1993

Industrial Agricultural Products Center Review 1993

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Industrial Agricultural Products Center
Review
1993
April 12, 1993

To: Joan P. Leitzel  
Senior Vice Chancellor for Academic Affairs

From: Milford Hanna  
Director

RE: IAPC Review

It is my opinion that the efforts of the IAPC have been well spent from the perspectives of attracting a critical mass of faculty interest, attracting research funding and working together on an effort that makes the University of Nebraska a research institute of note when anyone mentions industrial uses of agricultural commodities in the U.S.A.

The support of the UNL administration is greatly appreciated. The Center was conceived at a very appropriate time. The faculty and staff associated with the Center are contributing significantly to the overall national effort in this area. Although examples of products and processes that have been commercialized are limited, it is assumed that such will follow a solid and sustained research effort.

This program review will enhance the visibility of the Center within UNL and should provide valuable feedback on its perceived stature.

MAH:jsk
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INTRODUCTION

The Industrial Agricultural Products Center was established by the NU Board of Regents in May, 1988 as the Non-Food Agricultural Product and Market Development Center. A copy of the description of the Center as it was perceived in 1988 is presented in the following section.

There are two aspects of the original plan that are not goals of the current Director. The first is the pilot plant facility. Processing capabilities are not available in a common facility, but broad based capabilities are available on campus and are available on contractual or collaborative bases. The second is the notion that the Center should be self-sustaining. Considering the overall offerings of the Center, such a goal is not realistic. Although the internal financial support is nominal, it is vital to the Center's livelihood.

It is important to note that campus-wide administrative supervision for the Center has been provided by Dr. Irvin Omtvedt, Vice Chancellor of the IANR, under a directive of a couple years ago from the Chancellor. Semi-annual reviews are provided by the IAPC Advisory Committee whose specific membership is given in a subsequent section.
Background:

The Nebraska Non-Food Agricultural Product and Market Development Center was approved by the University of Nebraska Board of Regents on May 6, 1988. It was established by the University of Nebraska-Lincoln as a result of strong encouragement and support from several commodity groups and from industry and governmental leaders. Its primary mission is to help broaden markets for agricultural commodities produced in Nebraska by developing value-added products such as fuels, chemicals, synthetic materials and finished goods.

The Center is a partnership endeavor involving Nebraska agriculture, business, government, and education. Several departments within the Institute of Agriculture and Natural Resources, the College of Business Administration, and the College of Engineering and Technology will be actively associated with the Center. It is anticipated that other components of the University may also become involved as the program expands.

The original proposal was developed by Dr. Davis Clements, Chairman of the Department of Chemical Engineering; Dr. Sandy Grossbart, Chairman of the Department of Marketing; Dr. Tom Krepel, Director of University Relations; and Dr. Dale Vanderholm, Associate Dean for Agricultural Research. Dr. Irv Omtvedt, Vice Chancellor for the Institute of Agriculture and Natural Resources, was designated by Chancellor Massengale to provide campus-wide administrative oversight for the program. Dr. Davis Clements was appointed the Interim Director of the Center by the Board of Regents effective July 1, 1988.

Center Objectives:

- To broaden Nebraska's industrial and commercial activity through new applications of the State's agricultural commodities.

- To identify end products derived from agricultural commodities that have the greatest chance for commercial success.

- To solve technical problems in production and raw material conversion.

- To provide technical, marketing, and business assistance to farmers, entrepreneurs, and businesses.
**Primary Program Components for the Center:**

A coordinated, interdisciplinary approach will be used to fulfill the objectives of the Center. Primary program components include:

- **Marketing Analysis Program**
  To determine market potential and develop marketing strategies for new products and processes.

- **Crop Adaptation and Improvement Program**
  To identify new crops and improve existing crops which have the most potential for conversion to profitable end products.

- **Resource Conversion Program**
  To improve existing methods and develop new methods of producing end products from Nebraska produced commodities.

- **Pilot Plant Operations Program**
  To test commercial feasibility of new products and conversion processes. The pilot plant will serve as the key to the Center operations, as it will offer proof that laboratory technologies can be transformed into large scale, commercial production.

- **Technology and Information Transfer Program**
  To transfer the Center’s product ideas and practices to the private sector. This program will serve as an information clearinghouse on new agricultural product development.

**Organization:**

The Director will be responsible for the management of the Center. A separate professional staff will be identified for the Market Analysis, the Pilot Plant, and the Technology Transfer Programs. In addition, four UNL senior faculty members will be appointed part-time to coordinate the Crop Adaptation and Improvement, Resource Conversion, Technology Transfer, and Market Analysis Programs. All other staff will be appointed on a project basis.

The Center’s Advisory Board will consist of representatives from member companies, State government; the Corn Growers Association or the Corn Check-Off Board; and the UNL Vice Chancellors for Academic Affairs, Research, and the Institute of Agriculture and Natural Resources. The Board will guide policy, give direction, and ensure adequate communication of Center activities.
Projects and Activities:

The Center will administer the following types of projects:

- Client-fostered projects generated by laboratories, companies, or individuals who bring ideas to the Center for joint development.

- Contract work arising from specific projects funded by outside businesses, individuals, and government agencies.

- Center-sponsored projects designed to answer specific technical or marketing problems concerning products that exhibit a high potential for commercial success.

- Center-fostered projects as proposed by state educational institutions and government agencies, such as the Department of Agriculture or the State Energy Office.

Budget:

The financial plan calls for the Center to become self-sustaining after a four year start-up period. Federal, State, and private external sources of funding will be sought to support the program. Commodity check-off board funding and a grant from the Nebraska Ethanol Authority are being projected as the primary sources to get the Center operational and to improve the chance to receive federal funds. Following the start-up period, the Center will operate on income from member subscriptions, grants and contracts, royalties, and the endowment.

Conclusion:

The Nebraska Non-Food Agricultural Product and Market Development Center is an effort to bring many of Nebraska’s resources together to broaden the State’s economic base. The Center represents an opportunity for Nebraskans to exert more direction over their economic density by finding new uses and applications for agricultural commodities produced in our State. A coordinated team of researchers from a wide range of disciplines will be associated with the Center and help achieve its purpose. The Center will be a partnership of agriculture, business, education, and government striving to use Nebraska’s resources to shape a brighter, more stable future.

ITO, June 1988
PROGRESS TOWARD GOALS

Significant progress has been made toward the goals of the Center. Activities have centered on the identification of opportunities in terms of new industrial uses of agricultural commodities. Assistance has been provided to UNL faculty to procure funding research in the respective areas. In other cases, specific faculty positions have been identified. Subsequent hirings have built a strong group of faculty affiliates.

The main emphasis in the Center has been research on developing new processes and products. A fairly comprehensive list of projects funded and the faculty involved are listed in a subsequent section. Two strategic planning sessions have been held to assist with identification of research opportunities of particular significance to Nebraska's agricultural production. The proceedings of the two "Great Plains Strategic Planning Consortia" are given in a subsequent section.

At the same time and with very limited staff support, we have been providing technical, marketing and business assistance to individuals and businesses. As there is limited industrial activity in this area in Nebraska, one would not expect a lot of requests for assistance. As new products are developed, we hope the level of industrial activity will increase in Nebraska to capture our share of the benefits of value-added processing of agricultural commodities.
CENTER BUDGETS

Introduction

The IAPC has received baseline support initially through some one-time allocations and, more recently, through what is perceived as recurring funds. Funds available through a USDA-CSRS Special Grant (through the Agricultural Experiment Station) have also served well as baseline support.

Specific internal and external sources of support are given in the following subsections. The internal support has been for salaries only and covers 25% of Dr. Milford Hanna’s salary, 100% of Renee Sayler’s salary and 50% of Jean Kolar’s salary. Milford Hanna is the Director of the Industrial Agricultural Products Center, Renee Sayler is the Associate Director of Industry Development and Jean Kolar is the Center secretary.

Significant levels of research activity are underway on corn, soybeans, wheat, sorghum, and animal products. As shown in the attached list of funded projects, significant levels of funding have been received from the respective commodity groups at both the state and national levels.

Internal Funding

1988-89 Not known
1989-90 $60,000 provided by Chancellor’s Office
1990-91 $50,000 provided by Chancellor’s Office
1991-92 $78,800 provided by Agricultural Research Division of the IANR
$10,000 provided by Chancellor’s Office
1992-93 $77,500 provided by Agricultural Research Division of the IANR
$25,000 provided by Chancellor’s Office
1989-93 4-year UNL funding total has been $301,300

External Funding

A comprehensive list of external funding support follows.
<table>
<thead>
<tr>
<th>TITLE/INVESTIGATORS</th>
<th>FUNDING SOURCE</th>
<th>AMOUNT</th>
<th>EFFECTIVE DATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundamental Study on Grain-Starch Quality Milford Hanna and R. Chinnaswamy</td>
<td>Nebraska Corn Development, Utilization and Marketing Board</td>
<td>$17,950 (90-91)</td>
<td>7/1/90 to 6/30/91</td>
</tr>
<tr>
<td>Corn-Based Biodegradable Polymers (Bioplastics) Milford Hanna and R. Chinnaswamy</td>
<td>Nebraska Corn Development, Utilization and Marketing Board</td>
<td>$30,000 (89-90) $34,000 (90-91) $41,600 (91-92)</td>
<td>7/1/89 to 6/30/92</td>
</tr>
<tr>
<td>Liquefaction of Starch by Extrusion for Direct Utilization of High Starch Concentrations in Fermentors Mike Meagher</td>
<td>Nebraska Corn Development, Utilization and Marketing Board</td>
<td>$22,560 (90-91) $19,588 (91-92) $20,611 (92-93)</td>
<td>7/1/90 to 6/30/92</td>
</tr>
<tr>
<td>Use of Cereals and Grains as Substrates for the Acetone-Butanol-Ethanol Fermentation Robert Hutkins</td>
<td>Institute of Agriculture and Natural Resources - Development of Value-Added Products</td>
<td>$14,000 (90-92)</td>
<td>3/1/90 to 6/30/92</td>
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<td>Immobilization and Reactor Studies of a Xylan-Debranching Enzyme Mike Meagher</td>
<td>Institute of Agriculture and Natural Resources - IANR Reallocation Funds</td>
<td>$16,000 (90-92)</td>
<td>3/1/90 to 6/30/92</td>
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<td>Nonfood Agricultural Products Project Milford Hanna</td>
<td>USDA-CSRS</td>
<td>$103,332 (90-91) $104,280 (91-92) $104,194 (92-93)</td>
<td>5/1/90 to 10/31/92</td>
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<td>Erucic Acid Oils Characterization and Utilization Research Development and Commercialization Dave Clements</td>
<td>USDA-CSRS</td>
<td>$36,000 (89-90) $60,000 (90-91) $30,000 (91-92)</td>
<td>6/1/89 to 5/31/94</td>
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<tr>
<td>Investigating Milkweed as an Alternative Source of Fiber Milford Hanna</td>
<td>USDA-CSRS</td>
<td>$64,464 (89-90) $74,892 (90-91) $74,892 (91-92) $75,777 (92-93)</td>
<td>7/1/89 to 10/31/93</td>
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<td>Crambe and Rapeseed Demonstration Program Lenis Nelson</td>
<td>USDA-ES</td>
<td>$62,400 (88-89) $62,400 (89-90) $61,400 (90-91) $62,400 (91-92) final year</td>
<td>3/15/88 to 9/30/92</td>
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<td>Industrial Uses of Tallow--A Feasibility Study Milford Hanna</td>
<td>Nebraska Beef Industry Development Board</td>
<td>$11,000 (91-92)</td>
<td>7/1/91 to 6/30/92</td>
</tr>
<tr>
<td>Soy Graft Copolymer Plastic Resins: Production and Characterization R. Chinnaswamy and Milford Hanna</td>
<td>Nebraska Soybean Development, Utilization and Marketing Board</td>
<td>$15,800 (91-92) $18,030 (92-93) $18,760 (93-94)</td>
<td>7/1/91 to 6/30/94</td>
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<td>Preparation and Characterization of Starch-Xanthan Block Copolymer R. Chinnaswamy, Milford Hanna and Dave Clements</td>
<td>Nebraska Corn Development, Utilization and Marketing Board</td>
<td>$15,300 (91-92) $19,530 (92-93) $19,760 (93-94)</td>
<td>7/1/91 to 6/30/94</td>
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<td>Evaluation of Commercialization Potential Milford Hanna</td>
<td>Nebraska Corn Development, Utilization and Marketing Board</td>
<td>$35,140 (91-92) $35,140 (92-93)</td>
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<td>Biomass Industry Survey Renee Sayler</td>
<td>Western Region Biomass Energy Program (NEOS)</td>
<td>$9,999 (91-92)</td>
<td>1991 to 1992</td>
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<td>Industrial Agricultural Products Center Administrative Staffing Milford Hanna, Renee Sayler and Jean Kolar</td>
<td>Agricultural Research Division Institute of Agricultural and Natural Resources</td>
<td>~ $100,000</td>
<td>1991 to 1992</td>
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<td>Expandable Bead Starch-Based Plastic Foams Milford Hanna and R. Chinnaswamy</td>
<td>World Wildlife Fund</td>
<td>$35,600 (91-92)</td>
<td>1992</td>
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<td>Industrial Agricultural Products Center Milford Hanna</td>
<td>Nebraska Corn Growers Association</td>
<td>$60,000</td>
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<td>Modification of Soy Polymers for Plastic Film Incorporation R. Chinnaswamy and Milford Hanna</td>
<td>United Soybean Board</td>
<td>$28,050 (91-92) $28,730 (92-93)</td>
<td>1991 to 1993</td>
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<td>Water-Resistant Starch-Based Plastic Foams R. Chinnaswamy and Milford Hanna</td>
<td>National Corn Growers Association</td>
<td>$172,000 (91-94)</td>
<td>1991 to 1994</td>
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<td>Production and Utilization of Erucic Acid, Brassylc Acid, and Pelargonic Acid: Process Development and Evaluation L. Davis Clements</td>
<td>HEADE</td>
<td>$25,000 (92-93)</td>
<td>1992</td>
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<td>Transfer of Extruded Starch-Based Plastics Technology Milford Hanna</td>
<td>Nebraska Bankers Association</td>
<td>$15,000 (91-92)</td>
<td>1992</td>
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<td>Modified Soy Isolate as a Particleboard Adhesive Deland Myers, Milford Hanna and Navan Hetticharchy</td>
<td>United Soybean Board</td>
<td>$17,000 (92) $22,000 (93)</td>
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<td>Recovery of Corn-Derived, Value-Added Chemicals Using Pervaporation Mike Meagher</td>
<td>Nebraska Corn Development, Utilization and Marketing Board</td>
<td>$20,284 (92-93)</td>
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<td>Genetic Construction of Ethanol-Producing Lactobacilli</td>
<td>Nebraska Corn Development, Utilization and Marketing Board</td>
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<td>Industrial Diacids from Corn Oil</td>
<td>Nebraska Corn Development, Utilization and Marketing Board</td>
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<td>Continuous Production of Glucosides from Corn Starch</td>
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<td>Starch-Vinyllic Polymer Grafts form Chemical Intermediates and Biodegradables</td>
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<td>R. Chinnaswamy and Milford Hanna</td>
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<td>Economic Improvement of Corn Wet Milling by Optimizing Steep Conditions</td>
<td>Nebraska Corn Development, Utilization and Marketing Board</td>
<td>$11,832 (92-93)</td>
<td>7/1/92 to 6/30/92</td>
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<td>David S. Jackson</td>
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<td>$14,520 (94-95)</td>
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<td>Factors Affecting Edible Films and Coatings from Soy Protein</td>
<td>American Soybean Association</td>
<td>$1,000 (92-93)</td>
<td>7/1/92 to 6/30/94</td>
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<td>C. Weller, R. Testin (Clemson Univ.) and P. Vergano (Clemson Univ.)</td>
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<td>Effect of Sucrose on Physical Properties of Wheat Gluten-Based Films</td>
<td>The Sugar Association, Inc.</td>
<td>$10,680</td>
<td>7/1/92 to 6/30/93</td>
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<td>P. Chinnaswamy (Univ. of Mass.) and C. Weller</td>
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<td>Modification and Utilization of Grain Protein Films ($141,000)</td>
<td>USDA-CSRS</td>
<td>$23,500 (92-93)</td>
<td>10/1/92 to 9/30/95</td>
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<td>R. Testin (Clemson Univ.), C. Weller and P. Vergano (Clemson Univ.)</td>
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<td>Reactive Processing for Starch Grafts</td>
<td>USDA-CSRS Competitive Grants</td>
<td>$152,000</td>
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<td>R. Chinnaswamy and M. Hanna</td>
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<td>Utilization of Poultry Skin</td>
<td>ARD Interdisciplinary Research Project Program</td>
<td>$18,300 (92-93)</td>
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<td>G. Froning, S. Cuppett, R. Mandigo, S. Sumner and C. Weller</td>
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<td>Development of Implementation Strategy for Market Introduction of Tallow-Based</td>
<td>Federal and State Market Improvement Program</td>
<td>$29,300</td>
<td>7/1/92 to 6/30/93</td>
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<td>Biodiesel in Nebraska</td>
<td>USDA</td>
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<td>M. Hanna and R. Sayler</td>
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<td>Emissions and Power Characteristics of Soybean Oil Methyl Ester</td>
<td>Nebraska Soybean Development, Utilization and Marketing Board</td>
<td>$20,670</td>
<td>9/1/92 to 6/30/93</td>
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<td>M. Hanna and L. Leviticus</td>
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<td>Water Washing and Membrane Recovery of Glucosinolates from Crambe and Rapeseed</td>
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<td>$33,365</td>
<td>1/1/93 to 12/31/93</td>
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<td>Meals</td>
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<td>L. Johnson, M. Meagher, H. Noureddini</td>
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<td>Enhancement of Sorghum Refining</td>
<td>Nebraska Sorghum Marketing Board</td>
<td>$10,375 (92-93)</td>
<td>10/1/92 to 9/30/95</td>
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<td>C. Weller and M. Hanna</td>
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<td>$22,250 (94-95)</td>
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<td>FUNDING SOURCE</td>
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<td>EFFECTIVE DATES</td>
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<tr>
<td>Production and Use of Mono- and Di-Acids from Soybean Oil L. Davis Clements and H. Noureddini</td>
<td>American Soybean Association</td>
<td>$38,612</td>
<td>(7/1/93 to 6/30/94)</td>
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<td>Extrusion of Spent Fowl Meat to Improve its Utilization G. Froning, S. Cuppett, M. Hanna and R. Mandigo</td>
<td>Mussehl Poultry Research Endowment</td>
<td>$8,870</td>
<td>9/1/92 to 8/31/93</td>
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<tr>
<td>Soybean-Based Biodiesel: Utilization of By-Product H. Noureddini</td>
<td>Nebraska Soybean Development, Utilization and Marketing Board</td>
<td>$26,140</td>
<td>1993-95</td>
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<td>$24,640</td>
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<td>Microbial Stability of Soybean and Tallow Methyl Esters and Diesel Fuel Blends M. Hanna and L. Bullerman</td>
<td>Nebraska Beef Board</td>
<td>$14,915</td>
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<td>Microbial Stability of Methyl-Soyate and Diesel Fuel Blends M. Hanna and L. Bullerman</td>
<td>Nebraska Soybean Development, Utilization and Marketing Board</td>
<td>$17,915</td>
<td>7/1/93 to 6/30/95</td>
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<td>Soybean Oil as Drip Oil for Irrigation Pumps M. Hanna</td>
<td>Nebraska Soybean Development, Utilization and Marketing Board</td>
<td>$13,531</td>
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<td></td>
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<td>$4,450</td>
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<td></td>
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<td>$4,600</td>
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<tr>
<td>Oil Carriers for Tree Trunk Injectable Pesticides M. Harrell, W. Lovett and M. Hanna</td>
<td>Nebraska Soybean Development, Utilization and Marketing Board</td>
<td>$3,260</td>
<td>7/1/93 to 6/30/94</td>
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<tr>
<td>Use of Corn as a Value-Added Fermentation Substitute R. Hutkins and M. Meagher</td>
<td>Nebraska Corn Development, Utilization and Marketing Board</td>
<td>$20,284</td>
<td>7/1/92 to 6/30/94</td>
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<tr>
<td></td>
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<td>$21,248</td>
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<tr>
<td>Biodegradable Plastics: Block Copolymers D. Timm and H. Noureddini</td>
<td>Nebraska Soybean Development, Utilization and Marketing Board</td>
<td>$26,755</td>
<td>1993-95</td>
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<td>$25,755</td>
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<tr>
<td>M. Hanna and R. Sayler-UNL R. Nelson and M. Schrock-Kansas State University</td>
<td>Western Area Power Authority</td>
<td>$130,000</td>
<td>10/1/92 to 9/30/94</td>
</tr>
</tbody>
</table>
CENTER PRODUCTIVITY

Introduction

Productivity can be measured in terms of parameters such as faculty and industry involvement, grant activity, publications, patents, presentations and overall stature of the Center. Overall, the IAPC has been very productive. Summaries of activities in various categories have been prepared and are presented as parts of this section and other sections of this report.

Faculty and Industry Involvement

To have a quality program it is important to have both active faculty and clientele support and participation. The faculty associated with the IAPC and their respective areas of activity are outlined in a subsequent section. Neither the faculty affiliate or the funded project lists give much detail about the projects. Summaries are available through publications in the IANR and College of Engineering and Technology.

Industry personnel have been involved in two strategic planning sessions we have held, a plastics workshop we held in conjunction with our starch and protein research projects, as collaborators on research projects, as advisory committee members and as recipients of technical or other assistance. Many of these are identified in the following lists.
Industry Involvement with IAPC

• Strategic Planning Session Participants

Agricultural Utilization Research Institute, Crookston, MN
Archer Daniels Midland Company, Decatur, IL
Crete Mills, Crete, NE
DowElanco, Midland, MI
Excel Corporation, Schuyler, NE
Farmers and Merchants Bank, West Point, NE
Farmland Industries, Kansas City, MO
Genencor International, Inc., Rochester, NY
Kansas Department of Agriculture, Topeka, KS
Nebraska Technology Development Corp., Lincoln, NE
Nebraska Plastics, Cozad, NE
USDA-CSRS Industrial Oilseeds Program, Washington, D.C.

• Plastics Industry Workshop Participants

Alpo Petfoods, Crete, NE
Blackburn Manufacturing Company, Neligh, NE
C.J. Foods, Pawnee City, NE
Flexible Foam Products, Ralston, NE
ISCO, Inc., Lincoln, NE
Mid-American Industries, Inc., Mead, NE
Nebraska Plastics, Cozad, NE
Plastilite Corp., Omaha, NE
Weaver’s Potato Chip Co., Lincoln, NE
Winders & Geist, Inc., Lincoln, NE

• Research/Demonstration Collaborators/Cooperators

Ingersoll/Dresser Pump, Hastings, NE
T&L Irrigation, Hastings, NE
Excel, Schuyler, NE
Stratco, Leawood, KS
Interchem, Leawood, KS
Airlite Plastics Co., Omaha, NE
Fairbanks Irrigation, Inc., Wood River, NE
3 Farmers
ADM, Lincoln, NE
Natural Fibers, Ogallala, NE
• Research/Demonstration Collaborators/Cooperators-continued

Flakee Mills, Lincoln, NE
Wenger Manufacturing, Sabetha, KS
Ag Processing, Inc., Omaha, NE
Bio En-Gene-Er Associates, Wilmington, DE
Chief Ethanol Fuels, Hastings, NE
Extru-Tech, Inc./Star Tech, Inc., Sabetha, KS
Free-Flow Packaging Corp., Redwood City, CA
National Sun Industries, Inc., Enderlin, ND
Nebraska Plastics, Cozad, NE
Omaha Steaks International, Omaha, NE
Pioneer Hi-Bred International, Des Moines, IA
Western Sugar Co., Scottsbluff, NE

Publications, Patents and Presentations

Results of a wide array of research have been published. A fairly comprehensive list of technical publications follows this subsection. Not listed are numerous popular articles that have been widely distributed via newspapers and trade journals, as well as numerous television and radio spots.

The IAPC has been invited to display its activities annually at the Husker Feed Grains and Soybean Conference, to make presentations at two of the last three National Corn Classics (annual National Corn Grower's Conventions), and to make presentations to groups such as Ag Builders, the Lincoln Northeast and Tecumseh Kiwanis Clubs, the Lincoln Northeast Optimist Club and the Lincoln Journal/Star Farm City Breakfast.

The IAPC was a founding member of the Degradable Plastics Council which has become part of the Society of the Plastics Industry, and a founding member of the New Uses Council which is made up of industry, government and university representatives to promote new uses research and commercialization activity.

Dr. Hanna also served on the first Corn Research Evaluation Committee, a group of nine individuals representing industries and universities to advise the National Corn Grower's Association on research priorities.


Halvorsen, J.D., W.C. Mammel and L.D. Clements. 1991. Density estimation for free fatty acids and for vegetable oils based on their free fatty acid composition. Submitted to JAOCS.


UNL INDUSTRIAL AGRICULTURAL PRODUCTS CENTER
RESEARCH FACULTY AFFILIATES

This document contains information about all faculty members with research projects coordinated by the Industrial Agricultural Products Center. This includes both faculty from the University of Nebraska and from other institutions. Along with the biographical data for each affiliate is a listing of current and pending research projects which they are currently affiliated with. Projects for which the funding is pending are shown in italics.
UNL AFFILIATES

DAVID D. BALTENSPERGER: Assistant Professor of Agronomy

Panhandle Research and Extension Center
4502 Avenue I
Scottsbluff, NE 69361-4939
(308) 632-1261

1976 B.S. Nebraska Wesleyan University
1978 M.S. University of Nebraska
1980 Ph.D. New Mexico State University

Industrial Utilization Projects
Investigating Milkweed as an Alternative Source of Fiber

Research Interests
Development of varieties and production techniques for the Panhandle region of Nebraska and modification of the best available varieties for that area.

MICHAEL G. BOOSALIS: Professor of Plant Pathology

Department of Plant Pathology
448 Plant Science
Lincoln, NE 68583-0722
(402) 472-2559

1941 B.S. University of Minnesota
1948 M.S. University of Minnesota
1951 Ph.D. University of Minnesota

Industrial Utilization Projects
Investigating Milkweed as an Alternative Source of Fiber

Research Interests
Ecology of soil-borne fungal pathogens, biological control of plant fungal pathogens, integrated pest management, and chemical control of fungal diseases.
**LLOYD B. BULLERMAN:** Professor of Food Science and Technology

Department of Food Science and Technology  
349 Food Industry Complex  
Lincoln, NE 68583-0919  
(402) 472-2801

1961 B.S. South Dakota State University: Dairy & Animal Science  
1965 M.S. South Dakota State University: Bacteriology & Biochemistry  
1968 Ph.D. Iowa State University: Microbiology & Food Technology

**Industrial Utilization Projects**

Microbial Stability of Methyl-Soyate and Diesel Fuel Blends  
7/1/93 - 6/30/95

**Research Interests**

L. DAVIS CLEMENTS, JR.: Chemical Engineer

USDA-CSRS-SPSS
Office of Agricultural Industrial Materials
342 Aerospace Center
14th & Independence Ave, S.W.
Washington, D.C. 20250-2200
(202) 401-4929

1966 B.S. Oklahoma State University: Chemical Engineering
1968 M.S. University of Illinois: Chemical Engineering
1973 Ph.D. University of Oklahoma: Chemical Engineering

**Industrial Utilization Projects**

Production and Use of Mono- and Di-Acids from Soybean Oil
Production and Utilization of Erucic Acid, Brassylc Acid, and Pelargonic Acid: Process Development and Evaluation
Production and Utilization of Mono- and Di-Acids from Soybean Oil: Process Development and Evaluation
Industrial Diacids from Corn Oil
Preparation and Characterization of Starch-Xanthan Block Copolymer
Erucic Acid Oils Characterization and Utilization Research
Development and Commercialization

**Effective Dates**

7/1/93 - 6/30/94
7/1/92 - 6/30/94
1/1/92 - 12/31/94
1992 - 1993
7/1/91 - 6/30/94
6/1/89 - 5/31/94

**Research Interests**

The basis of my research is process design and process development. The primary activities include computer-aided process design techniques, estimation techniques for physical properties of industrial chemicals and chemical process technology. Current activities include applications utilizing vegetable oils as resources for industrial chemicals, derivative chemicals from ethanol and other fermentation products and applications of pyrolysis/gasification technologies for utilization of municipal solid wastes and agricultural residues.
TYRRELL CONWAY: Assistant Professor of Biological Sciences

School of Biological Sciences
314 Manter Hall
Lincoln, NE 68588-0118
(402) 472-2765

1979 B.S. Oklahoma State University: Microbiology
1984 Ph.D. Oklahoma State University: Microbiology

Industrial Utilization Projects

Genetic Construction of Ethanol-Producing Lactobacilli

7/1/92 - 6/30/94

Research Interests

Conversion of carbohydrates to ethanol and carbon dioxide using fermentation. Regulation of intermediary metabolism, particularly glycolytic pathways, using gene cloning. Genetic engineering to redirect bacterial metabolism which will allow the production of useful products.

PATRICIA COX CREWS: Associate Professor of Textiles, Clothing and Design

Department of Textiles, Clothing and Design
221 Home Economics Building
Lincoln, NE 68583-0802
(402) 472-6370

1971 B.S. Virginia Polytechnic Institute: Fashion Design and Merchandising
1973 M.S. Florida State University: Textile Science
1985 Ph.D. Kansas State University: Textile Science and Conversion

Industrial Utilization Projects

Investigation Milkweed as an Alternative Source of Fiber

7/1/89 - 10/31/93

Research Interests

Improving textile product performance, especially lightfastness.
SUSAN L. CUPPETT: Associate Professor of Food Science and Technology

Department of Food Science and Technology
352 Food Industry Complex
Lincoln, NE 68583-0919
(402) 472-5616

1968 B.S. West Virginia University
1970 M.S. West Virginia University
1985 Ph.D. Michigan State University

Industrial Utilization Projects

Extrusion of Spent Fowl Meat to Improve its Utilization
Utilization of Poultry Skins

Effective Dates
9/1/92 - 8/31/93
7/1/92 - 6/30/94

GLENN W. FRONING: Professor of Food Science and Technology

Department of Food Science and Technology
357 Food Industry Complex
Lincoln, NE 68583-0919
(402) 472-6452

1953 B.S. University of Missouri: Poultry Science
1957 M.S. University of Missouri: Poultry Products
1961 Ph.D. University of Minnesota: Food Science

Industrial Utilization Projects

Extrusion of Spent Fowl Meat to Improve its Utilization
Utilization of Poultry Skins

Effective Dates
9/1/92 - 8/31/93
7/1/92 - 6/30/94

Research Interests

Removal of cholesterol and lipids from eggs, poultry meat and beef using super critical carbon dioxide extraction. Study of heme proteins in poultry meat with particular emphasis on the cytochrome pigments. Study of "surimi-like" poultry meat products. Effect of post mortem electrical stimulation of poultry muscle. Role of egg white proteins and their fractionation on functional properties of egg white. Ultrafiltration of egg white for fractionation of egg white proteins. Effect of egg dehydration on egg white proteins and their functionality in food systems.
JOHN H. GOLBECK: Associate Professor of Biochemistry

Department of Biochemistry
307 Biochemistry Hall
Lincoln, NE 68583-0718
(402) 472-2931

1976 Ph.D. University of Indiana

Industrial Utilization Projects
Starch-Vinylic Polymer Grafts from Chemical Intermediates and Biodegradables

Effective Dates
7/1/92 - 6/30/95

ROBERT D. GRISSO: Associate Professor and Extension Engineer of Biological Systems Engineering

Department of Biological Systems Engineering
204 L.W. Chase Hall
Lincoln, NE 68583-0726
(402) 472-6714

1978 B.S. Virginia Tech University: Agricultural Engineering
1980 M.S. Virginia Tech University: Agricultural Engineering
1985 Ph.D. Auburn University: Agricultural Engineering

Industrial Utilization Projects
Biomass Collection Survey

Effective Dates
5/92 - 3/93

Research Interests
Soil mechanics, chemical application improvement, conservation tillage management and machinery management. Specific expertise in conducting field surveys of application of pesticides, anhydrous ammonia and energy requirement of tillage equipment.
MILFORD A. HANNA: Professor of Biological Systems Engineering and Food Science and Technology and Director of Industrial Agricultural Products Center

Industrial Agricultural Products Center
211 L.W. Chase Hall
Lincoln, NE 68583-0730
(402) 472-1634

1969 B.S. Pennsylvania State University: Agricultural Engineering
1971 M.S. Pennsylvania State University: Agricultural Engineering
1973 Ph.D. Pennsylvania State University: Agricultural Engineering

Industrial Utilization Projects

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Effective Dates</th>
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<tbody>
<tr>
<td>Oil Carriers for Tree Trunk Injectable Pesticides</td>
<td>7/1/93 - 6/30/94</td>
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<tr>
<td>Soybean Oil as Drip Oil for Irrigation Pumps</td>
<td>7/1/93 - 6/30/97</td>
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<tr>
<td>Microbial Stability of Methyl-Soyate and Diesel Fuel Blends</td>
<td>7/1/93 - 6/30/95</td>
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<tr>
<td>Vegetable Oils as Carriers for Trunk-Injectable</td>
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<tr>
<td>Arboricultural Pesticides</td>
<td>6/1/93 - 9/30/94</td>
</tr>
<tr>
<td>Engine Performance Analyses and Demonstration of Blended Tallow Esters as Diesel Fuel</td>
<td>5/1/93 - 6/30/94</td>
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<tr>
<td>Enhancement of Sorghum Refining</td>
<td>10/1/92 - 9/30/95</td>
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<tr>
<td>Development of Implementation Strategy for Market Introduction of Tallow-Based Biodiesel in Nebraska</td>
<td>10/1/92 - 9/30/93</td>
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<tr>
<td>Extrusion of Spent Fowl Meat to Improve its Utilization</td>
<td>9/1/92 - 8/31/93</td>
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<tr>
<td>Emissions and Power Characteristics of Soybean Oil Methyl Ester</td>
<td>8/1/92 - 6/30/93</td>
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<tr>
<td>Reactive Processing for Starch Grafts</td>
<td>7/1/92 - 6/30/95</td>
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<tr>
<td>Starch-Vinylc Polymer Grafts from Chemical Intermediates and Biodegradables</td>
<td>7/1/92 - 6/30/95</td>
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<td>Continuous Production of Glucosides from Corn Starch</td>
<td>7/1/92 - 6/30/94</td>
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<tr>
<td>Water-Resistant Starch-Based Plastic Foams</td>
<td>1/92 - 12/94</td>
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<td>Modified Soy Isolate as a Particleboard Adhesive</td>
<td>10/91 - 9/94</td>
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<td>Modification of Soy Polymers for Incorporation into Plastic Films</td>
<td>10/91 - 9/93</td>
</tr>
<tr>
<td>Gluten Graft Copolymer Plastic Resin: Production and Characterization</td>
<td>7/1/91 - 6/30/94</td>
</tr>
<tr>
<td>Preparation and Characterization of Starch-Xanthan Block Copolymer</td>
<td>7/1/91 - 6/30/94</td>
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<tr>
<td>Soy Graft Copolymer Plastic Resins: Production and Characterization</td>
<td>7/1/91 - 6/30/94</td>
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<tr>
<td>Evaluation of Commercialization Potential</td>
<td>7/1/91 - 6/30/93</td>
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<td>Liquefaction of Starch by Extrusion for Direct Utilization of High</td>
<td>7/1/90 - 6/30/94</td>
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<td>Starch Concentrations in Fermentors</td>
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<tr>
<td>Non-Food Agricultural Products Project</td>
<td>5/1/90 - 10/31/93</td>
</tr>
<tr>
<td>Investigating Milkweed as an Alternative Source of Fiber</td>
<td>7/1/89 - 10/31/93</td>
</tr>
</tbody>
</table>

Research Interests

Specific expertise in extrusion processing/engineering and vegetable oil expression and processing. General interest in production and value-added processing of agricultural commodities for food and non-food use.
MARK O. HARRELL: Associate Professor and Associate Forester of Forestry, Fisheries, and Wildlife

Department of Forestry, Fisheries, and Wildlife
4 Plant Industry
Lincoln, NE 68583-0814
(402) 472-6635

1975 B.S. William & Mary: Biology
1978 M.S. University of Wisconsin: Entomology
1980 Ph.D. University of Wisconsin: Entomology

Industrial Utilization Projects

Vegetable Oils as Carriers for Trunk-Injectable Arboricultural Pesticides 6/1/93 - 9/30/94
Oil Carriers for Tree Trunk Injectable Pesticides 7/1/93 - 6/30/94

Research Interests

Biology and control of insect pests and diseases of trees. Tree trunk injection methods for controlling tree pests.
ROBERT W. HUTKINS: Associate Professor of Food Science and Technology

Department of Food Science and Technology
338 Food Industry Complex
Lincoln, NE 68583-0919
(402) 472-2820

1979 B.S. University of Missouri: Food Science
1980 M.S. University of Missouri: Food Science
1984 Ph.D. University of Minnesota: Food Science

Industrial Utilization Projects

Genetic Construction of Ethanol-Producing Lactobacilli
Recovery of Corn-Derived, Value-Added Chemicals Using Pervaporation

Effective Dates
7/1/92 - 6/30/94
7/1/92 - 6/30/94

Research Interests

The primary area of interest involves applications of biotechnology to improve food and non-food fermentation processes. Current research is focused on physiological and genetic analyses of carbohydrate transport and metabolism by lactic acid bacteria used as food starter cultures. Mechanisms of acid tolerance, pH homeostasis and regulation, and bacteriocin production in lactic acid bacteria also being studied. Another major area relates to improving the fermentative abilities of lactobacilli and clostridia and the product recovery systems used in industrial fermentations, particularly those that yield ethanol, butanol, and other solvents from corn. These projects have been supported by over $400,000 of research funding in the last five years and have resulting in twenty publications in refereed journals.
DAVID S. JACKSON: Assistant Professor and Extension Specialist of Food Science and Technology and Assistant Professor of Agronomy

Department of Food Science and Technology
257 Food Industry Complex
Lincoln, NE 68583-0919
(402) 472-2814

1984 B.S. Cornell University: Food Science
1986 M.S. Texas A & M: Food Science and Technology (Cereal Technology)
1988 Ph.D. Texas A & M: Food Science and Technology (Cereal Technology)

Industrial Utilization Projects

Economic Improvement of Corn Wet Milling by Optimizing Steep Conditions
Liquefaction of Starch by Extrusion for Direct Utilization of High Starch Concentrations in Fermentors

Research Interests

Starch and biopolymer characterization and studying relationships between fundamental polymer structure and function. Corn processing technology and assessment of corn quality for food and non-food industrial end-uses. General interests also include extrusion processing of cereal grains and oilseeds into human foods, and other aspects of cereal technology and processing.

DAVID D. JONES: Assistant Professor of Biological Systems Engineering

Department of Biological Systems Engineering
212 L.W. Chase Hall
Lincoln, NE 68583-0726
(402) 472-6716

1984 B.S. Texas A & M: Agricultural Engineering
1986 M.S. Texas A & M: Agricultural Engineering
1988 Ph.D. Oklahoma State University: Agricultural Engineering

Industrial Utilization Projects

Formation of Refuse Derived Fuels (RDF) Using Naturally Occurring Binders
Investigating Milkweed as an Alternative Source of Fiber: Development of Handling and Processing Systems for Milkweed Pods

Research Interests

Risk assessment of complex systems, modeling of grain dust explosions, mathematical modeling, and value-added processing.
CHARLES A. KINGSBURY: Professor of Chemistry

Department of Chemistry
812 Hamilton Hall
Lincoln, NE 68588-0304
(402) 472-2706

1956 B.S. Iowa State University
1960 Ph.D. University of California (Los Angeles)

Industrial Utilization Projects

Modification and Utilization of Grain Protein Films
Starch-Vinylic Polymer Grafts from Chemical Intermediates and Biodegradables
Continuous Production of Glucosides from Corn Starch
Factors Affecting Edible Films and Coatings from Soy Protein
Preparation and Characterization of Starch-Xanthan Block Copolymer

Research Interests

Beef cattle nutrition including the use of byproducts from industrial processing with special emphasis on byproducts from alcohol production.

TERRY J. KLOPFENSTEIN: Professor of Animal Science

Department of Animal Science
C220 Animal Science
Lincoln, NE 68583-0908
(402) 472-6443

1961 B.S. Ohio State University: Animal Science
1963 M.S. Ohio State University: Ruminant Nutrition
1965 Ph.D. Ohio State University: Ruminant Nutrition

Industrial Utilization Projects

Utilization of Wet Distillers Grains and Condensed Solubles
Method of Storing Wet Corn Gluten Feed on Subsequent Beef Finishing Performance

Research Interests

Beef cattle nutrition including the use of byproducts from industrial processing with special emphasis on byproducts from alcohol production.
LOUIS I. LEVITICUS: Professor of Biological Systems Engineering and Supervisor Test & Development, Nebraska Power Laboratory

Department of Biological Systems Engineering
Biological Systems Engineering Lab
Lincoln, NE 68583-0832
(402) 472-2442

1960     B.S.     Institute of Technology: Agricultural Engineering (P&M)
1963     M.S.     Institute of Technology: Agricultural Engineering (P&M)
1969     Ph.D.    Purdue: Agricultural Engineering (P&M)

Industrial Utilization Projects

Emissions and Power Characteristics of Soybean Oil Methyl Ester 8/1/92 - 6/30/93

Research Interests

Tractor development and testing. Engine development and testing (power and emissions). Vehicle off-road performance. Farm safety -design and machine development. Fuels - testing and evaluation (alternative fuels in particular).

WILLIAM R. LOVETT: Associate Forester of Forestry, Fisheries and Wildlife

Department of Forestry, Fisheries and Wildlife
05 Plant Industry
Lincoln, NE 68583-0814
(402) 472-6640

1969     B.S.     University of Illinois: Forest Management
1975     M.S.     University of Illinois: Genetics

Industrial Utilization Projects

Oil Carriers for Tree Trunk Injectable Pesticides 7/1/93 - 6/30/94
Vegetable Oils as Carriers for Trunk-Injectable Arboricultural Pesticides 6/1/93 - 9/30/94

Research Interests

Selection of genotypes and provenances of several tree species for Nebraska environmental conditions. Vegetative propagation of selected phenotypes.
ROGER W. MANDIGO: Professor of Animal Science and Food Science and Technology

Department of Animal Science
A213 Animal Science
Lincoln, NE 68583-0908
(402) 472-6456

1961  B.S.  California State Polytechnic University: Animal Science
1963  M.S.  New Mexico State University: Animal Science
1967  Ph.D.  Oklahoma State University: Foods Science (Meats)

Industrial Utilization Projects

Extrusion of Spent Fowl Meat to Improve its Utilization  9/1/92 - 8/31/93
Utilization of Poultry Skins  7/1/92 - 6/30/94

Research Interests

Primary thrust of research emphasis in manufacture and processed meat value-added technology. Major emphasis is in areas of low-fat meat technology, restructured meats and utilization of recovered meat through processing.
MICHAEL M. MEAGHER: Assistant Professor of Food Science and Technology and Biological Systems Engineering

Department of Food Science and Technology
355 Food Industry Complex
Lincoln, NE 68583-0919
(402) 472-2342

1981    B.S.    Colorado State University: Engineering Science
1984    M.S.    Iowa State University: Chemical Engineering
1987    Ph.D.   Iowa State University: Chemical Engineering

Industrial Utilization Projects

Water Washing and Membrane Recovery of Glucosinolates from Crambe and Rapeseed Meals 1/1/93 - 12/31/93
Genetic Construction of Ethanol-Producing Lactobacilli 7/1/92 - 6/30/94
Recovery of Corn-Derived, Value-Added Chemicals Using Pervaporation 7/1/92 - 6/30/94
Biomass Collection Survey 5/92 - 3/93
Liquefaction of Starch by Extrusion for Direct Utilization of High Starch Concentrations in Fermentors 7/1/90 - 6/30/94

Research Interests

Fermentation and separation of alcohols and other value added chemicals from agricultural commodities. In the area of fermentation, interest is in improving the fermentation efficiency of the starch to ethanol fermentation by genetic construction of better ethanol producing organisms. Also, an alternative technology, i.e. extrusion, is being investigated to replace traditional gelatinization and liquefaction technology that are currently energy intensive. Another important area of research is the membrane separation technique pervaporation for the recovery of dilute chemicals from fermentation broths.
LENIS A. NELSON:  Professor of Agronomy

Department of Agronomy
342 Keim Hall
Lincoln, NE  68583-0915
(402) 472-1489

1970  B.S.  North Dakota State University: Agronomy
1984  M.S.  North Dakota State University: Agronomy
1987  Ph.D.  North Dakota State University: Agricultural Education

Industrial Utilization Projects

Investigating Milkweed as an Alternative Source of Fiber  Effective Dates
7/1/89 - 10/31/93

Research Interests

Adaptation of new edible and industrial oil and fiber crops including cultivar selection and variety testing. Development of educational programs to enhance producers’ acceptance of new crops and processes that are ready for adoption.

PAUL T. NORDQUIST:  Professor of Agronomy

West Central Research and Extension Center
Route 4 Box 46A
North Platte, NE  69101
(308) 532-3611

1954  B.S.  South Dakota State University
1960  M.S.  South Dakota State University
1971  Ph.D.  University of Nebraska

Industrial Utilization Projects

Investigating Milkweed as an Alternative Source of Fiber  Effective Dates
7/1/89 - 10/31/93

Research Interests

Agronomic aspects of milkweed production including studies of weed control, fertility, and insect damage and variety evaluations to select genotypes with superior disease resistance and floss yield. Sorghum breeding with the objective of germplasm improvement for shorter season cooler environments, and corn breeding with the objective of improved germplasm for higher pH environments.
HOSSEIN NOUREDDINI: Research Associate of Chemical Engineering

Department of Chemical Engineering
227 Avery Hall
Lincoln, NE 68588-0126
(402) 472-2751

1975   B.S.  University of Tulsa: Chemical Engineering
1977   M.S.  University of Nebraska: Chemical Engineering
1991   Ph.D. University of Nebraska: Chemical Engineering

Industrial Utilization Projects

<table>
<thead>
<tr>
<th>Description</th>
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<tr>
<td>Production and Use of Mono- and Di-acids from Soybean Oil</td>
<td>7/1/93 - 6/30/94</td>
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<tr>
<td>Water Washing and Membrane Recovery of Glucosinolates from</td>
<td>1/1/93 - 12/31/93</td>
</tr>
<tr>
<td>Crambe and Rapeseed Meals</td>
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<tr>
<td>Biodegradable Plastics: Block Copolymers</td>
<td>1993 - 1995</td>
</tr>
<tr>
<td>Soybean Based Biodiesel: Utilization of By-Product</td>
<td>1993 - 1995</td>
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<tr>
<td>Production and Utilization of Erucic Acid, Brassylc Acid, and</td>
<td>7/1/92 - 6/30/94</td>
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<tr>
<td>Pelargonic Acid: Process Development and Evaluation</td>
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<tr>
<td>Production and Utilization of Mono- and Di-Acids from Soybean Oil:</td>
<td>1/1/92 - 12/31/94</td>
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<tr>
<td>Production and Utilization of Erucic Acid Oils Characterization and</td>
<td>6/1/89 - 5/31/94</td>
</tr>
<tr>
<td>Development and Commercialization</td>
<td></td>
</tr>
</tbody>
</table>

Current research activities are in process development for production of industrial diacids from vegetable oils by catalytic oxidation of unsaturated fatty acids, utilization of by-product in soybean or tallow-based biodiesel through glycerolysis with triglycerides to help the economy of the biodiesel production, measurement of physical and thermodynamic properties of fatty acids and vegetable oils, and utilization of pyrolysis and gasification methods for municipal solid wastes.
WILLIAM A. SCHELLER: Professor of Chemical Engineering

Department of Chemical Engineering
225 Avery Hall
Lincoln, NE 68588-0126
(402) 472-2752

1951 B.S. Northwestern University: Chemical Engineering
1955 Ph.D. Northwestern University: Chemical Engineering

Industrial Utilization Projects
Biomass Collection Survey

Effective Dates
5/92 - 3/93

Research Interests

Fermentation processes, fuel ethanol and byproduct production and utilization, renewable fuels, biomass conversion processes, chemicals from biomass, oxygenated fuel additives, separation processes, phase equilibrium, and chemical reaction kinetics.

KHEM M. SHAHANI: Professor of Food Science and Technology

Department of Food Science and Technology
255 Food Industry Complex
Lincoln, NE 68583-0919
(402) 472-2815

1943 B.S. University of Bombay: Dairy and Agriculture
1947 M.S. University of Bombay: Dairy Microbiology
1950 Ph.D. University of Wisconsin: Dairy Technology and Biochemistry

Industrial Utilization Projects
Cofermentation of Whey and Corn

Effective Dates
5/1/90 - 10/31/93
**RICHARD K. SHOEMAKER:** Research Assistant Professor and Instrumentation Supervisor of Chemistry

Department of Chemistry  
824 Hamilton Hall  
Lincoln, NE  68588-0304  
(402) 472-6255

<table>
<thead>
<tr>
<th>Year</th>
<th>Degree</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1983</td>
<td>B.A.</td>
<td>Midland Lutheran</td>
</tr>
<tr>
<td>1988</td>
<td>Ph.D.</td>
<td>University of Nebraska</td>
</tr>
</tbody>
</table>

**Industrial Utilization Projects**

- **Continuous Production of Glucosides from Corn Starch**  
  7/1/92 - 6/30/94
- **Starch-Vinylic Polymer Grafts from Chemical Intermediates and Biodegradables**  
  7/1/92 - 6/30/95

**RICK A. STOCK:** Associate Professor and Extension Feedlot Specialist of Animal Science

Department of Animal Science  
C220 Animal Science  
Lincoln, NE  68583-0908  
(402) 472-6402

<table>
<thead>
<tr>
<th>Year</th>
<th>Degree</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1977</td>
<td>B.S.</td>
<td>Oklahoma State University: Animal Science</td>
</tr>
<tr>
<td>1979</td>
<td>M.S.</td>
<td>University of Nebraska-Lincoln: Animal Science</td>
</tr>
<tr>
<td>1982</td>
<td>Ph.D.</td>
<td>University of Nebraska-Lincoln: Animal Science</td>
</tr>
</tbody>
</table>

**Industrial Utilization Projects**

- **Utilization of Wet Distillers Grains and Condensed Solubles**  
  7/1/93 - 6/30/94
- **Method of Storing Wet Corn Gluten Feed on Subsequent Finishing Performance**  
  7/1/92 - 6/30/94
- **Level of Wet Corn Gluten Feed in Finishing Diet**  
  9/1/92 - 6/30/93
- **Utilization of Wet Corn Gluten Feed in Growing Diets**  
  9/1/92 - 6/30/93

**Research Interests**

Starch and protein utilization of finishing cattle. Utilization of byproducts to improve cost efficiency to feeding cattle.
SUSAN S. SUMNER: Assistant Professor of Food Science and Technology

Department of Food Science and Technology
356 Food Industry Complex
Lincoln, NE 68583-0919
(402) 472-7807

1982  B.S.  North Carolina State University: Food Science
1984  M.S.  University of Wisconsin: Food Science
1987  Ph.D.  University of Wisconsin: Food Science

Industrial Utilization Projects

Utilization of Poultry Skins  7/1/92 - 6/30/94

Research Interests

Food safety microbiology, quality assurance of foods, and the effects of new processing technologies on food safety. Specific microorganisms of interest include Salmonella, E. Coli 0157:H7, and Listeria Monocytogenes.

DELMAR C. TIMM: Professor of Chemical Engineering

Department of Chemical Engineering
234 Avery Hall
Lincoln, NE 68588-0126
(402) 472-3232

1962  B.S.  Iowa State University: Chemical Engineering
1965  M.S.  Iowa State University: Chemical Engineering
1967  Ph.D.  Iowa State University: Chemical Engineering

Industrial Utilization Projects

Biodegradable Plastics: Block Copolymers  1993 - 1995
MICHAEL S. TURNER:  Professor of Agricultural Economics

Department of Agricultural Economics
103 H.C. Filley Hall
Lincoln, NE  68583-0922
(402) 472-1710

1959  B.S.  Ohio State University: Agricultural Economics
1960  M.S.  Ohio State University: Agricultural Economics
1964  Ph.D.  Ohio State University: Agricultural Economics

Industrial Utilization Projects

Biomass Collection Survey  Effective Dates  5/92 - 3/93

Research Interests

Agribusiness management, value added opportunities, feasibility studies, marketing, and industry organization/reorganization.

ANNE MARIE KOPECKY VIDAVER:  Head and Professor of Plant Pathology

Department of Plant Pathology
406C Plant Science Building
Lincoln, NE  68583-0722
(402) 472-2858

1960  B.S.  Russell Sage College: Biology
1962  M.S.  Indiana University: Bacteriology
1965  Ph.D.  Indiana University: Bacteriology

Industrial Utilization Projects  Effective Dates

Investigation Milkweed as an Alternative Source of Fiber  7/1/89 - 10/31/93

Research Interests

Deterious and beneficial bacteria associated with economic plants and alternative crops, the ability of bacteria to cause plant disease and methods of control, and endophytic bacteria (those that live inside plants).
KENNETH VON BARGEN: Professor of Biological Systems Engineering

Department of Biological Systems Engineering
205 L.W. Chase Hall
Lincoln, NE 68583-0726
(402) 472-1645

1952  B.S.  University of Nebraska: Agricultural Engineering
1962  M.S.  University of Nebraska: Agricultural Engineering
1970  Ph.D.  Purdue University: Agricultural Engineering

Industrial Utilization Projects

Biomass Collection Survey
Investigating Milkweed as an Alternative Source of Fiber

Research Interests

Development of machines and components for harvesting, handling and processing agricultural crops and the evaluation of their functional and system performances. Current emphasis is on equipment for commercialization of milkweed as a fiber crop, and development and evaluation of sensors and control systems for agricultural and turf chemical applicators. Sensors of interest utilize infrared and machine vision technologies.

RANDY L. WEHLING: Associate Professor of Food Science and Technology

Department of Food Science and Technology
241 Food Industry Complex
Lincoln, NE 68583-0919
(402) 472-2857

1976  B.S.  Kansas State University
1980  M.S.  Kansas State University
1983  Ph.D.  Kansas State University

Industrial Utilization Projects

Continuous Production of Glucosides from Corn Starch

Effective Dates

5/92 - 3/93
7/1/89 - 10/31/93
7/1/92 - 6/30/94
**CURT WELLER**: Assistant Professor of Biological Systems Engineering and Food Science and Technology

Department of Biological Systems Engineering  
210 L.W. Chase Hall  
Lincoln, NE  68583-0726  
(402) 472-9337

1977  B.S.  University of Illinois-UC: Food Science  
1983  M.S.  University of Illinois-UC: Food Science  
1987  Ph.D.  University of Illinois-UC: Agricultural Engineering

**Industrial Utilization Projects**  

<table>
<thead>
<tr>
<th>Project</th>
<th>Effective Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhancement of Sorghum Refining</td>
<td>10/1/92 - 9/30/95</td>
</tr>
<tr>
<td>Modification and Utilization of Grain Protein Films</td>
<td>10/1/92 - 9/30/95</td>
</tr>
<tr>
<td>Factors Effecting Edible Films and Coatings from Soy Protein</td>
<td>7/1/92 - 6/30/94</td>
</tr>
<tr>
<td>Utilization of Poultry Skins</td>
<td>7/1/92 - 6/30/94</td>
</tr>
<tr>
<td>Effect of Sucrose on Physical Properties of Wheat Gluten-Based Films</td>
<td>7/1/92 - 6/30/93</td>
</tr>
</tbody>
</table>

**Research Interests**

Food and bioprocess engineering research with emphasis on value-added processing of agricultural commodities and physical properties determination. Concentration of research effort has been on property evaluation and modification of edible, degradable protein films.
NON-UNL AFFILIATES

PAVINEE CHINACHOTI: Associate Professor of Food Science
University of Massachusetts-Amherst
Department of Food Science
Chenoweth Laboratory
Amherst, MA 01003
(413) 545-1025

1979  B.S.  Mahidol University (Thailand)
1983  M.S.  University of Illinois
1986  Ph.D.  University of Illinois

Industrial Utilization Projects

Effect of Sucrose on Physical Properties of Wheat Gluten-Based Films  7/1/92 - 6/30/93

NAVAM S. HETTIARCHCHY: Associate Professor and Director of Food Science Program
Department of Food Science
University of Arkansas
2772 Young Ave.
Fayetteville, AK 72703
(501) 575-4779

1961  B.S.  University of Madras (India): Chemistry
1968  M.S.  Edinburgh University (Scotland, UK): Biochemistry
1974  Ph.D.  Hull University (England, UK): Biochemistry

Industrial Utilization Projects

Modified Soy Isolate as a Particleboard Adhesive  10/91 - 9/94
LARRY A. JOHNSON: Professor-in-Charge

Center for Crops Utilization Research
Iowa State University
1041 Food Sciences Building
Ames, IA 50011
(515) 294-0160

1969 B.S. Ohio State University: Food Technology
1971 M.S. North Carolina State University: Food Science
1978 Ph.D. Kansas State University: Food Science

Industrial Utilization Projects

Water Washing and Membrane Recovery of Glucosinolates from Crambe and Rapeseed Meals 1/1/93 - 12/31/93

Research Interests

Risk assessment of complex systems, modeling of grain dust explosions, and mathematical modeling.

DELAND MYERS: Assistant Professor of Food Science and Human Nutrition

Iowa State University
Center for Crop Utilization Research
1139 Food Sciences Building
Ames, IA 50011
(515) 294-5216

1978 B.S. University of Missouri-KC: Biology
1981 M.S. Iowa State University: Food Technology
1984 Ph.D. Iowa State University: Food Technology

Industrial Utilization Projects

Modified Soy Isolate as a Particleboard Adhesive 10/91 - 9/94
**RICHARD NELSON:** Extension Specialist, Energy Engineering Extension Programs
Kansas State University
Ward Hall
Manhattan, KS 66506-2508
(913) 532-6026

1981 B.S. Oklahoma State University: Mechanical Engineering
1982 M.S. Oklahoma State University: Mechanical Engineering
1989 Ph.D. Oklahoma State University: Agricultural Engineering

**Industrial Utilization Projects**

*Engine Performance Analyses and Demonstration of Blended Tallow Esters as Diesel Fuel*

**Effective Dates**

1/1/93 - 6/30/94

---

**MARK SCHROCK:** Professor of Agricultural Engineering

Agricultural Engineering Department
Kansas State University
Seaton Hall
Manhattan, KS 66506
(913) 532-5580

1969 B.S. Kansas State University: Agricultural Engineering
1971 M.S. University of Illinois: Mechanical Engineering
1978 Ph.D. Kansas State University: Engineering

**Industrial Utilization Projects**

*Engine Performance Analyses and Demonstration of Blended Tallow Esters as Diesel Fuel*

**Effective Dates**

1/1/93 - 6/30/94
ROBERT TESTIN: Associate Professor of Packaging Science

Department of Food Science
Clemson University
226 Poole Agriculture Center
Clemson, SC 29634-0357
(803) 656-2229

1958 B.Ch.E. University of Detroit: Chemical Engineering
1962 M.S. University of Pittsburgh: Chemical Engineering
1965 Ph.D. University of Pittsburgh: Chemical Engineering

Industrial Utilization Projects

Modification and Utilization of Grain Protein Films
Factors Affecting Edible Films and Coatings from Soy Protein

PETER VERGANO: Associate Professor of Packaging Science

Department of Food Science
Clemson University
225 Poole Agriculture Center
Box 340371
Clemson, SC 29634-0371
(803) 656-5684

1965 B.S. Rutgers, The State University: Ceramics
1965 B.A. Rutgers, The State University: Liberal Arts
1969 Ph.D. Massachusetts Institute of Technology: Materials Science

Industrial Utilization Projects

Modification and Utilization of Grain Protein Films
Factors Effecting Edible Films and Coatings from Soy Protein

Effective Dates
10/1/92 - 9/30/95
7/1/92 - 6/30/94
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ADVISORY COMMITTEE

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West Point, NE 68788
(402) 372-5331

Charles Butler
Crete Mills
P.O. Box 308
Crete, NE 68333
(402) 826-2113

Lloyd Castner
Nebraska Public Power
Columbus, NE 68601
(402) 563-5537

Rex German
Nebraska Plastics
P.O. Box 45
Cozad, NE 69130
(800) 662-2936

Tom Roode
Roode Packing Company
P.O. Box 510
Fairbury, NE 68352
(402) 477-5743
(402) 429-2253

Max Kellough
Nebraska Cattlemen’s Association
RR #1, Box 111
Friend, NE 68359
(402) 947-2061

Ron Maas
Wheat Board
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Lincoln, NE 68509
(402) 471-2358

Ray Marquardt
Agribusiness Program
University of Nebraska-Lincoln
312 CBA
Lincoln, NE 68583-0492
(402) 472-3156

Ronald A. Ochsner
Nebraska Corn Growers
Association
RR #2, Box 12
Saronville, NE 68975
(402) 773-4671

Larry Sitzman
State Department of Agriculture
301 Centennial Mall South
Lincoln, NE 68509
(402) 471-2341

Darrell Ullman
Department of Economic Development
301 Centennial Mall South
Lincoln, NE 68509
(402) 471-3786

Dale Vanderholm
Agricultural Research Division
University of Nebraska-Lincoln
109 Agricultural Hall
Lincoln, NE 68583-0704
(402) 472-2045

James Weyer
Nebraska Soybean Program
Box 95144
Lincoln, NE 68509
(402) 471-4894

Barbara Kliment
GREAT PLAINS STRATEGIC PLANNING

CONSORTIA
Great Plains Strategic Planning Consortium

Facilitator’s Report of the Meeting
12 September, 1991
Lincoln, Nebraska

Submitted by

L. Davis Clements
Department of Chemical Engineering
University of Nebraska-Lincoln

September 27, 1991
Facilitator’s Report

On September 12, 1991, a group of experts involved in various aspects of industrial (non-food) utilization of agricultural products met to consider ways to move the diverse efforts underway across the nation towards demonstrable successes. The group, listed in Appendix V, was chosen on the basis of a balance among university, industry and governmental sectors, over a wide range of professional disciplines and with a range of individual job functions.

The goal of the meeting was to develop insights into how success stories can be created in the field. The approach used was a modified version of group strategic planning. The session was designed to emphasize identification of arguments for and against further development of technologies for creation of industrial products from agricultural raw materials and to identify strategies to promote successful commercialization efforts.

A preliminary discussion of the Planning/Implementation Triangle (Figure 1) prompted the group to question what is truly the mission of the national effort in promoting industrial agricultural products. The results of the individual responses are given in Appendix I. The group responses, in Table 1, show a diverse viewpoint. While no attempt was made to arrive at a consensus statement of mission, it is clear that the variety of agendas at work in the area is itself a potential problem.
Figure 1

THE HIERARCHY OF PLANS

Purpose or mission

Goals To Achieve

Objectives Within Goals

Strategies To Follow

Policies: Major and Minor

Procedures and Rules

Programs: Major or Minor and Supporting

Budgets: Costs of Programs and Funding Procedures

From: Essentials of Management by Koontz and O'Donnell as modified by L. D. Clements, 1987
Table 1
Potential Mission Statements
Group Responses

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop technologies to utilize renewable resources.</td>
</tr>
<tr>
<td>Establish procedures and practices which promote environmentally sound</td>
</tr>
<tr>
<td>advice.</td>
</tr>
<tr>
<td>Enhance contribution of agricultural products.</td>
</tr>
<tr>
<td>Identify customer groups for agricultural products.</td>
</tr>
<tr>
<td>Efficient application of appropriate technologies.</td>
</tr>
<tr>
<td>Meet human and societal needs.</td>
</tr>
<tr>
<td>Develop industrial products for state/region to enhance highest return to</td>
</tr>
<tr>
<td>agriculture.</td>
</tr>
<tr>
<td>Convert agriculturally produced materials to meet consumer needs.</td>
</tr>
</tbody>
</table>

*See Appendix I for individual responses.*

The group was then challenged to justify the extensive efforts in research and development that are in progress. The argument has been advanced that since the first chemurgic movement of the 1930s, there has been no real success. Table 2 summarizes the group discussion of justifications and counter-arguments. Individual responses are in Appendix II.

Table 2
How Can We Justify Promoting Industrial Ag Product RD&D?
Group Responses

<table>
<thead>
<tr>
<th>Justification</th>
<th>Counter-Argument</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic sourcing</td>
<td>Isolationist rather than global outlook</td>
</tr>
<tr>
<td></td>
<td>Cheaper to import</td>
</tr>
<tr>
<td>Excess agricultural resources</td>
<td>Reduce subsidies</td>
</tr>
<tr>
<td></td>
<td>Allow market to work</td>
</tr>
<tr>
<td></td>
<td>Reduce production</td>
</tr>
<tr>
<td></td>
<td>Help feed the world</td>
</tr>
<tr>
<td>Use of renewable resources</td>
<td>Infringement on established programs</td>
</tr>
<tr>
<td></td>
<td>Too expensive</td>
</tr>
<tr>
<td></td>
<td>Cheap to use nonrenewables</td>
</tr>
<tr>
<td>Potential for profit</td>
<td>Who make the profit</td>
</tr>
<tr>
<td></td>
<td>Profit margin too low</td>
</tr>
</tbody>
</table>

3
| Opportunity to decrease cost of production | Lack of infrastructure
| Demonstrate successes
| Identify niche |
| Learn basic elements of nature and functions performed naturally | Time, effort and funds needed are excessive |
| Decrease problems and costs of pollution | Increase costs of production
| May generate other problems |
| Development of new business | Not enough trained personnel
| Take production out of rural communities
| Most new businesses fail
| Successful new businesses often move to the large urban areas
| New plants can be built cheaper than modification of older plants |
| Source of safer green products | Too costly |
| Recycle current products | Technology not available |
| Opportunity to recapitalize modern industry in smaller communities (adjacent to raw materials) | Decision to move based on poor sense of assumptions
| Future technologic changes will result in deja vu; i.e. decay of company town |
| Develop automation to accommodate smaller, safer jobs | Economy of scale
| Geography |
| Identify new mix of crops | Why change when returns for corn and soybeans are better
| Establish new government programs |
| Need a source of energy for mobile (vehicular) uses from domestic resources | Biodiesel is too expensive |
| Diversify economy - soften market cycle | Drive income down from current crops |
| Create raw materials that also create oxygen as byproducts | Is this as efficient as trees? |
| Technology usable for space exploration (closed cycle systems) | |
| Relatively few resources have been devoted to industrial ag products | If it was feasible economically, it would have been done |
| Filling a political need to deal with low ag commodity prices | If farm prices increased, we would not need new uses |
Within last 10 yr, there has been a quantum jump based on biology rather than engineering—genetic engineering (need to develop technology in USA) 

In past, we did world development; therefore, in 20 years, we will be importing agricultural commodities

Value added work to be accomplished and benefited by USA 

Developing countries will produce agricultural commodities; therefore, USA should be into manufacturing and marketing

See Appendix II for individual responses.

The essence of strategic planning is to "do the right thing" as opposed to "doing things right". In order to determine what the "right things" are, the group was asked to identify impediments that must be overcome in order to create the success stories needed for broader commercialization of industrial agricultural products. The individual lists reported in Appendix III led to the group list of impediments shown in Table 3.

**Table 3**

**Impediments to Developing Industrial Uses of Agricultural Products**

**Group Responses**

Developing interest among researchers.

Multiple sources of research with little coordination.

Resources for sustainable programs ($).

Resource availability for pilot plant operations.

Non-crisis projects.

Lack of expertise/willingness to invest time in development (universities).

Organization of project teams and lack of research cooperation.

Aversion to risk/sharing risk

Poor identification of market focus and market needs.

Lack of cooperation of researchers.

Fear of technology flight.

Funding priorities are in other areas.

Short term business attitude.
<table>
<thead>
<tr>
<th>Protection of intellectual property.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funding of technology transfer strategies (industry penetration).</td>
</tr>
<tr>
<td>Process gap between public sector development and private sector utilization.</td>
</tr>
<tr>
<td>No community (critical mass) of industry, academic and government.</td>
</tr>
<tr>
<td>Requires a change in status quo.</td>
</tr>
<tr>
<td>No clear mission, goals, objectives.</td>
</tr>
<tr>
<td>Educational process not producing appropriate investigators.</td>
</tr>
<tr>
<td>Inadequate reward system for involved scientists.</td>
</tr>
<tr>
<td>Many obvious small opportunities, but no large success story.</td>
</tr>
<tr>
<td>Fear of water availability for sustaining agriculture.</td>
</tr>
<tr>
<td>Insufficient communication/coordination from concept, technology, marketing, production (no organized exploitation).</td>
</tr>
<tr>
<td>Public need for short term gratification.</td>
</tr>
<tr>
<td>Regulatory and product liability limitations; also, political liabilities.</td>
</tr>
<tr>
<td>Modelling cannot occur without basic facts.</td>
</tr>
<tr>
<td>Who pays/who benefits.</td>
</tr>
<tr>
<td>Commodity (feedstock) prices/feedstock costs conflict.</td>
</tr>
<tr>
<td>Conflicting goals among agricultural producer, industrial, government and university interest groups.</td>
</tr>
<tr>
<td>Desire for immediate fix for long term problems.</td>
</tr>
<tr>
<td>Economics and technology of alternative sources may be more favorable.</td>
</tr>
<tr>
<td>Public perception of lack of research needs.</td>
</tr>
<tr>
<td>Political opposition by special interest groups.</td>
</tr>
<tr>
<td>Little understanding of comparative economics.</td>
</tr>
<tr>
<td>Lack of confidence in &quot;experts&quot;.</td>
</tr>
<tr>
<td>Complexity of product mix/may not be compatible.</td>
</tr>
<tr>
<td>Perception that policies is driven by those with little knowledge of the items in question.</td>
</tr>
<tr>
<td>Identification of individuals with pertinent ideas (modern day Edisons).</td>
</tr>
<tr>
<td>Unfulfilled premature promises/unrealistic expectations.</td>
</tr>
<tr>
<td>Looking for the &quot;miracle&quot; rather than stepwise advances.</td>
</tr>
<tr>
<td>Bulk density vs economy of scale.</td>
</tr>
<tr>
<td>U.S. is supplier of last resort.</td>
</tr>
</tbody>
</table>
Biomedical science means little to a generation raised on prevention rather than immunization campaigns.

Lack of understanding that models can be designed only subsequent to acquisition of basic facts.

"See Appendix III for individual responses.

After some discussion and a multi-vote prioritization, four issues surfaced as the most important. The four issues are:

- No clear statement of mission, goals, objectives (for commercialization of industrial agricultural products).
- Required funding resources for sustainable programs.
- Poor identification of potential markets, needs, etc.
- Insufficient communication/coordination among sectors from concept to commercialization.

The participants were divided into four discussion groups. Each group was to deal with a single issue. The groups’ findings are summarized in Tables 4, 5, 6 and 7.

Table 4
Issue: No Clear Statement of Mission, Goals and Objectives

<table>
<thead>
<tr>
<th>Group</th>
<th>Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td>Richard Nelson, Rex German, Mike Tumbleson</td>
</tr>
</tbody>
</table>

Q: Why are mission statements an impediment to success?
A: Lack of (1) focus, (2) strategy, and (3) accountability.

Solutions:

1. Identify achievable objectives
2. Develop strategy/work plan and specify time frame
3. Always (1) identify responsibilities (2) establish costs (3) project time frames (4) specify performance criteria
4. Develop "mission statement" as needed to accomplish objectives and obtain funding.

Discussion:

Players
RD&D Info (NEED) Goals
Limitations

Short term
Who identifies need
What do we have to know; what is missing
How to maintain basic research base

Table 5
Securing Resources for Sustainable Programs ($)

<table>
<thead>
<tr>
<th>Group</th>
<th>Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two</td>
<td>Joe Roetheli, Mort Rutenberg, Matt Wallig</td>
</tr>
</tbody>
</table>

Support for AARC (FY 92; FY 93; future)
(Alternative Agricultural Research and Communication)
Regional Approach
Multiorganizational Participation (Federal, State, University, Private)
Research and Development
Commercialization Assistance

Show a Few "WINNERS"
R&D Support from Commodity Support Program
Encourage Coordination of Check-Off Funds
Broader Awareness of Current RD&D (to encourage funding)
For Industry to Invest in University Studies:
   Specific objectives
   Time table
   Cost
   Confidentiality statement
   Relevant to business structure
   Potential for return
   Small companies have little margin for risk
### How Do We Identify Market Needs

<table>
<thead>
<tr>
<th>Group</th>
<th>Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three</td>
<td>Alan Gould, Ray Burns, Milford Hanna</td>
</tr>
</tbody>
</table>

#### Customer Groups

1. Crop/animal producers
2. Intermediate processor
3. "True" end user

**Target customers - dialogue - financial analysis**

<table>
<thead>
<tr>
<th></th>
<th>Corn</th>
<th>Oil Seeds</th>
<th>Canola</th>
<th>Beef</th>
<th>New Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starch, CHO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fats/Oils</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Fibre</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Protein</td>
<td></td>
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<td></td>
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<tr>
<td>Natl Cmpds</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Dry Miller</th>
<th>Wet Miller</th>
<th>Crusher</th>
<th>Fermenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starch</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fats/Oils</td>
<td></td>
<td></td>
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<tr>
<td>Fibre</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Formulator</th>
<th>Converter</th>
<th>Fermenter</th>
<th>Printer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starch</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fats/Oils</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Fibre</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

"Models are Built on Facts"

Who should build the matrix
Public sector activity
As diverse as possible
Discussion:

Dow is a technology/research driven company
X is not a research based company that is high volume and low technology
Companies who are not willing to invest in research generally gain from small increments because of high volume
With respect to end user, find an individual who is well versed and an expert in the field because looking for industry rather than company problems; also, need an individual who is well versed in the agricultural commodity and/or product and what can (has) been done

Table 7
Insufficient Communication/Coordination Among Sectors
From Concept to Commercialization

<table>
<thead>
<tr>
<th>Group</th>
<th>Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>Four</td>
<td>Renee Sayler, Dennis Olson, Needham Carswell, Ron Belyea</td>
</tr>
</tbody>
</table>

1. People to People Contact
2. Facilitation by Universities
3. Credibility with Industry
4. Team Efforts
   a. Within universities
   b. among government, industry and universities
5. Long Range Plan Among Industries and Universities
6. Must Understand Pay Off for All Parties Involved

Discussion: Need focused long range plan for coordination and communication.

As a means of summarizing the day’s work, the participants were again asked to consider the question "How do we pick/create a winner?" The individual responses are given in Table Appendix IV. The group discussion is summarized in Table 8.
Table 8
How do we pick a winner?
Group Responses*

<table>
<thead>
<tr>
<th>Need a dreamer, doer and a banker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lock them in until they agree on objectives, strategy and time frame</td>
</tr>
<tr>
<td>Develop understanding on industry needs</td>
</tr>
<tr>
<td>Develop teams within universities</td>
</tr>
<tr>
<td>Develop industry consortiums for funding of generic research endeavors</td>
</tr>
<tr>
<td>Identify contacts within universities, industry and government</td>
</tr>
<tr>
<td>Organize consortiums</td>
</tr>
<tr>
<td>Synchronize basic research, marketing, economic evaluation, process development</td>
</tr>
<tr>
<td>Focus on products from which academic and industrial expertise is available</td>
</tr>
<tr>
<td>Communication team should be a high priority</td>
</tr>
</tbody>
</table>

A six step process:
- Date to be set that facilitators would entertain proposals to be prioritized to the three top entries
- Reduce projects to two projects
- Propose best implementation plan for the two projects
- Identify the people to implement the project
- Eliminate one project so only one left
- Set time table to completion of the project
- Determine financial profitability from a market standpoint
  - Prime target would be 3 to 5 year study
  - Dog and pony show
- Need profitable and fairly large in volume (using feedstock and creating jobs)
- Once understanding of particular needs is developed, determine if there is a possible fit with basic research
- Match properties and functionality with commercial needs
- Go to current process and find a waste product and find ways to modify by physical, chemical or biological process
- Encourage technology transfer
- Study technology which has been mandated politically
- Work with visionary partners
- Establish groups that complement existing group

*See Appendix IV for individual responses.

The consistent theme in the responses to picking a winner was that the product/market is the focal point for organizing an effort. The consensus was that specific, tangible goals, rather than broad initiatives are the strategy to developing successes. There may be a number of participants from different sectors, but there has to be a common goal and all have to obtain a benefit from the effort.
The was a consensus that there should be a follow-up session which would be organized by commodity resource. The goal of the meeting would then be to focus on those products producible from a specific resource that have the greatest likelihood of commercial success. The strategic planning can then be directed towards identifying strengths to build upon, impediments to overcome, and strategies to do so. Tentatively, this follow-up meeting will be held in Lincoln on January 16, 1992.

Acknowledgements

I wish to acknowledge the support of the USDA-CSRS Office of Industrial Agricultural Products, and specifically, Deputy Director Paul O'Connell and Program Manager Joe Roetheli, for their push to engage the University of Nebraska Industrial Agricultural Products Center in this effort and their financial support. The participants are one of the most capable and cooperative groups imaginable. Finally, the support of the UNL-IAPC, Milford Hanna, Director, Renee Sayler, Market Analyst and Jean Kolar, Secretary, is deeply appreciated.
Great Plains Strategic Planning Consortium

Facilitator’s Report of the Meeting
January 15 and 16, 1992
Lincoln, Nebraska

Submitted by

Renee Sayler
Industrial Agricultural Products Center
University of Nebraska-Lincoln

April 24, 1992
Facilitator’s Report

On September 12, 1991 the Great Plains Strategic Planning Consortium (Appendix I lists participants) gathered to assist the Industrial Agricultural Products Center at the University of Nebraska-Lincoln in their effort to determine the strategic focus of their program. The results of this meeting set a framework for identifying specific projects with potential for increasing the use of Great Plains agricultural resources to meet industrial product needs.

As a continuation of process that began in September, a second meeting was held January 15th and 16th, 1992 to identify specific projects in which the Industrial Agricultural Products Center would participate. The group involved in this phase of planning was composed of individuals from private industry, academia and government with experience in the technical, economic/marketing and regulatory issues. Appendix II identifies the participants.

The meeting began with a review of AARC legislation and USDA activities by Joseph Roetheli, USDA-CSRS Program Manager for Industrial Oilseeds. A summary of agricultural resources available in Nebraska and of industrial use activities was provided by the facilitator. With this background, two teams of participants were formed. One team would address the area of proteins, vegetable oils and animal fats. The other would address the area of cellulosic biomass and starch or carbohydrates. Both teams consisted of a balance of technical, economic/marketing and government policy expertise. Appendix III documents the team membership.

The first task for each team was a brainstorming session to identify potential products for their respective areas of interest. Table 1 is a list of the general ideas derived by the teams.
<table>
<thead>
<tr>
<th>Biomass</th>
<th>Starch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prosthetics</td>
<td>Sugars</td>
</tr>
<tr>
<td>Pharmaceutical Carrier Agents</td>
<td>-nutritional flavors or fragrances</td>
</tr>
<tr>
<td>Bandages</td>
<td>Alcohol Fuels</td>
</tr>
<tr>
<td>Adsorbents</td>
<td>Ethylene</td>
</tr>
<tr>
<td>Absorbents</td>
<td>Organic acids for coating fruits and vegetables</td>
</tr>
<tr>
<td>Filters</td>
<td>Butanol</td>
</tr>
<tr>
<td>Construction Products</td>
<td>Acetone</td>
</tr>
<tr>
<td>-particleboard</td>
<td>Methane</td>
</tr>
<tr>
<td>-acoustic tile</td>
<td>CO₂-secondary recovery of oil from oil fields</td>
</tr>
<tr>
<td>-insulation</td>
<td>Baby Powder</td>
</tr>
<tr>
<td>-dimensional lumber</td>
<td>Paper</td>
</tr>
<tr>
<td>Paper/cardboard</td>
<td>Adhesives</td>
</tr>
<tr>
<td>Adhesives (lignin-based)</td>
<td>Biodegradable Plastics</td>
</tr>
<tr>
<td>Food Ingredients</td>
<td>CMA De-icer</td>
</tr>
<tr>
<td>Alcohol</td>
<td>Thermally Molded Plastics</td>
</tr>
<tr>
<td>Organic Acids</td>
<td>-automotive parts</td>
</tr>
<tr>
<td>Fuels (direct combustion)</td>
<td>Wire Insulation</td>
</tr>
<tr>
<td>Degradable Plastics</td>
<td>Encapsulating Agents</td>
</tr>
<tr>
<td>Textile fibers</td>
<td>Feed Additives from Fermentation</td>
</tr>
<tr>
<td>Packaging</td>
<td>Binding Agents (iron ore/charcoal)</td>
</tr>
<tr>
<td>Thickeners</td>
<td></td>
</tr>
<tr>
<td>Synthetic Rubber/Elastomers</td>
<td></td>
</tr>
</tbody>
</table>

**Proteins**

| Paper Products | Vegetable Oils and Animal Fats |
| Baking Products | Biofuels/biodiesel |
| -caseinates | Crude Oil Substitutes |
| -fat replacers/substitutes | Petrochemical Raw Material |
| -fibers from protein extrusion | Substitute |
| Biopharmaceuticals | Plastics/Plastic Substitutes |
| Allelochemicals | Polymers and Racemic Mixtures via Genetic Modification of Oil |
| Rubber and Natural Latex (genetic manipulation of plants) | Coatings - Reactive Diluents |
| Glues/Adhesives | |
| Rescue Waste Proteins from Processing Streams for Feeds Using Waste Protein Dehydration | |
| Plastics from Soy Isolates | |
| Perfume from Brassylic Acid | |
| Fuel Additives | |
| Food Grade Lubricants | |
| Whale Oil Substitutes | |
| Pelargonic Acid | |
Once general ideas for potential products were generated, the teams were asked to go back and broadly categorize their products. Then for each category, the teams were asked to identify the technical, economic/market and governmental opportunities and obstacles for product development. Table 2 documents the categories for each group. Table 3 through 12 document the opportunities and obstacles facing product development for each category.

Table 2
Product Categories

<table>
<thead>
<tr>
<th>Biomass and Carbohydrates</th>
<th>Fats, Oils and Proteins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petrochemical Substitutes</td>
<td>Protein Modifications for Food Additives</td>
</tr>
<tr>
<td>Biodegradables</td>
<td>Health Products</td>
</tr>
<tr>
<td>Structural Components</td>
<td>Biodiesels</td>
</tr>
<tr>
<td>Alcohol Fuels</td>
<td>New Crops</td>
</tr>
</tbody>
</table>

Table 3
Petrochemical Substitutes
(includes high value added products/plastics)

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Obstacles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential for high value-added products</td>
<td>Cost of processing</td>
</tr>
<tr>
<td>Raw materials in good supply</td>
<td>High scale-up costs</td>
</tr>
<tr>
<td>Large market</td>
<td>Process economics</td>
</tr>
<tr>
<td>Functionality of existing, renewable molecules, lots of carbon</td>
<td>Competition from established industries</td>
</tr>
<tr>
<td>National security</td>
<td>Many unidentified product uses/properties</td>
</tr>
<tr>
<td>Replace imported materials/balance of trade</td>
<td>Resistance to use of agricultural oils as chemistry is different from petroleum, tradition vs change, training issues</td>
</tr>
<tr>
<td>Environmentally friendly cradle to grave</td>
<td>US agricultural policy of price supports</td>
</tr>
<tr>
<td>Revitalization of rural America</td>
<td>US cheap oil policy</td>
</tr>
</tbody>
</table>

Table 4
Throw-Aways or Biodegradables

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Obstacles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce landfill</td>
<td>Identification of physical properties</td>
</tr>
<tr>
<td>Reduce litter</td>
<td>Performance and characterization of end-products</td>
</tr>
<tr>
<td>Social pressure</td>
<td>EPA/FDA regulations</td>
</tr>
<tr>
<td>Improved performance</td>
<td>Food safety</td>
</tr>
</tbody>
</table>
### Table 5
**Structural Components**

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Obstacles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social pressure from consumer</td>
<td>Cost of alternative material</td>
</tr>
<tr>
<td>Supply of traditional materials</td>
<td>Lack of focus in development efforts</td>
</tr>
<tr>
<td>Refurbish existing infrastructure-buildings</td>
<td>Manufacturing capacity</td>
</tr>
<tr>
<td>Affordable housing</td>
<td>New vs traditional building practices</td>
</tr>
<tr>
<td>Acoustical materials</td>
<td>Resistance to change</td>
</tr>
<tr>
<td></td>
<td>Trade unions</td>
</tr>
</tbody>
</table>

### Table 6
**Alcohol Fuels**

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Obstacles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government Regulation-Clean Air Act</td>
<td>Competition from petrochemical industry</td>
</tr>
<tr>
<td>Large market</td>
<td>CO₂ utilization</td>
</tr>
<tr>
<td>CO₂ utilization</td>
<td>Processing time/efficiency</td>
</tr>
<tr>
<td>Raw material availability</td>
<td>Raw material treatment costs</td>
</tr>
<tr>
<td></td>
<td>Co-product market dependence</td>
</tr>
</tbody>
</table>

### Table 7
**Protein Modification for Food Additives**

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Obstacles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Import substitution</td>
<td>Government policy</td>
</tr>
<tr>
<td>Environmentally sound cradle to grave</td>
<td>International policy of ag subsidies</td>
</tr>
<tr>
<td>Low-fat substitute consumer demand</td>
<td>Lack of processing infrastructure</td>
</tr>
<tr>
<td>Technology (partly in existence)</td>
<td>(need to build big plants)</td>
</tr>
<tr>
<td>Sufficient supply</td>
<td>Economics (high initial investment with</td>
</tr>
<tr>
<td>Favorable siting for rural areas</td>
<td>little availability of venture capital)</td>
</tr>
</tbody>
</table>

### Table 8
**Health Products**

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Obstacles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease of marketing</td>
<td>Product liability costs</td>
</tr>
<tr>
<td>Little price sensitivity</td>
<td>Regulatory/licensing costs of development</td>
</tr>
<tr>
<td>Need for waste reduction</td>
<td>Corporate desire for keeping low profile</td>
</tr>
<tr>
<td>Demand growth with aging population</td>
<td></td>
</tr>
<tr>
<td>Rural revitalization compatibility</td>
<td></td>
</tr>
</tbody>
</table>
Table 9
Biodiesels

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Obstacles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large volume</td>
<td>Current petroleum oil prices too low</td>
</tr>
<tr>
<td>Would improve trade balance</td>
<td>Government commitment</td>
</tr>
<tr>
<td>Air quality regulations</td>
<td>Viability as blends</td>
</tr>
<tr>
<td>Basic technology exists</td>
<td>Distribution facilities</td>
</tr>
<tr>
<td>Renewable energy resource</td>
<td>Crop yield variability/insecure supply</td>
</tr>
<tr>
<td>Raw materials available</td>
<td></td>
</tr>
</tbody>
</table>

Table 10
Products from Alternative Crops

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Obstacles</th>
</tr>
</thead>
<tbody>
<tr>
<td>High value-added</td>
<td>Need to identify uses</td>
</tr>
<tr>
<td>High functionality</td>
<td>Government programs tend to hinder rather than promote production</td>
</tr>
<tr>
<td>Utilization of idle acres</td>
<td>High R&amp;D costs</td>
</tr>
<tr>
<td></td>
<td>Limited supply/acreage for some crops</td>
</tr>
<tr>
<td></td>
<td>Lack of infrastructure for production and processing</td>
</tr>
<tr>
<td></td>
<td>Time, technology and money to develop uses</td>
</tr>
</tbody>
</table>

The two teams convened and discussed at length the issues facing product development in the identified categories. From the discussion a number of viable projects were identified:

- Biodegradables/Throw-aways
- Fermentation technologies to improve more efficient use of cellulosic substrates and CO₂ utilization
- Conduct engineering economic assessment of integrated ethanol/feedlot, e.g. Garden City study
- Use of animal fats as feedstock for biodiesels including emission and fungibility issues
- Promote the value of crambe meal protein for cattle feeding to improve the economics of using crambe as an industrial oil
- Develop alternative technologies for environmentally sound tanning of hides
- Improve useability of proteins at all stages of processing, particularly waste streams and paunch
- Develop first derivative, value-added products from oils and proteins:
  - polymers, lubricants, glues, fat substitutes, diesel fuels, calf milk replacers
• Develop higher value proteins from genetically engineered plants for nutritional needs and industrial products
• Identify specific limitations to explain impediments to commercialization (technical, infrastructure, market)
• Identify and foster development of partnerships between academia, industry and government including maintenance of a database of industrial uses of agricultural resources

The teams unanimously agreed that the Industrial Agricultural Products Center should adopt as goals the last two items on the above list, and they agreed that to focus on all of the other items would be beyond the resources available to the Center. Thus, participants were asked to select the four projects which they believe would be most important for the Industrial Agricultural Products to focus their attention. The results of the vote were as follows:

1. Use of animal fats as feedstock for biodiesels including emission and fungibility issues
2. Fermentation technologies to improve more efficient use of cellulosic substrates and CO₂ utilization
3. Biodegradables/Throw-aways

The development of biodiesels from animal fats was a distant winner with 20 votes, followed by improving the efficiency of fermentation focusing on end-product recovery with 10 votes and biodegradables/throw-aways with eight votes. There was additional discussion regarding methods to advance these projects, appropriate time frames for measuring progress and oversight responsibilities. The meeting ended with a consensus that annual or biannual strategic planning meetings would be of value to the participants of this meeting and a general agreement to keep one another informed of future activities.

Acknowledgements

I wish to acknowledge the support of the USDA-CSRS Office of Industrial Agricultural Products and specifically Deputy Director Paul O'Connell and Program Manager Joseph Roetheli for their encouragement and financial support in convening the Great Plains Consortium. The support and experience of L. Davis Clements, University of Nebraska, who provided the meeting structure is also appreciated. A special thanks to Mike Tumbleson from the University of Illinois who diligently kept notes during the September and January meetings. Finally, to all the participants who candidly shared with us their wisdom, our sincere thanks.
Industrial Agricultural Products Center

Developing innovative uses for agricultural resources.

University of Nebraska Lincoln
The Industrial Agricultural Products Center is working to develop both alcohol and biodiesel fuels which will burn cleaner, producing fewer emissions than similar products currently available in the marketplace.

Additionally, our researchers are designing new processes using agriculturally-based raw materials. Our goal is to significantly reduce the costs of producing biofuels.

Our alcohol fuel researchers are testing new methods for preparing corn, sorghum and other biomass for fermentation. We are also looking for ways to increase alcohol production efficiency, and improve methods of separation.

Our personnel also work with organizations throughout the midwest and across the Great Plains to share information and coordinate research efforts.

PLASTICS RESEARCH

The plastics industry is under increasing pressure to create products that are more environmentally friendly, and IAPe plastics research is designed to assist in meeting that goal. We are working in three areas of plastics research: foams, films and their degradation properties.

Foams

IAPe researchers have developed an extruded foam plastic that is 75 percent “plastic-free.” Composed mostly of cornstarch, this “biofoam” is water resistant, and looks and feels like polystyrene. However, unlike polystyrene, it is 75 percent degradable.

Researchers have created loose fill “packing peanuts” that provide the same package protection during shipping as polystyrene-based peanuts. The process, which also has the potential for molded foam applications, is now ready for adoption by a company that would like to produce packaging materials which are more environmentally-friendly.

The biofoam formula is also being tested using expandable-bead molding technology to produce more biodegradable items such as packing carton inserts, ice chests and hot drink cups.

Films

IAPe personnel are beginning to explore the potential uses of soybean, wheat and sorghum proteins in the production of packaging and coating films.

While these projects are in very early development stages, our goal is to develop readily compostable films for both food packaging and industrial applications.

Potential uses for these biofilms might include clothing bags used by department stores and dry cleaners, compostable garbage bags, grocery store vegetable bags and bubble plastic packaging material.

Degradation Studies

The IAPe is conducting composting studies on plastic garbage bags advertised as degradable. Results of a multi-year study indicate no significant reduction in film strength properties at the end of a three-year period.
Industrial Agricultural Products Center

University of Nebraska-Lincoln

Discovering industrial uses for Nebraska's agricultural products
Industrial Agricultural Products Center

For generations, Nebraskans have helped provide the nation with bountiful harvests of quality agricultural commodities. These were mainly used for human and livestock consumption, most of which were shipped out of state for processing. In today's agricultural market, high production isn't enough to guarantee economic success. New uses and new markets are needed. The University of Nebraska Board of Regents approved the establishment of the Industrial Agricultural Products Center on May 6, 1988 to research and develop industrial uses for agricultural commodities.

The objectives of the Center are:

1. To broaden Nebraska's and the nation's industrial and commercial base through new applications of agricultural commodities.
2. To identify which products derived from agricultural commodities have the greatest chance for commercial success.
3. To solve technical problems in production and raw material conversion.
4. To provide technical, marketing, and business assistance to farmers, entrepreneurs, and people in commerce and industry.

Dr. Milford Hanna and Dr. Rangaswamy Chinnaswamy work on an extrusion process to produce starch-based plastic foams and films.
The Center's Role

The Industrial Agricultural Products Center is finding new ways to produce and market non-food agricultural products in industry. It is a working partnership of agriculture, industry, science, business, engineering, technology and government. Through basic and applied research, the Center is finding new uses for existing crops and new crops which can be profitably grown in Nebraska. As a unit of the University of Nebraska-Lincoln, the Center includes faculty from the Departments of Agricultural Engineering, Food Science and Technology, Chemical Engineering, Chemistry, Agronomy, and the School of Biological Sciences. Its scientists study the basic properties of grains and other materials to learn how they can be better used in new or existing products. Through research, testing, pilot plant production and marketing studies, the Center can make it less risky for business and industry to adapt new technologies. Services can be strictly proprietary or in the public domain, according to need.

Dr. Michael Meagher and Dr. Khem Shahani discuss the analysis of a fermentation process. They are working to develop cost effective technologies to produce chemicals such as ethanol and lactic acid from agricultural products.
The Center provides aid for all steps of product development from basic research to identify the specific properties of a product or the specific processes to isolate or produce a product to market analysis and production. Experts work through five program areas to identify potential products and solve technical, business and marketing problems. There is extensive interaction between program elements and various disciplines, allowing teamwork to help overcome hurdles.

**Market Analysis**

Directed research will help determine market potential and develop marketing strategies for new non-food products and processes. Market analysis usually will be in one of two categories, each of which requires different research and planning steps. In one case, products will be developed to compete with those already on the market, and in the other case, a marketing analysis is needed for an entirely new product.

Dr. L. Davis Clements is studying the leachate from a lawn waste composting project involving biodegradable trash bags. He also is evaluating the properties of vegetable oils as needed in industrial applications.
Crop Adaptation and Improvement Program

This program identifies new crops and ways to improve existing crops which have the most potential for conversion to profitable non-food products. Scientists are studying specific properties of individual seeds, grains, and other crop materials to learn how they can be better used. Most chemicals currently used by industry come from petroleum; however, many of these chemicals also can be produced from plants that are now grown or may be grown in Nebraska.

Resource Conversion Program

This program focuses on improving existing methods and developing new methods of producing end products from Nebraska crops. In the past decade, important advances have been made in converting plant material into fuels. The Center is concentrating its research on the production of industrial chemicals from plant material by purification of natural products, chemical conversions and biological conversion.

Pilot Plant Facilities

A centralized pilot plant on the University of Nebraska-Lincoln campus or immediate vicinity could serve as the key to Center operations. By testing the commercial feasibility of new products and conversion processes, it will offer proof that laboratory technologies can be transformed into larger scale, commercial production. Decentralized pilot plant facilities are available in the areas of extrusion, fermentation, drying, distillation and extraction, separations, pyrolysis/gasification, filtration and centrifugation.

Technology and Information Transfer Program

This division works to transfer the Center's product ideas and practices to the private sector. It provides information on commercial opportunities, new products, updated methods and conversion processes through seminars and technical demonstrations. It also will provide help for product and process licensing.
The Center works with people from a variety of backgrounds — from the person next door who suggests a new use for biodegradable plastics to farmers, scientists, entrepreneurs and representatives of business and industry who want to explore new products and markets. Projects are initiated from four main sources:

Center-sponsored projects are designed to answer specific technical or marketing problems concerning products which have a high potential for commercial success, but require considerable development. These projects will result from long range plans to develop and promote products most likely to significantly strengthen Nebraska's economy.

Client-fostered projects are generated by individuals, laboratories, or companies who bring ideas to the Center for joint development.

Contract work is conducted for specific projects funded by outside businesses, individuals, commodity groups and government agencies.

Center-fostered projects are proposed by state educational institutions and government agencies, such as the Department of Agriculture or State Energy Office.

Dr. Milford Hanna and Robin Hilton evaluate the capability of an oil expeller to process crambe, an industrial oilseed.
The Industrial Agricultural Products Center is providing practical solutions to help Nebraska's agricultural base become a more important part of the nation's chemical and plastics industry. It provides the expertise, facilities and experience to help turn ideas into new products and technologies. Its broad range of resources allow it to tailor-make a program for the individual client.

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Dr. Tyrrell Conway is genetically engineering bacteria to improve the ethanol production process.