

# AGRICULTURE INFORMATION SYSTEMS FOR THE BEET SUGAR INDUSTRY

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## ABSTRACT

Today, collecting accurate information from growers and delivering meaningful reports is more important than ever for companies in the sugar industry. Near real-time data collection and reporting provides competitive advantage and improves value-added services for sugar companies and their growers. The challenge in the past has been collecting accurate information in a timely and complete fashion so that assessments could be passed onward to growers. Newer computerized technologies and widespread use of the Internet now allows companies to produce agriculture information systems that positively impact production and quality and add value to existing services. Discussed and shown will be some of the technology employed by AgTerra Technologies, Inc. being used in the sugar industry including Internet based forms and reports, Geographic Information Systems (GIS), Pocket PC, and digital pen and paper applications.

**Additional keywords:** Information technology, Internet, Extranet, Geographic Information Systems, GIS, remote imagery, crop reporting, harvest management, agriculture information systems, computer hardware and software, database systems, communication systems, online message boards, digital pen and paper.

## Introduction

Agriculture information and communication systems are fundamental to efficient and competitive beet sugar production and quality. While methods employed vary among North American based companies, agriculture information systems are helping to generate added value and competitive advantage within the industry. This paper reviews developments in technology which are contributing to improvements in beet sugar production, in terms of effective crop production procedures. The technical systems by which data is being acquired, applied and communicated are reviewed.

This paper is not designed to provide an exhaustive review of the technologies being used, or that are available, but rather to provide the reader with an applications overview of how the technology is being implemented today. Furthermore, the paper focuses on typical solutions used at the enterprise agribusiness level rather than on field based precision farming technologies.

## Discussion

The greatest opportunity for crop production improvement in the near future will not arise from bigger equipment, but from the smarter use of agriculture technology to derive the greatest value possible from existing resources.

Technology making this possible and feasible today include greater availability and ease of use of the Internet, powerful software applications, improvement in Geographic Information Systems (GIS) software, more accurate GPS systems, low cost and availability of Pocket PC and mobile phone devices, and automated systems for farm machinery including variable rate applicators and automatic steering systems.

In addition to technology advances, decision makers need to see the big picture for evaluation and planning purposes. This requires that information systems are able to translate data to easily understandable charts, graphs, maps and pictures, to show the trends and correlations clearly, leading to intelligent and timely decision making.

At the field level, accurate data collection and effective dissemination methods provide the foundation to derive value from agriculture technology. Crop scouts desire to work more effectively at collecting data while growers desire the information necessary to help reduce risk and meet requirements for government programs, insurers and crop lenders. Better communication, provided through agriculture technologies, involving researchers, growers, field personnel, factory operators and industry suppliers help disseminate knowledge to field level production.

### **Technologies**

Multiple technical systems are available for consideration when deploying agriculture technologies tailored toward the agribusiness needs and objectives. Table 1 lists different technologies employed in the sugar industry today and some of the advantages and disadvantages that currently exist with each technology. Sugar companies must assess internal business practices when deciding which technology, or combination of technologies, best match their needs and internal environment.

<b><i>Technical System/Solution</i></b>	<b><i>Advantages</i></b>	<b><i>Disadvantages</i></b>
<b>Web Based Data Collection/Reporting Systems</b>	Easy way to network 24 hours a day; web browsers are used by nearly everyone.	Driving users to a particular website on a regular basis may be difficult.
<b>Access to Digital Data</b>	Greater availability of spatial and tabular data including remote imagery and meteorological information empowers existing database systems.	Data sources are not usually unified in data structure and format. The data may be costly; especially for near-real time and real time data.
<b>GPS Systems</b>	Multiple vendors and platforms; GPS chipsets are more accurate than ever.	Submeter accuracy requires more expensive differential correction.
<b>GIS Software</b>	Basemaps easy to build; spatial analysis leads to crop and pest modeling; ortho imagery analysis.	Advanced functionality requires dedicated user or greater training.

Tablet PC/ Notebook Systems	Mobile computing in the field. Full power of desktop operating systems.	Relatively fragile and expensive units.
Pocket PC/ Mobile Phone Systems	Lower cost computing power; may be linked to GPS and Internet.	Small display; limited toolset may be troublesome for users.
Desktop Based Software Systems	May be more powerful and capable than mobile or Internet based systems.	Usually requires redundant data entry from field based forms; difficult to redistribute.
Digital Pen and Paper Solutions	Eliminates redundant data entry from field based forms. Intuitive method for data collection in multiple environmental conditions.	Cannot link up with GPS. Handwriting recognition not the same for all individuals.
RFID/Smart Tags	Electronic tagging system allows efficient collection of digital data.	Reading accuracy may be affected by metal and proximity of the detector to the RFID chip.
In-the-Field Data Collection Units	Low cost and able to transmit data electronically. Available for multiple weather parameters.	Networking weather stations for real-time data collection on an area wide basis may be cost prohibitive.

*Table 1: Agriculture Technologies in Use Today; Advantages and Disadvantages*

### **Applications in the Sugar Industry**

Agricultural technology is being deployed within the agribusiness and throughout the supply chain to help make wise use of existing resources. At the same time, these agriculture information systems add value to technology products and services and thereby provide competitive advantage. The way agriculture technology is used varies among sugar companies. But, all companies have a primary goal of improving communication and providing information faster than ever before to support problem solving and decision-making in a more timely fashion. Most agricultural activities require the ability for any user in the field to easily interact with an enterprise system. Field level access allows users to search and retrieve data from contracting, crop records, harvest management, payment, and accounting systems. Some examples of how the technology described in Table 1 is specifically being put to use in the sugar industry are described below.

### **Contracting and Shareholder Management**

1. *Contract management:* Agribusinesses are using technology to help manage basic grower and landlord information, contact and contract related information. Some

of these technologies include desktop and web based software as well as digital pen and paper technologies that collect basic information and signatures.

2. *Field information*: Some pertinent information being collected into agriculture information systems include planted and adjusted acres, permanent field information, conservation enrollment, etc. This information is ultimately used to guide such essential activities as production forecasts, harvest deliveries, and payment programs.
3. *Land use inventories*: Crop pests and diseases present significant challenges in beet sugar production. Recording prior field history and crop rotation related information helps the agribusiness facilitate wise management decisions for pest and diseases over a large number of acres.

### **Crop Production Records**

1. *Web based information collection and dissemination*: The Internet greatly facilitates the collection and redistribution of grower production information, grower reports and internal reports. Often, the information and reports are collected and redistributed usually based upon user permissions. This helps the agribusiness effectively deliver customized reports to the end user.
2. *Mapping applications*: Geographic Information System (GIS) software is providing an effective way to link data to maps and remote imagery. Typically data from a field is linked to a GPS (global positioning system) or digitized boundary based upon high resolution imagery. GPS data combined with GIS is also being used to plot the distribution of weed, pest and diseases and locate and delineate differences in crop condition. This helps the agribusiness and growers meet objectives such as assuring proper crop rotation. GIS technology also helps quantify crop production challenges that can then be modeled to minimize impacts from diseases and pests such as nematodes.
3. *Third party data sources*: Data from third parties can greatly enhance the capabilities of an organization's database. For instance, USDA-NRCS soil data and outside laboratory data may be linked with production parameters to understand relationships of production to soil type, salinity, pH, organic matter and more. Other USDA sources provide information including FSA common land unit boundaries and pest forecasting. Remote imagery also provides the agribusiness with visual information to help analyze production parameters.
4. *Mobile field data collection*: Mobile hardware devices such as notebook computers, pocket computers and mobile phones allow crop scouts to collect information (e.g. disease, pest information, disaster assessment) in a disconnected environment. The devices are linked to the main database system via instant wireless communications, or through manual syncing with a networked computer.
5. *Precision farming data*: Advances in agriculture technology at the precision farming level provide the enterprise-based agriculture information system with valuable site specific information. Site-specific data including soil sample information, electrical conductivity instruments and maps and data from fertilizer and chemical applications enhance modeling capabilities. Regional analysis and models are used to fine tune precision farming activities such as variable rate applications for seed, fertilizer, chemicals and more.



## Harvest Management

1. *Automated harvest management systems*: Automated scalehouse systems use automated weighing technology as well as Radio Frequency Identification (RFID) and barcodes to improve efficiency across the scale. In some cases cameras are being used to document loads. Automated technologies in the tare laboratories improve the analysis of beet samples for sugar and quality while automating reports. During storage, sensors help monitor the condition of beet piles and control automatic ventilation systems.
2. *Spatial related data*: Spatial analysis of remote imagery helps assess crop condition over wide areas. Spatial analysis algorithms help fine tune yield estimates and field observations. This enables beet sugar factories to better calculate harvest dates and prepare resources. Once sugar beets are piled, infrared imagery is used to examine beet pile condition for hot spots during storage.

## Value-Added Services

1. *Grower/ Shareholder portfolios*: Value adding existing services allows sugar companies to provide their growers/shareholders with information aimed at improving crop production and reducing risk in growing the crop. The knowledge based products reduce grower risk and help sugar companies maintain acreage bases. Grower/Shareholder portfolios provide users with pertinent documents related to field information including crop inputs, harvest reports, and maps.
2. *Grower tools*: Online calculators assist growers with everything from calibrating sprayers to calculating beet payments based upon what-if scenarios. Crop models that incorporate real time and climatological meteorological information into their algorithms aid growers in activities such as properly timing pesticide applications and managing irrigation.
3. *Staff resources*: Most beet sugar companies are requiring more from existing manpower. Mobile data access on remote devices and telecommunications are enabling staff to collect and communicate data more effectively and efficiently. Web based data collection systems reduce manpower previously needed for inputting data in databases while increasing the volume, accuracy and timeliness of the data collected. Smart reports are generated by these systems and automatically emailed or faxed to help manage crop production over large areas and acreage bases.
4. *Crop modeling*: Modeling pests, diseases and yield provide sugar companies with the ability to predict and act upon production challenges. The models combine information from agriculture information system databases, third party sources including universities, government agencies, and outside laboratories and consultants to provide a more integrated approach for determining insect and disease risk and crop cultural requirements. Often the results from these models are distributed in formats that may work with a grower's precision farming equipment and are built upon knowledge gained from the enterprise based agriculture information system.
5. *Identity preservation*: As genetically modified and other value added characteristics become more prominent, the need to track and preserve the identity

of these crops is paramount. Agriculture information systems are designed to match requirements for identity preservation and traceability.

### **Grower/Shareholder Communications**

1. *Extranets*: An extranet is a private and secure network that uses the Internet protocols and public telecommunication to securely share part of businesses' information with suppliers, partners, growers, or other businesses. These systems are being used in the sugar industry to deliver sugar beet related news feeds, automated emails, sponsored or subscription based products, production guides, blogs, online message boards and chat rooms, and harvest related reports to name a few examples.
2. *Web conferencing*: Often part of an Extranet, web conferencing is providing sugar companies with valuable communications that provide support and educate by feeding live or recorded videos, redistributing PowerPoint shows, helping growers market farm equipment, etc.

### **Implementation Challenges**

Several types of challenges limit a broader adoption of agriculture technologies: socio-economical, agronomical, and technological. Socio-economical barriers are principally costs and lack of skills. These include personnel training; hardware and software costs; grower acceptance; and logistics for implementation. Agronomical challenges within an agribusiness include access to basic information; ability to conduct adequate and timely data collection and scouting procedures; and availability of qualified agronomic services in-house. There are multiple technological barriers including those that relate to machinery, sensors; GPS devices; software; and remote sensing. These challenges and limitations must be addressed in the beginning since they dictate the systems and technology that will ultimately be employed by the sugar company.

Advances in computing technology and infrastructure are helping to make the use and distribution of information easier, cheaper and more robust. This reduces the level of skill and knowledge users must have to adapt existing and emerging technologies. But still, the amount of technology available can sometimes be an intimidating factor. An understanding of the available technologies, its benefits, and how they are best deployed meeting the requirements of the agribusiness enterprise must all be taken into account. Notwithstanding, the technology continues to advance at a very rapid rate and is likely to remain a key component for all sugar companies well into the future.

### **Conclusion**

Digital technologies are empowering agriculture information systems. These technologies offer a variety of potential benefits for the sugar industry including tools for contracting, crop production recordkeeping, harvest management, grower communications and adding value to existing services. All beet producing areas today have access to the Internet; many with high speed connections. This, combined with the fact that multiple data collection and communication technologies have become widely available in the last decade, provides beet sugar companies with powerful tools to impact the quality and production of sugar beets. Furthermore, these technologies are providing many companies with competitive advantages and the means to add value-added services

for growers without straining existing resources. Grower communication is being improved through convenient communication systems via the Internet and informational postings and news feeds via the web. Nevertheless, socio-economic, agronomic, and technological challenges exist to implementing agricultural technologies; the volume and advancement of the technology complicates the ability for a sugar company to match specific requirements and may delay implementation. In spite of these challenges, barriers are being progressively lifted and the adoption of these technologies will continue to be a significant component of agricultural information systems well into the future.