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Understanding Community Impacts: A Tool for Evaluating Economic Impacts from Local Bio-Fuels Production

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Abstract
The popularity of public investment in local bio-fuel production as a rural development initiative is growing. An important consideration in determining the level of public support for a plant's development, however, is accurately measuring public benefits resulting from plant activity. The purpose of the research reported here was to first develop a set of community multipliers associated with various bio-fuel plant configurations and then to develop an easy-to-use tool that allows local communities to measure potential benefits based on varying levels of plant activity.

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Introduction

The promotion of bio-fuel production has long been a popular strategy to revitalize rural communities. The interest in bio-fuel has been heightened with $3.00 per gallon gasoline and the fervor to reduce our dependence on oil overall and foreign oil in particular. Media coverage, traditionally limited to corn-producing regions, has been pronounced in national media outlets, including the Chicago Tribune's May 7, 2006 coverage of professional investors looking to firms specializing in bio-fuels (Oneal & Burns, 2006) to the Los Angles Times June 29, 2006 (Big Three, 2006) coverage of the major US auto manufacturers focusing on building cars that are able to run solely on bio-fuels.

At the local level, proponents anticipate that the construction and operation of bio-refining plants will not only increase local employment, but also enhance farm incomes through purchases of local farm production to be used as feed stocks. Despite optimism regarding the future of bio-refining, however, the current market environment is such that potential investors in bio-fuels plants often seek financial support from a local community before initiating facility construction. The rush to bio-fuels has almost reached a frenzied state, and communities are more often than not willing to jump on the bandwagon without considering the pros and cons of the proposal. The challenge to local policy makers is determining how extensive the community benefits will be as a result of subsidizing a bio-refining plant and then deciding, based on expected benefits, what an appropriate level of public investment might be.

There are several studies in the public and private domains that point to the potential benefits of siting a bio-fuels plant (Fortenbery, Deller, Park, & Thomas 2005; Low & Isserman, 2007; Nelson, MARC-IV Consulting, & Leatherman, 2001; Urbanchuck & Kapell, 2002). These studies, however, have generated a wide range of results, some of which are inconsistent with the impacts generally realized by other economic development activities (Swensen, 2006). In many cases, local communities are given the results of analysis conducted by private consultants, but are not in a position to evaluate the sensitivity of the results to assumptions made in the analysis.

Communities interested in making independent, informed decisions regarding the development of a local bio-fuels plant need an objective, independent analysis of the out-of-plant community impacts associated with bio-fuels production. Extension educators are often requested to provide such an analysis. Often promoters of agricultural interests are champions of bio-fuel plants and expect Extension to support such proposals. But in many instances the case for bio-fuel plants is oversold, with overly optimistic promises of positive economic impacts. Extension educators may find themselves in the unpleasant situation of removing themselves from an important community discussion or alienating a traditional clientele base. Extension educators are in need of an objective analytical tool to help inform local decision makers and concerned citizens.

To accommodate this need, we have developed a simple, menu-driven computer program for use by Wisconsin Extension educators and local decision makers. The general format can be mirrored for other geographic regions, allowing for unique impact estimates by location. The program is based on empirical input/output analysis developed using IMPLAN. It incorporates the economic multipliers identified with IMPLAN and allows users to evaluate expected community impacts based on three different activities: 1) total plant employment, 2) total plant sales, and 3) total income earned by plant employees.

Input/Output Analysis and Data Development

Input/output analysis is a modeling technique that measures the interaction between different sectors of an economy and identifies multipliers that reflect total economic activity generated as a result of a specific activity in a particular sector. One can think of an input/output model of the local economy as a spreadsheet capturing the flow of dollars within the economy. The columns of the spreadsheet represent buyers (demand) and rows represent sellers (supply), with the individual cells of the spreadsheet capturing the flow of dollars between buyers and sellers.

When a new business is located in a community, the total economic activity that occurs is not only that directly associated with the new business (such as sales to customers), but also activity that results from the new business buying services from other businesses and the activity that results from their employees spending at least some part of their income locally (for example, the local grocery store, the movie theatre, the local gas station). By changing elements in the spreadsheet (the input/output model), we can trace how that change ripples throughout the whole of the economy. Input/output analysis identifies a matrix of multipliers that measures both the direct and ancillary impacts associated with the new business.

Using IMPLAN, multipliers can be estimated that are both geographically and industry specific for those industry sectors recognized by IMPLAN. Unfortunately, bio-fuels is not a specific industry choice in IMPLAN. To develop our decision tool, multipliers for the state of Wisconsin were estimated by evaluating a bio-fuel plant's impact on the business sectors it would interact with; in other words, rather than "shocking" the local economy by inserting a bio-fuels plant, the local economy was "shocked" by growth in every other business sector the plant would be expected to interact with. The multipliers identified were then imbedded in the software decision tool. The tool provides the flexibility of evaluating community impacts based on different levels of plant activity, with specific multipliers based on a given production technology for each plant considered.

Input-output analysis is not without its limitations. In order to operationalize the model, several very restrictive assumptions must be made, including, but not limited to, constant returns to scale in not only the individual bio-fuel facility but also the larger overall economy. This results in what economists call a "perfectly elastic supply" (a horizontal supply curve). The latter assumption explicitly implies that there are no price responses to any shock to the economy. This can be troublesome in the case of bio-fuels because there may be a premium paid to local farmers that can be captured only indirectly by input-output analysis.

A second shortcoming is that the tool provided here uses only three metrics of economic activity: industry sales, employment, and income. The tool developed and reported here does not consider the fiscal impacts on local governments, environmental impacts, or social impacts.

Clearly these are legitimate concerns, and, as with any economic impact assessment, the analysis must be presented in the proper light. The ability of Extension educators to respond to such requests for information, however, creates a "teachable moment" within the community where these other factors can be raised and discussed. But care must be taken when working with communities in conducting impact assessment because "information overload" can become a serious problem (Leatherman & Deller, 2001).

As outlined by Shields and Deller in their 2003 *JOE* article, conducting a simple economic impact assessment, such as that reported here, provides the Extension educator with a "foot-in-the-door" to facilitate a more thorough discussion of the pros and cons of the proposed bio-fuel plant. To conduct more detailed impact assessment, the educator must have access to a CPAN-type model or a more advanced set of tools as explored by Shields and Deller (2003). IMPLAN, however, is widely available, and nearly every Extension service in the U.S. has at least one person familiar with, if not trained in its application. For a more thorough discussion of how to use economic impact assessment as a means to an Extension educational tool we encourage the reader to review the *JOE* article by Shields and Deller (2003).

Decision Software—Community Impacts of Bio-Diesel and Bio-Ethanol Plants

The community decision software, Community Impacts of Bio-Diesel and Bio-Ethanol Plants (BDBE for short), considers two different bio-fuel products and three different plant configurations (Fortenbery et al., 2005). The bio-fuel products considered are vegetable oil and recycled grease based bio-diesel and corn based ethanol. Two different size bio-diesel plants are considered and one ethanol plant. The bio-diesel plants include a 4 million gallon per year production plant and a 10 million gallon per year plant. The ethanol plant considered is a 40 million gallon per year plant. The technology for the bio-diesel plant is taken from Fortenbery (2005). This represents the current scale of plants under consideration in several Upper Midwest locations. The ethanol plant technology is based on Fortenbery and Deller (2006) and is consistent with the average size plant from McNew and Griffith (2005).

BDBE allows community impacts to be estimated based on a matrix of multipliers associated with plant employment, total plant sales, and total plant employee income. The software allows community policy makers to evaluate long-run impacts from the development of a new plant and also the marginal increase in community benefits associated with public investments in plant expansion and/or investments in technologies that improve the efficiency of an existing plant. The software does not account for short-run activity resulting from initial plant construction, including jobs associated with construction.

Generally, the community impact results estimated with BDBE should be viewed as lower bound estimates of actual impacts. Economic impacts associated with price increases in inputs purchased (including primary feed-stocks) are not considered. This allows community leaders to make conservative estimates relative to the community benefits associated with plant development and increases the likelihood that the anticipated pay-back from any public investment will actually be realized.

Figures 1 through 3 are illustrations of the BDBE program screens. The top panel in Figure 3 is a picture of the BDBE input screen. The user selects both the Type of Analysis and the Type of Industry from drop down menus. The user then enters an event level associated with those choices. The second panel shows the results from selecting employment analysis of a bio-ethanol plant for evaluation. In the example illustrated here, the user has indicated the plant will employ 32 people (the event level). The first rows below the input section identify the multipliers associated with bio-ethanol plant employment, and the second row presents estimated employment levels based on the multipliers. The cell labeled Initial identifies direct employment at the plant, and the Indirect cell refers to jobs created as a result of business to business transactions between the ethanol plant and other businesses (e.g., utilities, transport firms, office supply companies, etc.). The Induced category represents additional jobs created from activity associated with labor spending wages in the local economy (e.g., spending income in grocery stores, movie theaters and barber shops). The total is the sum of all jobs created.

Figure 1.
Front Page of the BDBE Program Screens

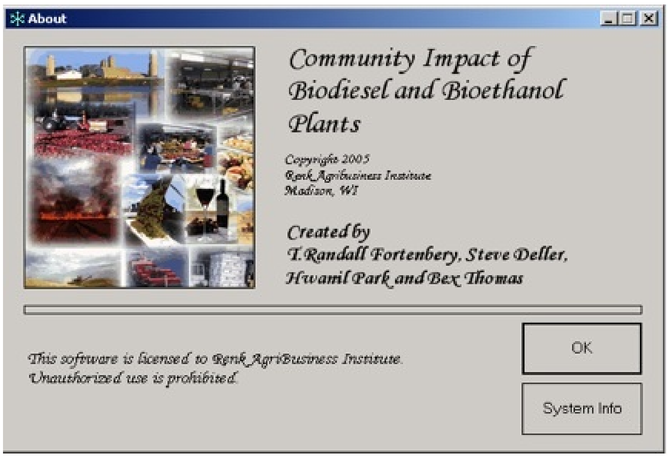


Figure 2.
Menu Selection - Second Page of the BDBE Program Screens

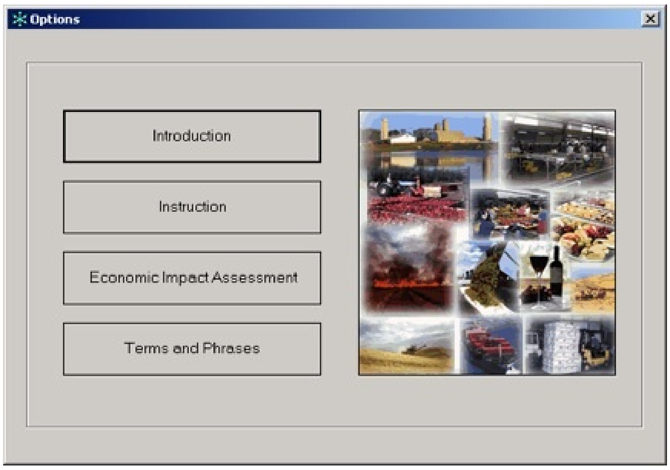
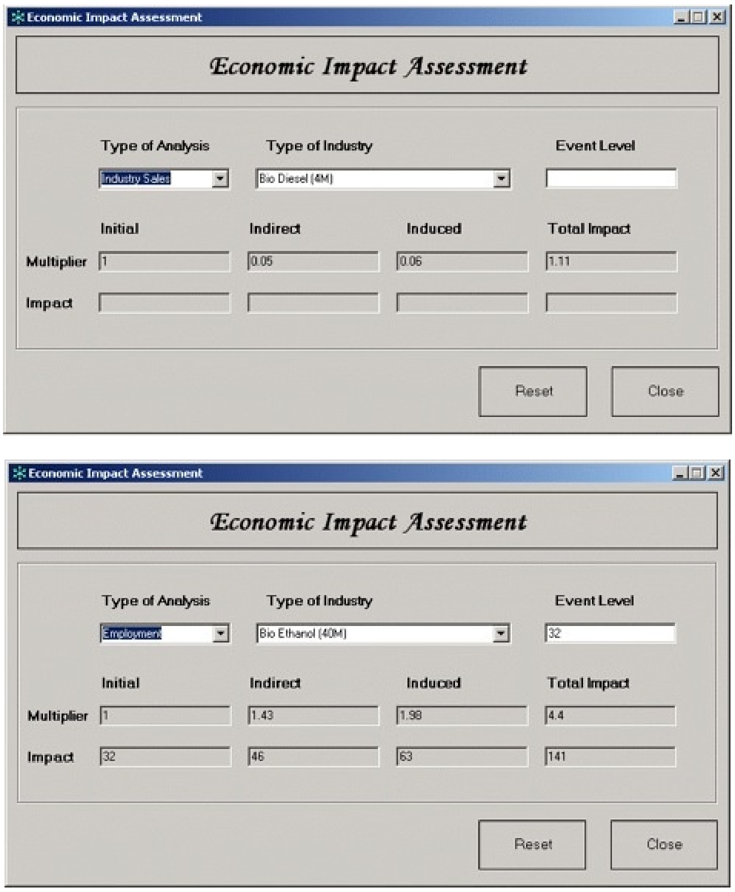


Figure 3.
Economic Impact Assessment Pages of the BDBE Program Screens



Software Applications

An important application of BDBE is conducting sensitivity analysis on potential changes in plant configurations. For example, total plant sales can be altered in the event level window to facilitate different assumptions relative to either prices received by the plant or assumptions concerning standard operation as a percent of full capacity. Plants expected to operate at 80% capacity would have less total sales than those operating at full capacity, and the resulting economic impacts would be less. Because the assumptions used to estimate the initial multipliers are less generous than most previous studies relative to overall plant impacts, the results from BDBE can be combined with other studies to identify a range of potential benefits.

The multipliers estimated thorough IMPLAN and used to develop BDBE are provided in Table 1. Note that the multipliers vary considerably across plant configurations. This in and of itself is an important element of Extension educational programs. Each proposed plant configuration results in a unique community impact, and the estimated impacts from one configuration are not directly transferable to another configuration. Communities considering public investment in bio-fuels plants can compare expected returns across plant types.

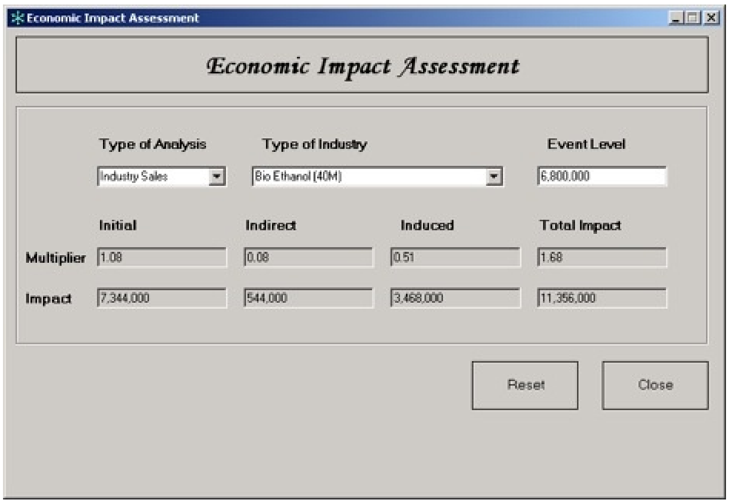
Table 1.
Estimated Multipliers by Plant

Jobs	Direct	Indirect	Induced	Total
Four Million Gallon per Year — Bio-Diesel	1.00	0.25	0.45	1.70
Ten Million Gallon per Year — Bio-Diesel	1.00	0.55	1.00	2.55
Forty Million Gallon per Year — Ethanol	1.00	1.43	1.98	4.40
Industry Output				
Four Million Gallon per Year — Bio-Diesel	1.00	0.05	0.06	1.11
Ten Million Gallon per Year — Bio-Diesel	1.00	0.04	0.05	1.09
Forty Million Gallon per Year — Ethanol	1.08	0.08	0.51	1.68
Total Income				
Four Million Gallon per Year — Bio-Diesel	1.00	0.46	0.62	2.08
Ten Million Gallon per Year — Bio-Diesel	1.00	1.03	1.38	3.41
Forty Million Gallon per Year — Ethanol	1.00	0.36	0.39	1.75

BDBE can be used to estimate the impacts from the development of a single plant or the aggregate statewide impacts from the development of, say, 10 separate bio-plants. (Their total activity levels would be summed and entered in the event window.) In addition, BDBE can be used by Extension educators to help community leaders understand the marginal impacts expected from a change in plant size or efficiency. In many communities that have an existing bio-fuels plant (in most cases ethanol), serious discussion has centered on both plant expansion and the adoption of new technologies that improve existing plant productivity.

As an example, the impacts associated with adopting an enzyme technology developed by Lucigen, a relatively new enzyme company that has focused a part of its enzyme innovations on increasing the yield from corn based ethanol production, are provided in Figure 4. The increased output is based on Lucigen's estimates (J. Biondi, Chief Operating Officer, personal conversation, July 11, 2006). By inputting the marginal increase in plant sales anticipated by adopting Lucigen technology, the impacts associated with increased plant efficiency can be calculated. Again, this allows local policy makers to evaluate the expected return to the community associated with public investment in plant expansion or the adoption of new technology.

Figure 4.
Measuring Marginal Impacts from Increased Productivity, Thus Increased Sales



An important provision in facilitating community use of BDBE is ensuring accessibility. The program was developed in Virtual Basic and compiled to be a stand-alone program. All components were then place in a zip file. The zip file can be downloaded from a public Web site <www.aae.wisc.edu/renk> and unzipped. The program includes an introduction to the basic concepts of input/output analysis, a glossary of terms to facilitate the understanding of various effects (for example the differences between indirect and induced effects), and the input section itself. The input section is quite simple to use and the results are presented directly on the input screen. No explicit knowledge of IMPLAN is needed.

Conclusions

An important component in community evaluation of returns to public investments in bio-fuels plants has been missing. To date there has been no independent means for communities to easily evaluate the economic impacts of either new plant development or investments in plant expansion or technological improvements. The computer program presented here helps to partially fill that need and provides Extension educators with an objective economic impact tool. The plant models used to construct the matrix of multipliers are representative of plants currently in operation or under consideration, and most technological innovations in development do not appear to alter the production function significantly.

This program can also serve as a framework for other stand-alone economic impact programs designed for specific industries. Many times access to complex impact modeling software such as IMPLAN is limited or is beyond the scope of the Extension educational program. Programs such as BDBE can be constructed for a range of specific industries and are readily accessible to all Extension educators.

In addition, by taking parts of IMPLAN, the BDBE can minimize the chance of misapplication of the more complex IMPLAN system. As noted in our introductory comments, impact assessment can be misapplied, misused, and abused, and the wide availability of IMPLAN has to some extent facilitated the proliferation of poorly conducted impact assessment. By using IMPLAN to develop customized impact multipliers specific to different types of bio-fuel facilities, the potential for "IMPLAN abuse" is minimized. As noted by Shields and Deller (2003), impact assessment not only provides Extension educators with a "foot-in-the-door" but also creates a "teachable moment" to raise additional questions and facilitate more in-depth discussions. But, as with any impact assessment, the analysis, or in this case the tool represented by BDBE, does not supply a global answer but rather a reasonable estimate of specific economic impacts.

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