subtle changes in wording, most would agree that these old ideas, in substantial measure, still ring true. The interdependence between the household and the firm remains strong if not intensified, and farm production and profits remain only intermediate ends rooted in more ultimate ends of family consumption and utility. But, it is perhaps in these subtle changes that we uncover the clues regarding the evolution of the farm-household interrelationships that affect our approach to farm policy analysis.

So what are the differences? Most notable is the absence by Heady of any reference to off-farm work or other activity, but such an omission was substantially right for the times. In his view, family activities were critical to resource allocation, but any labor available in the household flowed only in one direction—into farming activities. One major source of conflict between the firm and the household was in the proportions of current income allocated between current consumption and re-investment in the farm business. Clearly, the net flow of funds was primarily in one direction—from the farm to the household. This simpler view of the farm-household interaction is depicted in Figure 1, and the subtle, and not so subtle changes are traced schematically in Figures 2 and 3. Physical flows in the figures are represented by dashed lines, while financial flows are the solid lines.

*A F-H Model: The Subsistence Farm Perspective.* Heady's initial conception of F-H interactions was one in which primary factors and intermediate inputs were combined to produce agricultural commodities (Figure 1). Much of the farm labor was supplied by the household, and few intermediate inputs were purchased. Feed was home grown, and green manure was used to sustain soil texture and productivity.

Some commodities were sold, while others were consumed and contributed directly to household utility. Time was divided among farm labor, household tasks and leisure, the latter (what little there might be) contributing directly to utility.

Farm revenue is from sales of agricultural commodities, as well as commodity program payments. Any yearly revenue not spent on farm inputs (including farm investments in any year) goes to the household, where it contributes directly to utility through the purchase of goods and services. Any money paid to family labor also goes directly to household income, whereas unpaid family labor effectively reduces input costs below what they would have been if labor had to be hired. Any government payments for conservation or land retirement programs during that period of time are assumed to reduce input costs, or enhance the value of farm assets. Wealth, in the form of farm assets, contributes to household utility.

Absent any opportunities for off-farm work, any net flow of funds (small as they might be in some years) would be from the farm to the household. Thus, along with the decision on how much household labor was to be used on the farm, the other major farm-household decision was the distribution of net farm revenue between household consumption and farm investment.

*A F-H Model: Where There are Non-farm Opportunities.* As farmers continued to adopt new technology and substitute capital and newly available purchased inputs to reduce costs, labor was released from agriculture. Much of the surplus labor left the rural areas, but as some rural areas prospered, in large measure due to the growth in an agribusiness industry to serve the needs of production agriculture (or through other rural development efforts), there were increased off-farm employment opportunities for farm family members. As the industry continued to mature and consolidate, some farm households unable or unwilling to adopt technology and expand the size of the farming operation, sought out off-farm jobs as a way to sustain a certain rural-farm lifestyle.

This major change in the rural livelihood strategies of many farm families has led to more complex farm-household interactions (Figure 2). The most obvious are decisions about an additional use for the time of household members. Off-farm jobs contribute directly to household income, but for some at least, these jobs have led to an accumulation of non-farm assets, often facilitated by substantial job-related benefits such as health insurance and retirement programs. These assets and benefits either contribute directly to household utility as wealth, or augment the flow of current income to the household. With one exception, the other physical and money flows of the simpler model in Figure 1 remain, although the relative size of the flows along any path could be altered dramatically. The one exception is that the net flow of funds between the farm operation and the household can be in either direction.

*A F-H Model: With Non-farm Opportunities and a Multifunctional Agriculture.* What sets the third, perhaps contemporary, view of the F-H model in Figure 3 apart is more about society's explicit recognition of the value of agriculture's multifunctional nature than it is about any change in farm and off-farm economic opportunities for farm households. In this model, farm households are assumed to value the multifunctional attributes as well, but perhaps differently from others in society.<sup>12</sup> Further, farm payments are assumed to be de-coupled from farm production, as depicted by the flow of funds directly from the government to the farm, rather than directly to the commodity outputs.

The multifunctional nature of agriculture is not new, but only recently has it been elevated to a place of prominence in the agricultural policy debate, along with the broadened range of other non-trade concerns including food security, food safety and quality, animal welfare and rural development. While the concept of multifunctionality appears to have various interpretations, the major intent is to characterize agricultural production as a multi-output activity for which there are important non-commodity outputs in the production processes. In addition to food, fiber, and agricultural raw materials, these multiple outputs may include landscape amenities and cultural heritage that yield "social" benefits not traded in organized markets.<sup>13</sup> These non-market outputs have no price because an individual's enjoyment (consumption) of the good does not reduce the quantity available to others, and it is not possible

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<sup>12</sup> Some might argue that in earlier times farm families derived utility directly from their stewardship of the soil, rather than just indirectly through the effects of the value of farm assets as is now suggested in Figure 1. I wouldn't disagree, and this omission above was for purposes of simplicity, and to draw sharp distinction between that situation and the policy implications from society's growing recognition of the value of several important multifunctional non-commodity outputs.

<sup>13</sup> Some multifunctional outputs, such as those related to environmental quality, have enjoyed an elevated place of prominence on developed countries policy agendas for some time.

to prevent someone consuming the good once it is made available (Blandford and Boisvert, 2002).<sup>14</sup>

To recognize the social values of agriculture that are not traded in organized markets and comprehend the significance of this view for domestic and international policy, “we must devise a way to “level the playing field” in order to compare policies affecting the production of non-commodity outputs with those affecting commodity outputs, even though it is difficult to value non-commodity outputs or to determine how inputs are combined in their production. We need not agree on every non-commodity output to include in a definition of multifunctionality. We must agree, however, not to list only those with social benefits; there are non-commodity outputs that impose social costs. It also matters little whether these social benefits or costs derive from an externality or the public good nature of the non-commodity outputs” (Blandford and Boisvert, 2002, p. 9).

Boisvert (2001a, b) accomplished this task by characterizing multifunctionality as joint production--a situation in which two or more outputs are technically interdependent (Shumway et al., 1984).<sup>15</sup> Originally, the definition of joint production focused only on commodity outputs – the classic definition refers to things that cannot be produced separately, but are joined by common origin or non-allocable input (e.g. wool and mutton from sheep, wheat and straw, or soybean meal and oil). There are two other important, but quite distinct conditions, that give rise to inter-linkages between products: when there are technical interdependencies in the production process; or when outputs compete for an (allocable) input that is fixed at the firm level.

In leveling this policy playing field, it is critical to realize that a simple view of joint production in fixed proportions is unlikely to apply more generally in multifunctionality. Where outputs occur in other than fixed proportions, changes in the relative prices of both inputs and outputs will affect the supply of both commodity and non-commodity outputs in agriculture.

Boisvert (2001a,b) has captured the critical aspects of joint production in a simple model with two commodity outputs and two non-commodity outputs – (e.g. a landscape amenity) and a negative externality (e.g., pollution). The environmental residual might be nitrate leaching; as one applies more fertilizer to a fixed land area, leaching would increase, as would output. However, if a fixed amount of fertilizer were applied to more land, output would rise, but leaching would fall because the fertilizer intensity of production would fall. In this case, pollution is not generated in fixed proportion with commodity output, but production is joint nonetheless. There is no way to disentangle or isolate the separate contribution of the purchased input to the production of the commodity and its effect on the resulting level of pollution. Landscape amenities are assumed to increase with land in agriculture, but as is often held to be the case, as the extent of land in agriculture increases, the smaller is the amenity value placed on an additional unit of agricultural land. Thus, the level of landscape amenities increases, but again not in the same proportion to commodity output.

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<sup>14</sup> These characteristics of public goods are non-rivalry and non-exclusivity. Unlike public goods, positive and negative externalities are divisible and can be depleted, but are also not priced.

<sup>15</sup> This discussion draws heavily on two technical annexes prepared by Boisvert (2001) as part of an OECD report entitled *Multifunctionality: Towards an Analytical Framework*.

Further, by simply “pricing” the non-commodity outputs through subsidies or taxes (as is seen in the financial flows from the government to the non-commodity outputs in Figure 3), the various commodity and non-commodity joint products, technically interrelated for one or more reasons, are revealed to be *economically interdependent* as well.<sup>16</sup> This in turn would facilitate a comparison of direct policy intervention to affect the levels of these non-commodity outputs with the indirect effects that come through traditional agricultural commodity policy. Not surprisingly, if we set the subsidy on amenities and the tax on pollution at their marginal social values, we obtain the welfare maximizing Pigouvian outcome for internalizing the external benefits and costs of the non-commodity outputs (Spulber, 1985).

### **Implications for Data, Modeling, and Policy Analysis**

The major point to underscore from these three figures is that the data and modeling capacity required for effective policy evaluation can be altered dramatically by changes in: the organization of farms, off-farm job opportunities, and the agenda of farm policy.

#### *Modeling Considerations*

In his early production economics text, Heady (1952) recognized that by embracing both the farm and the household, micro-economic analysis would be more complex, except under the most stylized conditions where the farm and the household could be treated separately, or perhaps more appropriately in a recursive fashion (Exhibit 1).<sup>17</sup> This would mean that the profit maximizing outputs and input demands of the firm could be solved for initially, and this profit could then be used in the household model to solve for the utility maximizing consumption levels. The sufficient conditions for which this is true are several: a) a single period model; b) farmers are price takers; c) complete markets exist for all inputs and outputs; and d) the household must not consume all its own output.<sup>18</sup> If these conditions do not hold, there will exist a virtual (or shadow) price for a commodity that will be endogenous to the firm—a function of both technology and preferences.

The reality of the farm household, of course, is not this simple. The possibility for such an orderly recursive analysis are confounded once there is explicit recognition of: a) the tradeoff between current and future consumption; b) farmer’s risk averse behavior in the face of uncertainty, or c) any constraints on capital (Exhibit 1). The more complex approach is also required if one can’t observe multifunctional outputs directly. In this case it would not be possible to realize a Pigouvian policy solution through direct taxes and subsidies on the non-commodity outputs. Rather, incentives to move in the direction of socially optimal levels of the

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<sup>16</sup> Leathers (1991) relates the notion of joint production to cost and profit by appealing to the notion of economies of scope, which can be defined in a somewhat simplified manner for our purposes. For any group of outputs,  $Y_1, \dots, Y_m$ , there are economies of scope if:  $C(Y_1) + C(Y_2) + C(Y_3) + \dots + C(Y_m) > C(Y_1, \dots, Y_m)$ . That is, if there are economies of scope, the cost of producing the  $m$  products jointly,  $C(Y_1, \dots, Y_m)$ , is less than the cost of producing the products separately.

<sup>17</sup> In the basis farm-household model, the household utility function is maximized subject to a cash income constraint, a constraint on household time, and a production or technology constraint. These constraints are then often combined into one where household expenditures are set equal to Becker’s concept of a full income in which the value of the household’s stock of time is recorded plus a measure of farm profits. All labor and time are valued at the wage rate (Singh et al., 1986).

<sup>18</sup> These conditions were established by Strauss (1986) in rigorous mathematical terms, and as they mention by others some years earlier.

multifunctional outputs might come indirectly through taxes or incentive payments to affect: a) inputs use; b) the use of a particular technology; or c) the adoption of a particular set of production practices.

### *An Ideal Data Set?*

Under these more realistic conditions, one can easily be discouraged by the long list of data required to estimate the full farm household model. At a minimum one must have data for consumption expenditures, farm and off-farm labor supply, farm and non-farm outputs and inputs, assets, and prices for all goods, inputs, and labor. Information about the use of certain technologies and participation in government programs is also needed. Basic demographic characteristics are needed to account for the effects of differences in education, human capital and stages in the life cycle on production, consumption, and labor supply decisions. But, it is exactly the extent of the data that calls for a commitment at the national level for the collection and maintenance of a farm-household data base. It is at this level that appropriate sampling designs can exploit economies of scale in data gathering, ensure regional representation, and possibly exploit the advantages for analysis of a panel of time series cross sectional data on the same farm households.

I have just come close to describing the ideal data set any agricultural economist might long for to effect agricultural policy analysis at the farm-household level. There are many developed countries today that now conduct separate household budget surveys and farm management surveys. Since data on both consumption and production activities are needed to estimate the complete farm-household model, one way to envision this ideal data set would be to have both surveys administered to the same households, or at least include some significant overlap.<sup>19</sup> The ARMS data constitute a significant step toward realizing this more ideal data base, in that information about household income and assets are added to the farm production data, but ARMS stops well short of a complete consumption or budget survey.

I am not so naïve as to believe that all remaining gaps between ARMS and the ideal situation will be closed any time soon, even if there were a commitment to do so at the highest levels of government. Further, if one is concerned about documenting the effect of policy on the production of multifunctional outputs from agriculture, neither the standard farm management nor budget surveys assemble the required data.

Progress toward any ideal data base will remain incremental, but it is still possible to learn a great deal from incomplete data. This is hardly a revelation to applied economists. Many routinely conduct policy analysis by focusing only on the essential structural or reduced form equations,<sup>20</sup> by imposing separability, by appealing to the economics of duality, or by aggregating production or consumption activities. The conceptual underpinning of the complete

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<sup>19</sup> Not surprisingly this strategy would assemble a comprehensive list of indicators bearing a striking resemblance to what is now collected through the household questionnaire administered by the World Bank as part of its standard Living Standards Measurement Study (LSMS) survey for developing countries. According to Deaton (1997), Ainsworth and Munoz (1986) provide an excellent description of the typical LSMS survey.

<sup>20</sup> Within the context of off-farm labor supply, Goodwin and Holt (2002, p. 188) provide a good discussion of the differences between structural and reduced form modeling in making the transition from a conceptual or theoretical model to empirical work.

farm-household model can help to assess the effects of these required simplifications on the final analysis.

### *Emerging Priorities for Policy Analysis*

The present challenge is to identify the most critical, additional pieces of data for the study of an evolving domestic policy agenda. Clearly, we need basic data on off-farm income to document its significance relative to farm income in the well being of farm households. But to assess the important interplay between farm and household decisions as it is affected by changes in agricultural policy, we also need data about the household's and the farm's endowment of land and other natural resources. A couple of examples can serve to illustrate these points. The first has to do with the increased price and income risk that most observers expected would have followed from the enactment of the budget-driven 1996 farm bill. The second is the elevated status of concerns for the environment and other non-commodity multifunctional outputs from agriculture.

With its focus on shrinking the overall level of support for agriculture and on moving the industry toward free market status, the 1996 Farm Bill signaled the beginning of the end for several program provisions that for years have helped farmers manage risk. This Bill substantially reduced deficiency payments and acreage set-asides, and other measures, such as price supports, commodity loans and loan guarantees, are scheduled to be phased out over a several-year period during which eligible farmers would receive risk-free transition payments. In return, farmers will then be free to produce whatever they want and compete in markets on their own merits (Barry, 1999).

This particular experiment with farmers managing their own risk was short lived as the government pumped billions of dollars of extra financial assistance into the farm sector in response to the recent downturn in farm prices. In the longer term, Barry (1999) and I'm sure other experts in farm finance would agree, argues that one critical policy issue is to identify both gaps in the risk bearing capacity of farmers and an appropriate policy response if one is needed. Table 5 contains some 13 options that could be examined in a comprehensive assessment of risk management. In addition to the expected list of management strategies and financial measures, off-farm income is included. This is perhaps not surprising, and there has been for some time evidence that off-farm income does reduce farm household income inequality (e.g. Boisvert and Ranney, 1990; Findeis and Reddy, 1987; and Ahearn et al., 1985).

Merely having this capacity to document the risk reduction effects of off-farm income is perhaps sufficient justification for collecting such data through ARMS, but I would argue that it also paves the way for much more systematic analysis of how farm households manage risk. The theory of risk aversion tells us straightaway that off-farm income is a viable candidate for a farm household's portfolio of income generating activities along side a diversified set of production activities. What is also true, however, is that diversification into off-farm jobs may be to improve the efficiency of labor use on farms too small to employ all household labor efficiently due to land or capital constraints. By considering farm and off-farm work as the only two activities and land and labor as the only constraints, this interplay between the role of diversification and efficiency of resource use is easily seen graphically. One need only trace out in activity space the



successive graphic solutions to the quadratic programming problem that generate the Mean-Variance efficiency locus (e.g. re-label the graph on page 11 of How and Hazell, 1968).

Just (1974) and Trill (1976) were among the first to include a measure of farm income variability in output supply equations. Any reduction in output due to risk would certainly be reflected in the demand for farm inputs, including labor. After controlling for education and other household demographics, recent attempts to separate these two major reasons for working off the farm include measures of farm size, cropping efficiency, and farm income variability in the equations to explain participation in off-farm jobs (Mishra and Goodwin, 1997; and Goodwin and Holt, 2002).<sup>21</sup>

Regardless of the new directions for farm policy, the effects of program payments on farm-level risk and production decisions must still be understood. Using aggregate data, Mullen (2001) has found recently that risk reduction from de-coupled farm payments would also lead to output expansion through the wealth effect for farmers exhibiting decreasing absolute risk aversion. Her thesis also contains a good discussion of how risk, resource constraints, and special labor skills might interact with farm payments to affect labor allocation between farm and off-farm activities. Had Mullen been able to take a holistic view of the farm household using micro data, her results could have been more precise and have provided a range in response levels. It is only through access to these micro data that we can uncover any changes in behavior that spill over into farming operation from additions to non-farm income and assets. The effects could be not only in terms of the level of production but also encourage some farmers to be among the first adopters of new, but as yet unproven farm technology.

To resolve these issues and the ones implicit in the several paragraphs above, we certainly need data for the farm business and the farm household, but additionally we may need the data for a panel of households (e.g. data for the same farm households over a series of years). Otherwise, there is no way to track production, price, or income variability.<sup>22</sup> Such panel data offer other advantages in tracing the demographic changes in the household that may affect a household's response to policy initiatives.<sup>23</sup>

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<sup>21</sup> While we can learn a great deal from these analyses, their applicability for national level policy evaluation can be rather limited. Studies of this kind generally rely on data from a special study or are possible only by matching data from different sources. For example, Mishra and Goodwin match data from a 1992 survey of Kansas farm households with farm records from the Kansas Farm Management Association. Because of the need to measure farm income variability, farms were excluded from the analysis if they did not have income records for at least eight of the past 10 years. Goodwin and Holt, on the other hand, were not able to include farm income in their off-farm labor equations because their two sources of data were inconsistent. Some of these limitations will go away as we continue to collect yearly farm household data on a consistent basis.

<sup>22</sup> Even with panel data the access to data on prices and price variability will remain problematic because it is common to collect data on input and output quantities, along with data on sales and expenditures. In ARMS, for example, providing price data is optional. Unit values can still be calculated by dividing revenues and expenses by quantities, but their interpretation as prices for across-farm comparisons remains problematic because of differences in quality, marketing costs, etc. Deaton (1997, pp. 271-315) discusses similar issues in the context of household consumption surveys. By relying on price data from other sources, one may be able to capture yearly or regional price variation, but any across-farm price variability within a region would be blurred.

<sup>23</sup> Many of you at the conference are more familiar than I am with the difficulties in the design and maintenance of a longitudinal data base; the call for such a data set has certainly been heard before. It will be echoed again both because of its value in informing many policy debates, but also because economists now have a deeper understanding of the econometrics of panel data.

But the need for data doesn't end here if we are indeed serious about policy provisions that are to recognize the multifunctional character of agriculture. It is perhaps easiest to illustrate by discussing environmental quality, because regulating non-point source pollution remains one of the most difficult challenges in agricultural policy.

Recent studies have produced several policy schemes with theoretical appeal, but no single proposal has emerged as the clear answer to the non-point problem in practice. Pollution is not easily observable and depends on many site-specific factors that vary spatially, implying that the socially efficient policy is potentially different for each farm. Policy design is further complicated by the unavoidable production risk and the uncertainty about the relationship between environmental residuals and farm inputs and production inputs and outputs due to weather variability, etc. Environmental provisions of farm legislation are increasingly taking the shape of incentives to affect input use or adopt certain production or land use practices. The relationship between incentive policies, production risk, and input or other management decisions is complex (Ramaswami, 1992). A change in the price of a polluting input, for example, has an ambiguous effect on its use. The policy response cannot be predicted without knowledge of risk preferences as well as whether the input is risk increasing or decreasing, depending in part on the nature of the soil resource (Leathers and Quiggin, 1991; and Peterson and Boisvert, 2001). The same ambiguity would likely apply to predicting which farmers would respond to incentives to adopt environmentally friendly management practices or agree to put their land into conservation practices.

To assess environmental provisions of farm legislation, we need data sufficient to estimate differences in the productivity and environmental vulnerability of land in farms for much the same reason that we need data on the heterogeneity of farm households and firms to assess the economic well being of the farm sector. These data are not only critical to understanding participation in environmental programs,<sup>24</sup> but also are an integral component in measuring the contribution of participants to the various dimensions of environmental quality.<sup>25</sup> Only then is it possible to target programs regionally or locally to ensure program effectiveness (Jaroszewski, 2000).

With these data in the hands of program administrators, the added costs of environmental program design and administration due to asymmetric information about the quality of soils or other natural resources might be substantially reduced. Rather than having to design programs that meet incentive compatibility restrictions so that the appropriate program is self-selected by local farmers to match particular resource situations, programs could be tailored to local conditions. The costs of asymmetric information have been shown to be substantial in even rather simple programs offering incentives for reduction in fertilizer applications to lower nitrate residuals (Peterson and Boisvert, 2001).

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<sup>24</sup> Participation in these programs is clearly one of the choices in farm households' portfolio of livelihood strategies along with farming activities and off-farm jobs. Thus, it is not surprising that models of participation include variables accounting for income from all sources if the data are available (e.g. Purvis et al., 1989).

<sup>25</sup> More extensive data on fertilizer, pesticide, and other chemical use may be helpful in this regard as well.

These requirements for soils data are extensive and costly to collect. However, with continuing advances in GIS technology, extensive soils maps, data from the National Resources Inventory (NRI), and data bases of soil characteristics (e.g. Soils 5 data), the task of assembling data on the nature of the land resources controlled by farms in the ARMS sample would seem feasible.<sup>26</sup> Given the expense, there is a case to be made for directing attention initially to “hot” spots where significant environmental problems have been identified, and the intensity of effort to collect agricultural data for the purpose of studying environmental problems may vary by region and locality. But, no regions and localities should be overlooked entirely. It is exactly the lack of similar data on soils and other natural resources to match with farm costs and returns data that has heretofore also limited our ability to study resource productivity and the adoption of technology at the farm level.

It is essential to understand that it is not sufficient to assemble these data without also advancing our analytical capacity to estimate the contribution of natural resources to agricultural productivity, or measure the environmental consequences of agricultural production (e.g. soil erosion, chemical and nutrient runoff and leaching, and air quality). Despite substantial progress to date, there is still need for methodological and modeling innovations involving enhanced collaboration among the biological, physical, and social scientists *a la* Antle and Wagenet (1995).<sup>27</sup>

#### *Data on the Social Value of Agriculture’s Multifunctional Non-Commodity Outputs*

The main purpose of this conference is to articulate the need for individual farm and farm household data to inform the debate over new directions in farm policy. And, up to this point, the discussion has been focused toward that end. A point of departure for the discussion, however, is the presumption that new policy initiatives will elevate to a place of prominence the social values and costs stemming from the several important non-commodity outputs of a multifunctional agriculture. Before making some final observations, therefore, it would seem appropriate to comment briefly on the role these values play in policy evaluation and how they can be obtained.

In the farm-household framework in Figure 3, these non-commodity outputs are valued both by society and by the farm households, but how the value of these non-market outputs is perceived is likely to be quite different between the two groups. The perceptions of value by the farm household is likely to affect farm and household decisions directly, whereas the societal

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<sup>26</sup> In some states such as New York, it is already necessary for farmers to have their fields outlined on soils maps so that the area by soil type can be delineated for the administration of the agricultural use-value assessment program. Soils types are combined into several productivity groups; these groups form the basis on which the size of the agricultural use-value property tax exemption is calculated.

<sup>27</sup> For example, Boisvert et al. (1997) discuss the difficulties in incorporating bio-physical simulation models of leaching and runoff for individual soils into economic models. Based on the output from these simulation models, they estimate a recursive set of equations that relate nitrogen runoff and leaching to weather, detailed soil characteristics, and farm practices and input levels. This is a “middle ground” strategy for estimating nitrate residuals. The equations are a procedure based on the simulation output from the bio-physical models that can be used to provide quantitative estimates of the distribution of runoff and leaching for a range of soils without the need for repeated runs of the simulation model for each economic application. By applying these estimated equations to field-level soils information for a sample of New York dairy farms, it was possible to evaluate the effects of different policies on the distribution of these nitrate residuals (Boisvert et al., 1997; and Peterson and Boisvert, 1998, 2001).

values will only affect decisions if farmers are remunerated or penalized appropriately to move toward socially optimal levels of their production.

Efforts to estimate how farmers value these non-commodity outputs date to the hedonic pricing studies that value attributes of land related to soil erosion.<sup>28</sup> More recently, there have been some efforts to understand how the potential health consequences, cost of cleanup, and potential legal liability from nutrient and chemical contamination might be reflected in land prices or in farmers input purchase decisions. Using reduced form equations derived from a farm household production model, Beach and Carlson (1993) find that the value farmers place on water quality and their concern for safety are both reflected in their willingness to pay for or use pesticides differing in toxicity. Using farm and field level data, Boisvert et al. (1997) also estimated a reduced form household production model to discover that land prices were reduced when the environmental vulnerability of the soils reached a relatively high level.

The broader question from a policy perspective is finding the value society places on these non-commodity outputs such as amenities and the several dimensions of environmental quality. These values are needed to set the levels of incentives or penalties appropriately to move us closer to the social optimum. In cases such as the conservation programs, enrollment is best conditioned on the combined contribution of the land (and the particular conservation practice being established) to overall environmental quality. These non-market values could also be used to give weights to the several components of an Index of Environmental Benefits on which this combined contribution could be assessed.

Research into valuation of non-market goods is largely the domain of environmental economists. Fortunately, many early environmental economists have their academic roots in agricultural and resource economics. A legacy for quality data and rigorous quantitative analysis born out of these roots has clearly been passed on to the new generations of environmental economists. In this sense, we can be optimistic about continued progress to discovering societal values for these non-commodity outputs.

Much of the valuation work is based on contingent valuation method (CVM), discrete choice modeling, and more recently on experimental economics. In their now landmark book on the subject, Mitchell and Carson (1989) document the contingent valuation method and its numerous applications, as of that date, to valuing a diverse range of public goods. Refinements in CVM and related methods continue, as do the applications. But, as has often been the case in the study of agricultural economics problems, empirical CVM results are often based on data generated from special, small-scale studies at the local or regional levels. By the nature of the method, the goods valued are defined quite specifically and narrowly. For these reasons, it is often difficult to find values directly applicable for national policy analysis. For example, in an illustration of policy to promote environmental amenities and penalize pesticide and nitrate damage, Peterson et al. (1999), based their marginal social value of landscape amenities on various estimates from the literature as summarized by Poe (1999). Their pollution function was

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<sup>28</sup> See Boisvert et al., 1997, for a selected list of these studies.

calibrated from pesticide and nitrate damages estimates derived from Poe (1998); Schultz and Lindsay (1990); Powell (1990); and Pimentel et al. (1992).<sup>29</sup>

The extent to which these non-market values elicited from respondents at certain locations can be applied elsewhere is the subject of substantial debate in the environmental economics literature. The issue is referred to as benefits transfer--the validity of the application of a data set that was developed for one particular use to a quite distinct application (Brookshire and Neill, 1992). In her review of the literature, Jaroszewski (2000) makes it clear that the environmental economists are not of a single mind on this issue, but progress continues.

### **Some Final Observations**

Since the early years of farm commodity policy formation and before, agricultural economists, other agricultural scientists, and policy makers have relied on quality data to identify problems and point to policy solutions. As a new research agenda began to emerge in the mid-1970's to address the policy issues of an agricultural industry forever changed through the adoption of technology, and the expansion of international markets, it was clear that our agricultural data systems had to evolve as well. We have always known that the data requirements for effective agricultural policy analysis can be altered dramatically by changes in: the organization of farms, off-farm job opportunities, and the agenda of farm policy.

I began this paper with the premise that there are currently two driving forces affecting agricultural policy economists' demand for micro-level data about the farm business, its soils and other natural resource endowments, and the farm household. The first has been with us for some time, and it relates to the increasing heterogeneity of the agricultural sector—reflected in the sharper distinction between large commercial farms and a topology of small family farms including those with limited resources as well as those whose primary occupation is agriculture. For these latter groups in particular, the interrelationships between the farm and the household have grown increasingly complex, with off-farm income contributing a much larger share of total family income. The second force is the effort to re-focus agricultural policy on explicit recognition of the social values or costs of important non-commodity outputs from a multifunctional agriculture, while at the same time maintaining a balance with the longer standing concern for living standards of the agricultural community.

As this new policy agenda unfolds some of its effects on the well being of farm households will be revealed in national income accounts; the effects of the provision of these important non-commodity outputs will be reflected in economy-wide indicators of natural resource use, etc. But these aggregate data will reveal almost nothing about the processes by which these changes come about or about the effectiveness of various policy initiatives.

Historically, we have always relied on micro-level results to understand these processes by which policy change is effected. We must continue to do so. Because of the increased

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<sup>29</sup> Peterson et al. (1999) caution that if land is subsidized and the polluting input is taxed, an optimal subsidy on agricultural land does not equal the net value of land amenities. Thus, results from non-market valuation surveys or other techniques to elicit amenity values may not be appropriate for setting the farmland subsidy, even if the values are "corrected" to account for the value of pollution generated per acre.

complexity of the farm firm and farm household interactions, there is a compelling need to gather information not only on the production of agricultural products by the farm business, but also on the other forms of activity by the farm household. It is only then that we can know how the total resources of the household are organized to provide a sufficient level of income and the extent to which some households make an explicit trade-off between income and the pursuit of a rural lifestyle.

With agriculture as a major user of land and other natural resources, the recognition of agriculture as a multifunctional industry underscores explicitly its critical role in the supply of highly valued non-commodity outputs. By elevating these policy issues to a place of prominence, farmers, as part of a broader class of land and natural resource managers, would be remunerated for their contributions to the range of positive non-commodity outputs or penalized for negative outputs. Here, again, it is only through micro-level analysis within a holistic farm-household framework that we can determine how these programs might be combined with other resources to affect the well being of farm households. To be effective in moving us closer to the socially optimal levels of these non-commodity outputs, these policies must bring into much sharper focus the spatial diversity of various non-commodity outputs, be they site-specific, local, area-specific, regional, or nationally differentiated. This will require augmenting the farm and farm household data with farm-level information regarding the quality of soils and other natural resources.

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<b>Table 1. Categories of Data in the United States' Agricultural and Rural Economics Data System</b>		
<b>Category</b>	<b>Category</b>	<b>Category</b>
<b>Current Commodity Statistics</b> <i>Crop and Livestock Statistics</i> <i>Commodity Supply and Utilization</i> <i>Prices and Indexes</i> <i>Market News</i>	<b>Marketing</b> <i>Market Basket Statistics</i> <i>Marketing Bill Data</i> <i>Related Statistical Series (e.g. price and Productivity indexes)</i>	<b>Natural Resource Economic Data</b> <i>Land Use</i> <i>Inventory of Conservation Needs</i> <i>Water</i> <i>Forests</i> <i>Weather Indexes</i> <i>Remote Sensing</i>
<b>Farm Data</b> <i>Farm Income and Expenses</i> <i>Enterprise Budgets</i> <i>Costs and Returns Series</i> <i>Ag. Sectors of I-O Model</i> <i>Output, Input, and Productivity Data</i> <i>Farm Population</i>	<b>Data on Farm Related Businesses</b> <i>(e.g. Census of Business and Manufacturers data by appropriate SIC code)</i>	<b>International Data</b> <i>The World Census of Agriculture</i> <i>Annual country Statistics</i> <i>World Food Data</i>
<b>Production Resources and Costs</b> <i>Finance</i> <i>Credit Institutions</i> <i>Farm Real Estate</i> <i>Machinery and Equipment</i> <i>Fertilizer</i> <i>Feed</i> <i>Pesticides</i> <i>Farm Labor</i> <i>Insurance</i>	<b>Food Consumption and Nutrition</b> <i>Food Consumption and Related Data</i> <i>Index of Supply and Utilization</i> <i>Nutritive Value of US Diets</i>	<b>Rural Area Development</b> <i>Rural Poverty</i> <i>Rural Housing</i> <i>Health</i> <i>Local Governments</i>
Source: Upchurch (1977).		

<b>Table 2. Major Categories of Data in the 2001 Agricultural Resource Management Study (ARMS)</b>			
<b>Section</b>	<b>Description</b>	<b>Section</b>	<b>Description</b>
<b>A</b>	<b>Land in Farm/Ranch</b>	<b>G</b>	<b>Farm Labor</b>
	Acres Operated		Operator
	Conservation Acres	<b>H</b>	Spouse
	Rent Received		Unpaid Family
	Rent Paid		<b>Farm Assets</b>
Type of Farm	Land		
<b>B</b>	<b>Acres and Production</b>	Building	
<b>C</b>	By Crop	Machinery	
	<b>Livestock</b>	Inventory, etc.	
Livestock and Poultry by Type	<b>I</b>	<b>Farm Debt</b>	
<b>D</b>		Seasonal Production	
<b>Commodity Marketing and Income</b>	<b>J</b>	Loans	
Marketing Contracts		Loans from Banks, Co-ops, Individuals, Govt.	
Production Contracts		<b>Farm Operator</b>	
Cash/Open Market Sales-Crops	<b>K</b>	Demographics of Operator, Spouse, and Household	
Cash/Open Market Sales-Livestock		Anticipated Changes in Farm Business and Man- agement Practices	
<b>E</b>		<b>Farm Household</b>	
<b>Other Farm Income</b>		Off-farm Work by Household Members	
Government Payments, by Type, Environmental, Deficiency, Disaster, Transition, etc.	<b>F</b>	Type of Work and Reasons	
Custom Work		Benefits from Off- farm Work	
Forest Products		Non-farm Assets	
Sale of Machinery, etc.		Living Expenses	
<b>Operating and Capital Expenditures</b>		Changes in House- hold Income	
Operating Expenses, Includes Hired Labor			
Cost of Capital			
Expenditures			

Source: 2001 Agricultural Resource Management Study Phase III, NASS, USDA.

Table 3. An Example SAM

	AGR	Man	Ser	Lab1	Lab2	Cap	Land	URBAN	RFARM	RNFARM	Low	High	Govt	ROW	Total
AGR	3,602	5,052	2,247	-	-	-	-	-	-	-	133	92	5,844	14,405	31,375
Man	5,608	7,510	3,126	-	-	-	-	-	-	-	4,353	3,296	3,783	13,334	41,008
Ser	5,968	3,951	9,437	-	-	-	-	-	-	-	11,038	9,057	4,131	11,466	55,047
Lab1	1,646	2,032	13,663	-	-	-	-	-	-	-	-	-	-	106	17,446
Lab2	3,789	2,634	2,806	-	-	-	-	-	-	-	-	-	-	56	9,286
Cap	6,192	1,299	8,401	-	-	-	-	-	-	-	-	-	-	-	15,892
Land	322	-	-	-	-	-	-	-	-	-	-	-	-	-	322
URBAN	-	-	-	10,690	5,376	4,497	31	-	-	-	-	-	-	-	20,593
RFARM	-	-	-	41	105	95	240	-	-	-	-	-	-	-	481
RNFARM	-	-	-	4,825	2,799	1,909	-	-	-	-	-	-	-	-	9,534
Low	-	-	-	-	-	-	-	7,603	208	3,433	474	1,700	4,199	-	17,617
High	-	-	-	-	-	-	-	12,990	273	6,102	-	-	1,010	-	20,374
Govt	1,644	451	2,509	1,890	1,006	9,391	52	-	-	-	1,620	6,229	1,608	-	26,399
ROW	2,604	18,081	12,859	-	-	-	-	-	-	-	-	-	5,823	-	39,366
	31,374	41,008	55,047	17,446	9,286	15,892	322	20,593	481	9,534	17,617	20,374	26,399	39,366	304,739
		42,946			42,946				30,608		37,991				
					12,339						7,383				

Table 4. Percentage Distribution of Returns to Value Added

	Lab1	Lab2	Cap	Land	URBAN	RFARM	RNFARM
URBAN	61	58	28	9			
RFARM	0	1	1	75			
RNFARM	28	30	12	0			
Low					37	43	36
High					63	57	64
Govt.	11	11	59	16			

### **Exhibit 1. A 1950's View of the Interaction between the Farm and the Household**

1. "In no other industry is the interdependence between the household and the firm so strong as in agriculture" (p. 417).
2. "Not only are the firm and household intertwined in terms of physical location and economic decisions, but the supply of labor to the firm is provided partly through the particular household" (p. 417-8).
3. "Production and profits are, ..., only intermediate ends of farming." "...[T]hey represent means to more ultimate ends rooted in consumption and utility" (p. 418).
4. "The selection of production processes which allow an income flow consistent with the need for cash withdrawals to be used in consumption stands at a level with pure profit maximization in determining the manner in which resources can be used" (p. 418).
5. "The firm-household complex is important not only in defining the organization of resources and family activities which will maximize utility at a given point in time, but also in helping explain uncertainty precautions, capital accumulation, soil conservation, and other production-consumption decisions which relate to time" (p. 418).
6. "A 'pure type' of firm-household interrelationship is that of subsistence farming, in which the family neither sells nor buys products in the market" (p. 419).
7. "The firm and the household come into conflict particularly over the portions of the income flow to be allocated between (a) current consumption or (b) re-investment in the business as a basis for later income and consumption" (p. 423).
8. "The important elements of firm-household relationships spring from time, uncertainty, and capital limitations. If it were not for the time-uncertainty complex, ..., capital limitations would not arise and the firm-household interaction would be unimportant. Both units would have unlimited funds and either could be treated as an economic entity apart from the other" (p. 423).

Source: Heady (1952).

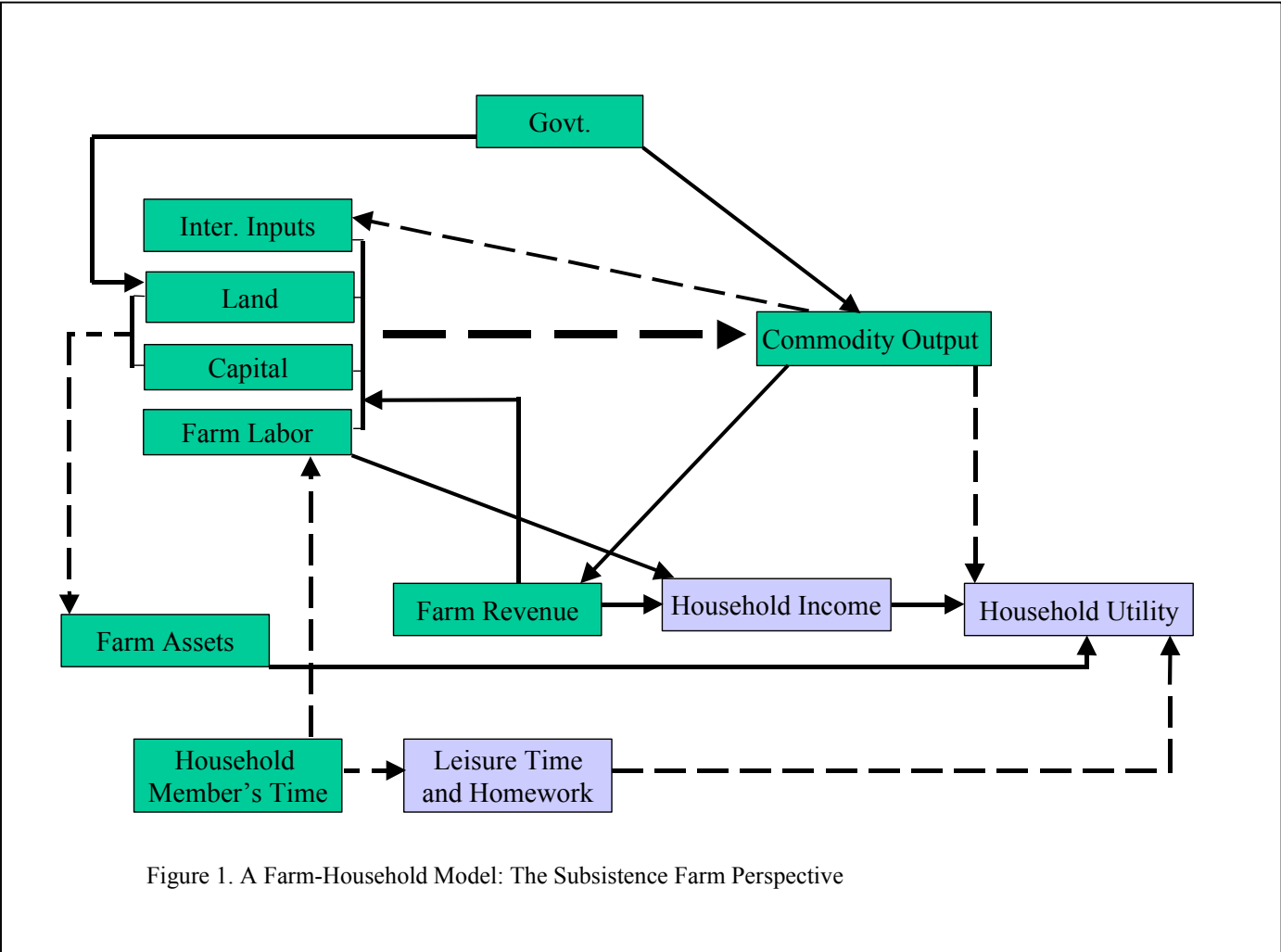


Figure 1. A Farm-Household Model: The Subsistence Farm Perspective

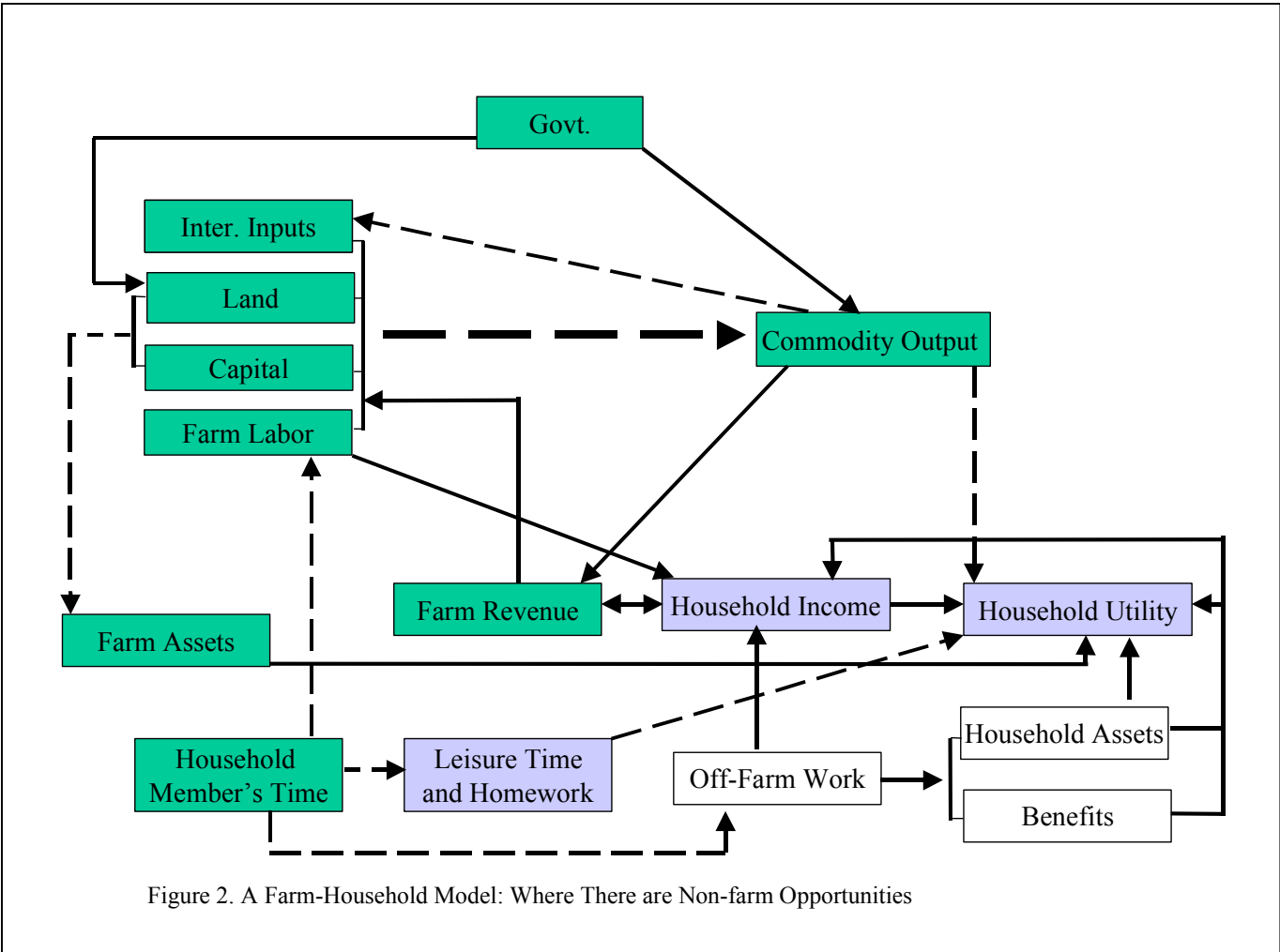


Figure 2. A Farm-Household Model: Where There are Non-farm Opportunities



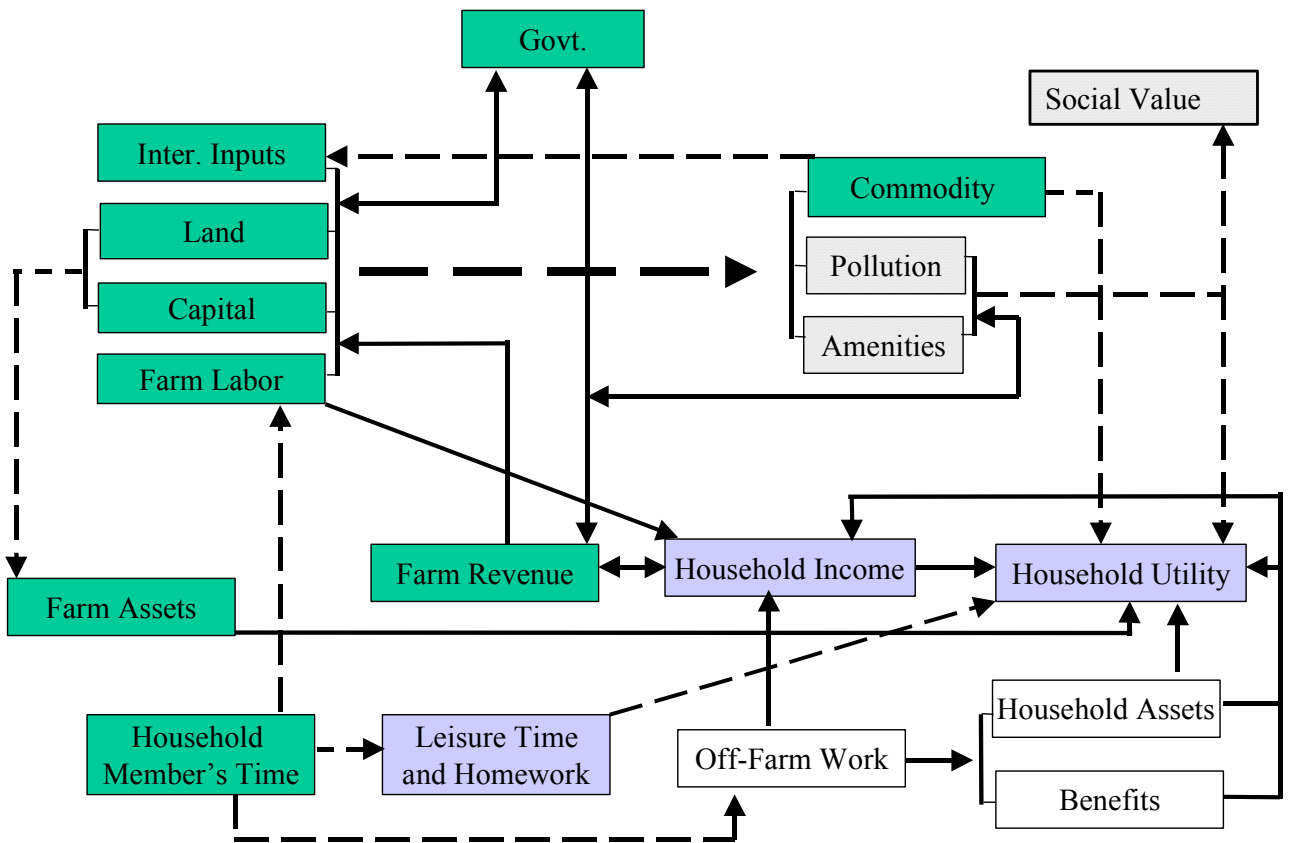


Figure 3. A Farm-Household Model: With Non-farm Alternatives and a Multifunctional Agriculture

<b>Table 5. List of Farmers' Risk Management Options</b>	
Enterprise Diversification	Lender Relationships
Protective Production Practices	Share Leases and Custom Work
Vertical Integration	Information Investment
Production and Marketing Contracts	Off-Farm Employment
Hedging and Option Contracts	Insurance
Financial Reserve Maintenance	Government Program Utilization
Leverage and Liquidity Management	
Source: Barry (1999).	