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Potential to operate greenhouses and aquaculture in conjunction with Iowa's ethanol plants

Abstract: Iowans looking for value-added enterprises to pair with ethanol plants can consider greenhouses and aquaculture operations as options.

Question & Answer

Q: What are the options for farmers interested in enterprises to link with ethanol production?

A: The project describes situations in the United States where greenhouse and/or aquaculture operations have been paired with power plants to take advantage of inexpensive energy. The contributing authors offer opinions about the hurdles that need to be overcome to make these businesses successful and suggest plant crops and fish species that would be valuable in the marketplace.

Background

Iowa's ethanol-processing industry has expanded to include 29 dry-grind ethanol production facilities since 2001. Eighteen additional plants are under construction or expansion, and another 30 plants are in various stages of planning. As the fuel ethanol industry matures, operators of individual plants are looking for opportunities for resource enhancement.

One option may be to co-locate new production facilities for fish, fruits, herbs, vegetables, and ornamental plants alongside the ethanol processing plants. The waste streams from the plants potentially could supply water and heat to both greenhouse and aquaculture operations, and carbon dioxide might be captured for the benefit of greenhouse plants. Little public information exists about the economics and likely problems of this business arrangement. More knowledge is needed to help innovators estimate energy availability and requirements, and to point out other helpful research possibilities.

Project objectives were to:

1. Conduct a "gap" analysis of available energy from ethanol plants and energy needs for greenhouse and aquaculture enterprises, and
2. Assemble and maintain a research support group to evaluate opportunities and constraints related to building a biorefinery cluster of ancillary and/or related businesses adjacent to existing biofuel plants.

Approach and methods

Preliminary discussions among ISU faculty and staff who were involved in ethanol processing, aquaculture, greenhouse production, and business development revealed the need to develop a better understanding of the true potential to capture and use waste heat and other co-products (distillers grain and CO_2) from ethanol plants for other production enterprises.

Discussion group members from the ISU departments of horticulture and natural resources ecology and management were asked to describe greenhouse and aquaculture operations that were similar to those in Iowa, estimate their energy needs, and suggest crops/products with profit potential. A scientist at the Iowa Energy Center was asked to estimate the available energy from a typical Iowa ethanol plant. ISU Extension Value Added Agriculture Program representatives were charged with compiling the report and identifying the "gaps" or potential problems that would need

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to be overcome to make greenhouse/aquaculture operations feasible in conjunction with Iowa ethanol plants.

Results and discussion

The ad hoc research team collected market and operations information about greenhouses and aquaculture facilities and estimated waste heat energy available from ethanol plants. Key issues identified as important to the success of these ventures were:

- Selection of high-value crops or fish species,
- Sufficient low-cost energy to overcome the high cost of heat and light during the winter months,
- Planning for back-up power sources, and
- Assurance of coordinated management between the ethanol plant and greenhouse/aquaculture facility to avoid costly mistakes.

Operating either greenhouse or aquaculture facilities in Iowa means high energy costs for heat, particularly during the winter, and long hours of darkness for three to five months that would require supplemental light to keep greenhouse plants efficient and productive. The costs of heating and lighting have always been limiting factors for Midwest greenhouse and aquaculture enterprises.

Another important factor is the choice of crops or species of fish that can be grown in Iowa and have a high enough market value to be profitable. Ornamental crops, herbs, and berry fruits are high-value products that benefit from reduced shipping and handling and would likely profit from an extended local growing season. Iowa is a net importer of fish, so aquaculture operations could provide fresh supplies of certain types of fish for restaurant and grocery sales as well as for stocking supplies and bait.

In some parts of the United States, greenhouse and aquaculture facilities are operated next to power plants and reap energy savings by using waste energy from the plants. Some members of the research support group have consulted with managers of these facilities. Theoretically this arrangement should work well, yet some operators have faced significant problems. Power plants need to shut down periodically for maintenance, and these power interruptions have killed greenhouse crops, resulting in large financial losses. Similarly, aquaculture operations have suffered fish kills from direct transfer of chemicals in the water coming from power plants to the tanks. Coordinated management of both facilities is required and back-up heaters are a must. Water from the power plant should be used only as a source of heat energy (run through a heat exchanger) and not as a water supply for either greenhouses or aquaculture tanks.

Conclusions

Based on the energy estimates and anecdotal evidence about current ethanol, greenhouse, and aquaculture operations generated by this study:

- There is sufficient waste heat energy from a 50-mgy ethanol plant to provide significant supplemental heating for greenhouse and aquaculture operations. Feasibility studies are warranted for specific greenhouse and aquaculture operations co-located with ethanol plants.
- Further study is needed to assess benefits and determine appropriate levels of using other co-products such as carbon dioxide and distillers grains in greenhouse and aquaculture operations.
- Success of greenhouse and aquaculture operations co-located with power plants and ethanol plants depends on coordinated efforts and regular communication among the managers of each business to avoid costly operational mistakes.
- Iowa, as a net importer of most greenhouse products and many fish species, would benefit from increased local production.
- Greenhouse crops and fish species must be of relatively high market value to overcome high energy costs, particularly for winter production in Iowa. Possible choices might include ornamental plants and flowers and herbs for greenhouses, and walleye, fathead minnows and hybrid striped bass for aquaculture.

Impact of results

The project achieved the goal of forming a discussion/research team that could provide ongoing support to entrepreneurs who initiated development of greenhouse and/or aquaculture facilities to run in conjunction with Iowa's dry-grind ethanol plants. The data and supporting anecdotal evidence provided significant insight into the current status of the greenhouse and aquaculture operations as they relate to the Midwest, and outline the considerations necessary in

planning new enterprises in these areas. If calculations for specific sites indicate that co-locating these businesses is feasible, the model could be replicated in several communities where ethanol plants are located.

Education and outreach

A presentation about the project was made at the Leopold Center Marketing and Food Systems Initiative meeting March 11, 2008.

Interested persons may contact Connie Hardy at 515-294-8519, or the other contributing authors of this report, if they have specific questions about greenhouses or aquaculture.

Leveraged funds

No additional funds were leveraged for this project.

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