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Title: **Potential Local Economic Impacts of Alternative Farming Systems: A Case Study**

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Abstract:

The sustainability of alternative farming systems must be assessed using ecologic, economic, and social indicators. In this study, ecologic risks are assessed as threats to water quality from commercial agrichemicals, soil loss, energy use, and cropping diversity. Economic indicators are relative income or profitability with indirect implications for financial risks associated with cropping diversity. Social impacts are reflected in implications for farm size and ownership structure, number of farm families in the community, and for the economic and social quality of life of farmers and others who live and work in rural areas.

Two alternative farming scenarios were developed for returning land currently enrolled in the Conservation Reserve Program (CRP) to agricultural production in Putnam County, MO. The conventional scenario reflects currently typical farming systems for North Missouri. The alternative scenario reflects more ecologically sustainable systems of farming. Alternative cropping systems utilized crop rotations, intensive input management, and reduced tillage. Livestock systems used management-intensive, or planned rotational grazing.

Annual CRP payments in Putnam County total approximately $1,692,000 for the 26,000 acres currently enrolled in the CRP. An estimated 50 percent of current CRP land would be used for crops and 41 percent for livestock production based on a survey of post-CRP intentions of Putnam County CRP contract holders.

Returning CRP land to crop and livestock production could result in a two-fold increase in total direct, or first round, economic impacts in comparison to impacts of CRP payments. Gross farm income alone might be expected to rise to $2.4 million and $3.4 million respectively for conventional and sustainable systems respectively compared with $1.7 million in total CRP payments for the county.

Farming activities have direct, indirect, and induced impacts on the local economy. Direct impacts are associated with purchases of production inputs and sales of farm commodities. Indirect effects result when local input suppliers or marketing firms buy raw materials, products, or personal services from local sources. Induced impacts arise from consumptive spending, and occur when people spend money they earn from their production activities.

Total economic impacts from returning land presently in the CRP program to production using conventional farming systems was projected to total $6,269,500: $2,087,500 direct effects, $776,000 indirect effects, and $3,406,000 induced effects. The alternative, more sustainable farming scenario resulted in a total impact of $7,858,900: $2,368,200 direct effects, $925,700 indirect effects, and $4,565,000 induced effect. The more-sustainable farming systems were projected to generate 25 percent more total economic activity than conventional farming systems.

Potential Local Economic Impacts of Alternative Farming Systems: A Case Study

People and money can move or be moved. Most natural resources cannot. Resources such as land, minerals, landscapes, and climates must be utilized, at least initially, in or near the geographic locations where they exist. Most rural communities were established for the purpose of realizing private and social benefits from the use of natural resources located in rural places. People became dispersed across the American countryside, scattered individually and in communities, because natural resources were similarly dispersed (Ikerd, 1993).

Except for mining and timber towns, the historic purpose of most communities in the United States was to develop and gain from the value inherent in agricultural land. Obviously, farms and farm families contribute directly to local economies of the communities in which they are located. Historically, however, even non-farm economic activity in many rural communities has been related closely to the number and types of farms in the surrounding area. Rural service centers evolved into trade centers as early farmers came to rely more on mechanization, markets, and purchased inputs.

Over the past 50 years many rural communities seem to have lost their purpose. The basic trend during this period has been toward fewer, larger, and more specialized farms. One result of the industrialization of agriculture has been reduced production costs reflected in lower food prices. However, another result has been a declining rural population, an associated shrinking demand for local market outlets and locally purchased farm inputs, and the resulting economic decay of many rural communities. Many rural communities have attempted to diversify their economies in order to reduce their dependence on agriculture. However, agricultural land is still among the most valuable of the "geographically-fixed" resources in many rural areas. The long run sustainability of such communities is still closely tied to the sustainability of local farms and farmers.

If past trends toward fewer, larger, and more specialized farms were to continue unchecked, little hope would be found for revitalizing rural communities in agricultural areas. However, as the efficiency of agriculture has increased, the remaining benefits to society from further efficiency gains have continued to decline. The average consumer spends little more than a dime of each dollar of their disposable income for food (Dunham). Less than a penny of each dime spent for food goes to pay farmers for value added on farms. The other nine cents goes to marketing firms and input suppliers. Thus, food consumers have little to gain from further reducing farm level costs of agricultural production.

While societal benefits from a more efficient agriculture have been declining, the environmental risks and social costs associated with agriculture have been rising. The same industrial technologies that support large-scale, specialized farming systems are the primary sources of rising environmental risks and social concerns. The commercial fertilizers, pesticides, and fossil fuels required for large-scale, specialized crop production have become sources of rising concern for resource depletion, water pollution, and food contamination. Concerns for animal welfare, manure disposal, and routine use of growth hormones and antibiotics are all magnified by the concentration of livestock in large-scale production units. Larger farms mean fewer farms and fewer farming families in rural areas. It takes people, not just production, to support schools, churches, public services, and the retail trade needed for viable rural communities. Rising environmental risks and social costs must be weighed against declining economic benefits in assessing the net social benefit of continuing the industrialization

of U.S. agriculture. Thus, the industrialization of agriculture may be nearing an end, even though some commodity sectors are still moving toward larger, more specialized systems.

An Alternative Public Agenda for Agriculture

American farmers are being asked to address a new public agenda. For example, the 1990 farm bill states that Federally funded research and extension programs shall be designed to, among other things, accomplish the following: (1) satisfy human food and fiber needs; (2) enhance the long run viability and competitiveness of food production; (3) enhance the environment and natural resource base; (4) expand economic opportunities in rural America, and enhance the quality of life for farmers, rural citizens, and society as a whole." (U.S. Congress, Title XVI, Subtitle A, Section 1602). The new public agenda for agriculture may be placed under the conceptual rubric of agricultural sustainability. The term "sustainable agriculture" has been defined in many different ways. However, most recent definitions reflect agreement that sustainability is a characteristic of the performance of farming systems rather than a characteristic of any specific set of farming practices, methods, or enterprises.

A consensus also seems to be evolving concerning a set of performance measures by which the sustainability of agricultural systems may be evaluated (Stockle, et. al.). These performance criteria are generally consistent with those set forth legislatively as directives for research and extension related to sustainable agriculture. The Food, Agriculture, Conservation, and Trade Act of 1990 defines sustainable agriculture as "integrated systems of plant and animal production practices having site specific application that will over the long term:

- satisfy human food and fiber needs,
- enhance environmental quality and the natural resource base upon which the agricultural economy depends,
- make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls,
- sustain the economic viability of farm operations, and
- enhance the quality of life for farmers and society as a whole" (U.S. Congress, Title XVI, Subtitle A, Sect. 1603)

The quality of life dimension of sustainable agriculture is further defined to include systems which "increase income and employment -- especially self-employment -- opportunities in agricultural and rural communities and strengthen the family farm system of agriculture, a system characterized by small and moderate sized farms which are principally owner operated" (Congressional Record 10/22/90:H11128).

More concisely, a sustainable agriculture must be ecologically sound, economically viable, and socially responsible (Ikerd, 1994). An agriculture that meets these performance standards would be capable of maintaining its productivity and value to society over time and, thus, would be perpetually sustainable. We cannot prove empirically that one system of farming is perpetually sustainable and another is not. We can only ask the question: is a system ecologically sound, economically viable, and socially responsible? All three are necessary and no one is sufficient. Sustainability is a question rather than an answer, a direction rather than a destination. Sustainability is a relative concept. One system can be said to be more or less likely to be sustainable than another. But in an inherently uncertain world, it is impossible to prove conclusively that one system is sustainable and another is not.

Community Impacts of Alternative Agricultural Systems

One approach to achieving agricultural sustainability is to reduce reliance on the commercial inputs associated with rising environmental risks while maintaining economic viability and social acceptability. Such a system of "alternative agriculture" is defined in a National Research Council (NRC) report as a system of food and fiber production that systematically pursues the following goals: More incorporation of "natural" processes such as nutrient cycling, nitrogen fixation, and pest-predator relationships; reduction in off-farm inputs with greatest potential environmental risks; greater reliance on biological and genetic potential of plants and animals; improved matching of farming activities with resource limitations; and improved management and conservation of soil, water, energy, and biological resources (NRC, p. 4).

The NRC report suggests that the goal of agricultural sustainability should be pursued through more intensive management of "natural" or biological production processes. The fundamental question is whether the multiple objectives of a sustainable agriculture; including economically viable farms; efficiently produced food and fiber, and an enhanced quality of life for farmers and society; can be achieved by relying more on intensive management of internal resources, particularly land and labor, and less on external inputs, such as commercial fertilizers and pesticides.

From a community economic standpoint, a shift from reliance on inputs external to the community, such as commercial fertilizer and pesticides, to reliance on resources that are internal to the community, such as labor and more intensive management, can result in significant changes in local employment and other economic activity, even if total agricultural production and total sales by the agricultural sector remain essentially unchanged.

"Arguments can be made in both directions regarding whether an agriculturally dependent community benefits more from a high production, high input system or from a comparably profitable reduced input system" (Lockeretz p. 75). Heffernan points out that the net impact of substituting local resources for external inputs will depend on the nature of the substitution. Reductions in the use of purchased inputs such as pesticides and fertilizers, for example, will reduce local business activity. However, larger farmers often purchase such inputs from manufacturers, bypassing the local community. For example, an evaluation of detailed purchase records of 30 farmers in southern Minnesota indicated that as farms get bigger, they may tend to buy a smaller percentage of their inputs in local markets (Chism, 1993). The study also confirmed that farms with livestock as well as crops may spend more locally, but only up to a point. Very large livestock operations spent much more in total than did their smaller counterparts, but had no greater impact on the local economy because they had a much higher percentage of non-local spending. Reduced purchases by farmers who buy most of their inputs elsewhere will have little negative effect on the local community.

Few commercial farm inputs are manufactured in rural communities. Local economic impacts of locally purchased inputs, in most cases, are associated only with the functions of wholesaling and retailing rather than manufacturing. The value added to pesticides and fertilizers by these local merchandising activities are typically only a small fraction of total purchase costs. Also, in cases where farmers spend less on some inputs, there may be offsetting purchases of different types of inputs. For example, purchases of tillage equipment may replace

herbicides and legume seeds, or manure compost may replace commercial nitrogen, as farmers move to farming systems with lower environmental risks.

A key concept in evaluating the relative impacts of alternative farming systems on rural communities is substitution of management and labor for land, capital, and external inputs. If one type of resource is effectively substituted for another, productivity increases, or at least remains at comparable levels. The primary differences between conventional and more management intensive sustainable systems of farming are not differences in productivity, but differences in the balance of human and non-human resource use. Management intensive, sustainable systems rely more on human resources relative to land, capital, and purchased inputs and, thus, earn greater returns to labor and management relative to land, capital, and purchased inputs.

Increased returns to farmers in their managerial roles represent increased incomes which can be spent in their local community. Increased returns to farm operators' labor, family labor, and locally hired labor also may add to local incomes and local spending. The full value of returns to management and labor, not just a merchandizing margin or the locally added value, accrues as spendable income to residents of the local community.

Measuring Sustainability

Sustainability must be measured in terms of ecological soundness, economic viability, and social responsibility of alternative systems of farming. Environmental soundness might include measures of surface water and groundwater quality, soil and water conservation, energy conservation, farm safety, and biological diversity. Economic viability measures might include economic competitiveness, comparative advantages in crop and livestock enterprises, farm profitability, and financial risks. Social responsibility could include assessment of availability and prices of food and fiber, farm size and ownership structure, rural landscape, ethics of farming practices, and the overall quality of life for farm families and others who live and work in rural communities.

Obviously no single study can evaluate the full range of potential impacts associated with long run sustainability. However, explicit consideration must be given to the ecological, economic, and social implications of alternative systems. A system judged to be superior in one or more of these three dimensions, and not inferior in any other, may be judged more likely to be sustainable. In cases where a system is judged superior in one or more dimensions, but inferior in the other(s), no definite conclusions can be drawn regarding relative sustainability. Thus, studies which focus on one or more interval-scale measures of ecologic, economic, or social sustainability must at least provide ordinal estimates, or ranking, for the other dimensions. For example, no conclusions regarding sustainability can be drawn from comparisons of economic and environmental performance without assessing social performance. A farming system that is more ecologically sound and economic viable than another, but is less socially or culturally acceptable, may or may not be more sustainable (Ikerd, 1994).

A sustainable community must have the same basic characteristics as a sustainable farming system. A sustainable community must be an ecologically sound, economically viable, and socially responsible entity. Obviously, the sustainability of a community in total is impacted by the sustainability of the various geographic, economic, and social elements which constitute a community as a whole. Few studies have attempted to quantify the relative impacts of

alternative farming systems on the sustainability of local communities. Farming systems which conserve local resources, protect the local environment, support the local economy and contribute to a desirable quality of community life, help sustain local communities.

Lockeretz compared the economics of high input conventional cropping systems with lower input alternatives in an attempt to draw conclusions regarding their impacts on local communities (1989). The underlying assumption was that lower input systems were more ecologically sound. Thus, lower input systems would contribute more to community sustainability, if they made equal or greater contributions to the economic viability of the local community. The results from five regional comparisons were inconclusive with respect to sustainability. In general, the lower input systems were found to contribute less per acre to the local economy than did the higher input systems, resulting in a conflict between the relative economic and ecologic performance of the two types of cropping systems. This conflict was addressed through questions regarding the long run sustainability of higher input systems of farming. No attempt was made to quantify any differences in consumer spending resulting from supporting fewer or more farm families on conventional versus alternative farms. Nor was there any attempt to address quality of life or social issues such as farm size, self employment opportunities, or viability of family farms in the local community.

A South Dakota study went beyond the work of Lockeretz in evaluating impacts of alternative farming systems on consumer spending and marketing services in addition to business spending for production inputs (Dobbs and Cole). They paired five farms classified as "sustainable" with five "conventional" farms representing different regions of South Dakota. Data for the "sustainable" farms were gleaned from on-farm interviews, but four of the five "conventional" farms were "synthesized" from various sources. The "sustainable" farms were virtually "organic" farms in that none used inorganic fertilizer and only one farm reported appreciable use of commercial pesticides.

First-round economic impacts on local input purchases and marketing services were clearly negative for the "sustainable" farms. Not only did the organic farms purchase fewer inputs and market fewer products per acre, but they also purchased more of their inputs and marketed more of their products outside the local community. This seems to be a clear reflection of the nature of "organic" production in rural areas. Organic markets may well be more urban than rural, and few rural communities have local suppliers of organic inputs. First-round, farm household income effects clearly depended on whether organic premiums were included or excluded from the analysis. Without organic premiums, four of the five "conventional" farms produced more income per acre, but with premiums included, three of the five "sustainable" farms produced more income per acre. On-farm incomes account for a major portion of the local employment supported by farming activities. Thus, induced economic impacts, income impacts on consequent consumer spending, tend to magnify the farm household effects.

In spite of the stated conclusions, the South Dakota study produced inconclusive results with respect to agricultural "sustainability." The assumption, explicit in this case, was that the "organic" farms included in the study were more ecologically sound than the conventional farms. They were even labeled as being "sustainable." However, sustainability requires that such farms also be economically viable and socially responsible. Two of the five "organic" farms clearly were not more economically viable than the conventional farms based on the economic data

presented. One organic farm was reported to generate $15 per acre less income than its paired "conventional" farm and another generated $40-$45 per acre less than its "conventional" partner. In cases where one farm is more ecologically sound and the other is more economically viable, no conclusions can be drawn regarding relative sustainability.

With organic premiums included, three of the five organic farms appeared to be more economically viable than their conventional counterparts and contributed as much or more than their conventional counterparts to the local community. One of the other farms received nothing and the other only a small amount from organic premiums. One might conclude that the organic farms receiving organic premiums were more sustainable than were their conventional counterparts. The authors questioned the sustainability of organic premiums, which would seem also to put in doubt the sustainability of organic farming. However, their more serious problem in drawing conclusions regarding sustainability is that the study omits any consideration of the social or quality of life dimension of sustainability.

The authors state explicitly that their "analyses have ignored any differences in size between conventional and sustainable farms that may exist at present or in the future"(p.78). They recognize that larger farms may tend to bypass local input suppliers and local markets, and that families on large and small farms may have different consumption spending patterns. They also state: "Because some people believe that sustainable farms require more intensive management, one might expect sustainable farms to be smaller, on the average, than conventional farms" (p.78).

A Nebraska Study compared detailed economic data provided by 28 farmers, half of which were classified as "conventional" and the other half as "sustainable" based on current farming methods (Kleinschmit, et. al.). The farms identified as "sustainable" were only about one-half as large; in terms of acres farmed, head of livestock, and total sales; as those called conventional. However, the sustainable farmers actually reported a higher average farm income, or return over direct costs per farm, in spite of their smaller size. A total of 169 people were supported by the 28 farms included in the Nebraska survey. It was estimated that an additional 44 people could have been employed on the same number of acres with at least as high a per capita income if all farms in the survey area had been of the same average size as the sustainable farms. If all farms were like those in the conventional group, 22 fewer people could have been supported in the area, a total difference of 66 people. Total family income with all sustainable farms, including on-farm and off-farm income, would have been more than double that of an all conventional community, and 80 percent higher than in the current community.

Lacking some treatment of farm size, ownership structure, or other indicators of social responsibility; it is impossible to draw conclusions regarding relative sustainability. Previous studies have treated the social dimension of sustainability only superficially, if at all. The balance between human resources and natural and capital resources is critical in developing more sustainable systems of farming which in turn are capable of helping sustain rural communities. The linkage between more sustainable systems of farming and increased economic opportunities for smaller to moderate-sized farms and for other forms of self-employment in rural areas is critical in assessing the social dimension of agricultural sustainability.

A Case Study of Sustainability

A more sustainable agricultural sector of a local economy can provide a cornerstone to

the foundation for a diversified, sustainable rural economy which includes off-farm agricultural activities and related non-agricultural activities in the community. Agriculture is an important geographically linked sector of many local economies, even in cases where farming represents a small proportion of total economic activity in the community. A sustainable agriculture could be expected to protect and conserve the rural environment and resource base and to enhance the quality of life for those who live and work in the community.

Significant changes in systems of farming, thus, might be expected to have significant impacts on the sustainability of communities with significant agricultural sectors. The Conservation Reserve Program was initiated by the 1985 farm bill as a means of removing environmentally fragile (i.e., highly erodible) land from degrading land use practices (i.e., cultivation for commercial crop production). The program has been successful in reducing ecological risks, through conserving top soil and reducing water quality risks associated with use of commercial inputs. Land owners were paid to remove land from production according to bids offered and accepted on a voluntary basis. Thus, the program made economic sense, at least from the standpoint of participating land owners. However, the CRP program may or may not be economically viable from the standpoint of program cost to taxpayers. Its societal sustainability is also questionable from the standpoint of its impacts on those who actually farm the land and others who live and work in rural communities.

The case study presented here represents an attempt to evaluate the potential impacts of returning land currently in the CRP program to agricultural production in Putnam County, Missouri. Indirectly, implications can be drawn also regarding the community impacts of enrolling land into the CRP program in that county over the past ten years.

The case study is based on two alternative scenarios for returning current CRP land to agricultural production. A conventional scenario was designed to reflect farming methods currently typical of northern Missouri farms. An alternative scenario was based on assumptions of increased use of crop rotations, more intensive input management strategies, and reduced tillage methods for cropping system. Pasture systems utilized planned, or more management intensive, rotational grazing systems for beef cattle production. The alternative scenario was designed to achieve a balance of ecologic, economic, and social benefits. An attempt was made to retain as many of the ecological benefits of the CRP program as practical while using the land in ways that would be profitable to local farmers and supportive of the local community. In other words, the alternative scenario was designed to reflect farming systems that might be more sustainable for local farmers and more sustaining of the local community.

The same acreage of the same crops were produced under both scenarios, using recent cropping history for the county, to simplify the comparison. However, continuous corn and soybean systems, conventionally used on about half of Putnam County's crop land, were replaced with crop rotations under the alternative scenario. The alternative scenario utilized no-till and ridge-till systems to replace conventional tillage on erodible lands. No-till provides more erosion protection and less fuel use at similar levels of herbicide use, while ridge tillage allowed herbicide use to be cut in half with somewhat less effective erosion control and greater fuel use than no-till. A combination of no-till and ridge till on northern Missouri soils could be expected to reduce soil loss to the predefined "Tolerance" (T) level or less while significantly reducing reliance on commercial pesticides and fossil fuels (Monson and Ikerd).

Conventional fertilizer application was set at levels so as to not limit yields under the

most favorable growing conditions. Fertilizer use for the alternative scenario was adjusted for realistic yield goals with allowances for peak yield reductions in the most favorable growing years. A detailed description of assumptions supporting the two scenarios and methods of analysis may be found in a 1994 masters thesis by Traiyongwanich.

The alternative cropping system based on ridge tillage indicated that farmers could reduce direct production costs by 25 percent and increase returns over direct costs by 26 percent in comparison with conventional farming methods. The no-till system showed a 12 percent reduction in direct costs and a 19 percent increase in net returns per acre over conventional cropping methods.

The alternative or sustainable system of cattle production was represented by a planned, or management intensive, rotation grazing system with 24 paddocks. Conventional livestock production was represented by a three paddock grazing system, which likely overestimates the intensity of current management of typical Putnam County livestock operations. The alternative system would allow farmers to stock more than 50 percent more cows on the same number of acres than would the conventional grazing system.

The more sustainable grazing system resulted in a 35 percent increase in direct production costs as a result of higher stocking rates per acre of pasture. However, total livestock sales were increased by 51 percent under the alternative scenario resulting in a 73 percent higher net return over direct costs for the sustainable system.

Costs and returns per acre were multiplied by the numbers of acres of CRP land to be returned to crop and livestock production in Putnam County, assuming the CRP program was allowed to expire. A survey of post-CRP intentions of Putnam County CRP contract holders indicated that 50 percent of current CRP land would be used for crop and 41 percent for livestock production (Traiyongwanich).

The results indicate an increase in total input purchases of $946,000, if CRP land were returned to conventional crop production compared with $707,000 for input purchases if the more sustainable alternative cropping systems were used. However, input costs for the conventional livestock system were lower, totaling $1,030,000, in comparison with the alternative system, totaling $1,401,000, due to higher stocking rates. Thus, combined total input purchases were actually higher for alternative systems, $2,108,000, than for the conventional systems, $1,976,000. In addition, combined returns over direct costs, or gross farm income, were nearly $1 million higher for the ridge-till sustainable system, $3,404,000, as compared with the conventional system, $2,421,000. The no-till system also returned $862,000 more than the conventional system, netting $3,283,000.

Total annual CRP payments in Putnam County currently average about $65/acre for an annual total of approximately $1,692,000 for the 26,000 acres enrolled in the program during the first nine sign-ups. It was estimated that returning CRP land to crop and livestock production under either the conventional or alternative system would result in more than a two-fold increase in total direct, or first round, economic activity. Returning CRP land to conventional crop and livestock production would add $2,705,000 in total economic activity. Returning the same number of acres to production using more sustainable crop and livestock systems could result in a $3,820,000 increase in total direct economic activity in comparison to current CRP payments. Gross farm income could be expected to rise to $2.4 million and $3.4 million respectively for conventional and sustainable systems compared with $1.7 million in total

CRP payments for the county.

This analysis of the first round, direct impacts indicates that returning CRP land to production under an alternative scenario for crop and livestock production would contribute to the economic viability of local farms and of the Putnam County economy while minimizing the environmental risks of bringing CRP land back into production. The 26,000 acres enrolled in the CRP program theoretically could support twice as many farm families as were supported by CRP payments, assuming that a dollar in net cash farm income will support as many people as a dollar in CRP payments. In addition, nearly 40 percent of CRP payments made to Putnam County landowners were going to persons living outside of Putnam or any adjoining county.

There is no single figure that accurately represents the dollars required to support a farm family. However, if some theoretically typical farming operation required a net cash return of $30,000 per farm, Putnam County CRP land returned to more sustainable production could support 56 additional farm families, nearly a 10 percent increase over 1992 county farm numbers. However, the "average" net cash income from farming in Putnam County in 1992 was only $6,600 per farm, indicating that most farms are part-time operations. So if post-CRP farmers were more typical of those currently in the county, far more families could be supported on part-time farms. Part-time farmers represent a potential labor supply for additional non-farm enterprises in the county, but are likewise dependent upon the availability of non-farm employment at home or within a reasonable commuting distance.

Measuring Indirect and Induced Economic Impacts

Farming activities have direct, indirect, and induced impacts on the local economy. Direct impacts are the first round impacts associated with purchases of production inputs, sales of farm commodities, and the resulting net cash farm income. Indirect effects result when local input suppliers or marketing firms buy raw materials, products, or business services from local sources.

Substantial leakages typically occur between direct and indirect economic impacts. A large portion of total production inputs may be purchased from sources outside the local community. Even when inputs are purchased locally, only a small proportion of the total sale price may go to local manufacturers, local service providers. Additional indirect effects occur when local manufacturers or service providers buy their raw materials or services from other local sources. However, additional leakages occur with each round of activity until additional impacts from a given initial transaction eventually becomes negligible.

Sales of farm commodities may also create indirect effects on the marketing, processing, or value-added sector of the local economy. Commodities sold locally generate sales commissions and other types of income for local marketing firms. Marketing firms may purchase supplies or employ local residents, resulting in indirect economic impacts similar to those associated with input purchases. As in the case of purchases, leakages occur at each round of activity, and eventually any additional impact from a given marketing transaction becomes negligible.

Total indirect effects represent the sum of all local economic activity occurring "after," but in response to, the initial direct transactions associated with input procurement and commodity sales. Indirect impacts are associated with the local business sector, including manufacturing, wholesaling, and business services. Induced impacts, on the other hand, are associated with local consumptive activities.

Induced impacts occur when people spend money they earn from participating in the local economy. Obviously, those earning income from agricultural transactions include farmers and

farm workers. However, employees of local input suppliers, marketing firms, and other service providers also earn income from local agricultural transactions. As in the case of indirect impacts, initial consumption expenditures have second, third, and higher round impacts. Those who work for local retailers spend part of their incomes for local goods and services, which in turn generates income for local residents who provide those goods and services. And as in the case of indirect impacts, leakages at each round of consumption spending eventually reduce additional impacts from a given retail transaction until they become negligible.

The production of grain and livestock in Putnam County, Missouri resulted in direct, indirect, and induced economic impacts on the local economy. Economic impacts of input purchases and consumption expenditures were based on previous estimates of production costs and net cash farm income. Marketing impacts were estimated separately. Allowances were made for differences in sales between conventional and alternative systems and for the amount of grain fed to livestock. Total marketing margins were estimated at $110,400 for CRP land returned to conventional farming systems and $138,770 for the same land returned under the alternative farming scenario.

Indirect and induced economic impacts for the Putnam County case study utilized an input/output model (Implan software and 1991 data base). The Implan model was used to generate indirect economic impacts of production and marketing activities. The Implan system provides for 528 industrial or business sectors. For the analysis in this study, the sectors were aggregated to form 49 total sectors. Several agricultural commodity sectors and wholesale trade, retail trade, fertilizer and chemicals, feed manufacturing, and farm machinery sectors were left unaggregrated.

Different combinations and quantities of inputs were utilized in conventional and alternative scenarios. The proportions of crop and livestock inputs "purchased" locally and "produced" locally were based on the 1991 Implan data base for Putnam County. An examination of Implan generated direct coefficients for Putnam County revealed mostly zero and near zero values for the 49 Implan business sectors. This implies many of the inputs used on farms in the county are not produced in the county, and a large proportion of input purchases by Putnam County farmers were made from suppliers located outside the county.

Given the low level of direct coefficients for farm inputs, little accuracy was lost by using the same direct coefficients for conventional and alternative systems of farming. Thus, differences in direct impacts between conventional and alternative systems reflect differences in total value of agricultural production rather than any differences in local purchases or local production of agricultural inputs. Adjustments of direct coefficients would be necessary in cases where a large portion of inputs were produced and/or purchased locally.

Induced effects were generated from estimated consumption data and the Leontief matrix which was provided by Implan for Putnam County. The Implan Leontief matrix reflects the distribution of impacts on the local economy associated with an average dollar of consumption spending. Much of the difference in total economic impact between conventional and sustainable scenarios resulted from differences in induced impacts associated with the higher net cash income expected to result from use of alternative crop and livestock systems. Greater net cash farm income translates into a larger number of farm families and a higher level of local economic activity.

Refinements in the basic Implan procedure are required in cases where the economic activity of interest is related to gross profits or cash incomes of independent business operators. This may be one of the more significant procedural conclusions from this case study. The Implan model utilizes default relationships between total consumptive transactions and income

of hired workers based on the total local economy, unless specific adjustments are made to estimate induced impacts for a specific sector. In this case, default values for induced impacts associated with farm income, or gross profits, were replaced with direct estimates, reflecting significant differences in estimated returns over direct costs between the two farming scenarios. The Implan analysis reported here measured total economic activity rather than personal income. However, differences in induced impacts, arising from differences in personal income, accounted for most of the difference in total economic activity between the two scenarios. Differences in the ability of the two systems to support farming families account for most of the local economic advantage for the more sustainable system of farming.

A statistical summary of Implan results indicates that returning current Putnam County CRP land to conventional production would increase total production and marketing activities by $4,508,900. Increased farm owner/operator net cash income, or gross profits, would account for $2,421,400 of this total. Direct impacts, net of farm income, were $2,087,500. Total indirect impacts were estimated to be $776,000. The business sectors of the local economy receiving the largest benefits would be agricultural services, wholesale trade, and banking, insurance, and real estate, in that order.

Induced economic impacts were derived from two sources: hired workers in the business sectors, including hired workers in business sectors affected by consumptive activity, and income which accrues to farm owner/operators and supports their consumptive activities. The estimated $2,421,400 in farm income was assumed to be spent on consumption activities. The total induced impact from farm consumptive spending was estimated at $2,577,000. The relatively small difference between initial spending and total induced impact results from the fact that few consumption items are produced in Putnam County. For hired workers in the business sector, the induced impact was estimated at $829,000. Thus, total induced spending was $3,406,000 for the conventional farming scenario. Most of this impact would be felt by the retail and service sectors of the Putnam County economy. The total economic impact; direct, indirect, and induced; from returning land presently in the CRP program to conventional production is projected to total $6,269,000. The largest component of this economic impact would come from increased consumption spending with a smaller proportion coming from impacts on input supply, marketing, and business services sectors.

The alternative, more sustainable, production scenario was estimated to increase total production and marketing activities by $5,651,500. Increased farm owner/operator net cash income would account for $3,283,200 million of the alternative system total. Direct impacts, net of farm income, totaled $2,368,300. Total indirect impacts were estimated to be $925,700. The business sectors of the local economy receiving the largest benefits would be banking, insurance, and real estate; wholesale trade; and agricultural services, in that order.

The estimated $3,283,200 in farm income for the alternative scenario, when spent for consumption activities, resulted in a total induced impact from farm consumptive spending of $3,494,200. For hired workers in the farm and business sector, the induced impact was estimated at $1,070,800, resulting in total induced spending of $4,565,000 for the alternative farming. The total economic impact; direct, indirect, and induced; from returning land presently in the CRP program to conventional production is projected to total $7,860,000.

In summary, the total economic impact from returning land presently in the CRP program to production under the alternative scenario is projected to total $7,860,000: $2,368,200 direct effects (excluding farm income), $925,700 indirect effects, and $4,565,000 induced effect (including farm income). This compares with $6,269,400 under the conventional farming scenario: $2,087,500 direct effects (excluding farm income), $776,000 indirect effects, and

$3,406,000 induced effects (including farm income).

The economic impacts of crop production under both scenarios were very similar, even though their conservation and environmental quality impacts would be quite different. Most of the difference in economic impact arises from the livestock sector. The production and profit potential is significantly higher from the management intensive grazing system. The alternative system generated an estimated 25 percent higher level of local economic activity than did the conventional system. Most of the $1,590,600 advantage for the sustainable system is associated with the higher level of income generated for farm families and their associated consumption spending in the local community.

Conclusion

Sustainability must be measured in terms of ecological soundness, economic viability, and social responsibility of alternative systems of farming. Environmental soundness in this case is measured in terms of threats to water quality from commercial agrichemicals, soil conservation, energy conservation, and cropping diversity. Economic viability measures for the Putnam County study focused primarily on relative profitability with some indirect implications for financial risks associated with cropping diversity. The social responsibility dimension of sustainability was reflected in implications for farm size and ownership structure, and for the economic quality of life of farmers and others who live and work in Putnam County. More farming families might also contribute indirectly to the viability of local schools, churches, health care, and other public institutions.

The alternative farming system may be concluded to be more sustainable than the conventional system because it was found to be more ecologically sound, economically viable, and socially responsible than was the conventional system. The alternative systems appears to be more economically viable and socially responsible to the Putnam County community than is the current CRP program. The question of whether the alternative system would be considered more economically viable than the CRP by current CRP land owners is beyond the scope of this study. Current CRP land use practices are quite likely more environmentally sound and resource conserving than are those in the alternative, or sustainable, land use scenario. Returning land to production under the alternative scenario would retain more of the ecological benefits than would returning the land to conventional production. However, significant trade offs among environmental, economic, and social benefits remain when the sustainable scenario is compared with the CRP program. Sustainability is a question to which the answer is seldom either definite or clear.

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