Lesson 1: Missouri Crops and Their Uses

Most of the world's food supply comes directly or indirectly from crops. Besides food, crops contribute to the production of clothing, household and industrial products, fertile soil, and cleaner air. Americans tend to take crop production for granted due to the endless supply of food and other products that are available and affordable. This is due in part to the United States having the world's best producers who use the most up-to-date technology. However, many people in the world still go hungry, barely receiving simple food resources from crops. With this realization, and the knowledge that the world population is continually increasing, efficient crop production is as important for Missouri producers as it is for the rest of the world. This lesson provides an introduction to Missouri crop production including a discussion of the major crops produced and their many uses.

Major Agricultural Crops in Missouri

The state of Missouri is blessed with fertile soil but has broad variations in climate and topography. Due to these variable conditions, everything from grapes, grain crops, hay, and pasture land for livestock production is produced in Missouri. Rich, productive soil in Missouri's northwest, central, northeast, and southeast regions is ideal for crop production; the hilly and wooded areas of the Ozarks provide pasture and favorable weather for growing vegetables and fruits. More than 20 agricultural crops are produced in Missouri. The major crops are soybeans, corn, grain sorghum (also called milo), wheat, hay, cotton, and rice. Additional high-yielding crops produced are tobacco, vegetables, and fruits.

Soybeans are the state's largest cash crop and is grown throughout the state except in the south central region. The 107 million bushels of soybeans produced in 1998 illustrate its economic value and popularity among the state's producers.

Corn and grain sorghum, which are grown throughout Missouri, are also raised in large amounts with a combined total of nearly 311.6 million bushels of grain harvested in 1998. In addition, 1 million tons of these two crops were cut for silage, an animal feed made from immature or green corn and grain sorghum plants.

Winter wheat is also grown statewide with 50 million bushels or more produced annually since 1986. Wheat prices in recent years have led to a reduction in acres planted, but yields per acre have increased enough to compensate for this change. With its unique ability to lay dormant during cold weather, winter wheat is often double-cropped (planted in the same growing season) with soybeans to increase profits for Missouri producers.

Hay is a very large feed crop and Missouri ranks first in hay production (excluding alfalfa) in the United States. It is grown all across the state with the largest production area in the central region.

Cotton and rice production occurs in the uplands in the southeast corner of the state, or "Bootheel." Cotton is also grown in the southwest region of Missouri. Both cotton and rice add millions of dollars to the state's economy each year.

Along with the major crops, the production of tobacco, vegetables, and fruits also provide important revenue to the state. Tobacco is produced in the uplands along the Missouri River in the northwest region. Vegetables and fruits are grown mainly in the river bottoms along the Missouri and Mississippi rivers.

Table 1.1 – 1998 Top 10 Missouri Crops

1998 VALUE OF MISSOURI CROPS*			
NO.	***CROP***	***VALUE OF PRODUCTION***	***AVG. VALUE PER UNIT***
1	Soybeans	$856.8 million	$5.04 bu
2	Corn (Grain)	$550 million	$1.93 bu
3	All Hay	$532.9 million	$68.5 ton
--	*---Alfalfa*	$-----	$102.00 ton
--	*---Other Hay*	$-----	$61.50 ton
4	Winter Wheat	$137.4 million	$2.39 bu
5	Cotton	$118.6 million	$0.706 lb.
6	Rice	$64 million	$8.65 cwt.
7	Grain Sorghum	$45.6 million	$1.72 bu
8	Cottonseed	$17.6 million	$131.00 ton
9	Tobacco	$10.9 million	$1.905 lb.
10	Potatoes	$9.7 million	$5.15 cwt.

**Adapted from 1999 Missouri Farm Facts*
Updates available at <http://ext.missouri.edu/agebb/moass>

Table 1.1 lists the top 10 Missouri crops in 1998 according to their production value. The average

market price per unit that producers received for these crops is also listed. Current values may be obtained from the most recent *Missouri Farm Facts* available from the Missouri Agricultural Statistics Service or on the Internet at <http://agebb.missouri.edu/mass>.

Main Uses of Major Missouri Crops

Crops can have several uses, but most are produced for very specific needs. The following paragraphs list the main use of each of the major crops grown in Missouri.

Soybeans are the world's foremost provider of protein and oil. Whole soybeans are processed into protein-rich meal and used for livestock feed. Intensive processing of soybeans has made them just as important for industrial use. Soybean oil, which is processed from the whole bean, is used mostly for cooking purposes. Soybean oil is also used in industrial products such as diesel fuel, inks, paints, and plastics. Soybean meal, the cake left from the crushed bean, is ground and most commonly used as a high protein supplement in livestock and poultry feed.

Many products can be manufactured from corn as can be seen in Figure 1.2, but the main use of this commodity is for livestock feed. Approximately 60% of all corn growth in the United States is fed to domestic livestock as ground grain, silage, high-oil, and high-moisture corn. During the 1997-98 marketing season, the estimated feed usage of corn was more than 16.3 billion bushels and Missouri ranked 10th in the nation for grain corn production.

In 1998, 5% of all U.S. grain sorghum was grown in Missouri. Because of its similar composition to corn, grain sorghum's main use is also for livestock feed. Sorghum acreages tend to fluctuate annually but due to sorghum's resistance to drought and heat, acreages often increase if a dry, hot year is expected.

In 1998, the state ranked first in the nation in hay production, excluding alfalfa, and fourth in the nation in all types of hay production. That same year, hay acres were the second largest crop acres harvested across the state. All hay produced in the state is used as a livestock roughage feed source. The demand for hay within the state is great since Missouri also ranks second in the United States in the total number of beef cows.

Winter wheat is the primary wheat crop grown in Missouri, with spring wheat grown in some areas of the state. The seeds from both varieties are used mainly in the production of flour. Wheat production has steadily increased over the past decade due to the use of improved varieties and better fertility management by Missouri producers.

Cotton production is another important crop to the state, bringing in the fifth highest cash crop receipts in 1998. Cotton's main use throughout the world is for cotton fiber. Fiber is picked from mature cotton plants and then processed into thread that is woven into cloth and textiles. Clothing is the major use of all processed cotton fibers; however, a large amount is used in the production of textiles for home furnishings such as towels and sheets.

Rice is used almost entirely for human consumption, providing the main food source for almost half the human population of the world. Because of world population growth, the demand for rice continues to increase. The *USDA Supply and Demand Report* stated that the world use of rice in 1996 through 1997 was more than 370 million metric tons. The United States exports 40% of all rice grown in the country because U.S. technology has created the highest-quality and most sought-after rice in the world. Most of the remaining rice grown in the country is consumed as food. Although Missouri rice acres are limited (approximately 100,000 acres since 1995), yields continue at 5,000+ pounds per acre.

Main Uses of Components of Major Crops

Crop components are the parts of a plant (the seed, stem, leaves, or roots) that undergo separate or additional processing to form products for consumer use. Although Missouri's major crops are produced for one main use, most of these crops have other components that can be used in similar or very different ways.

Soybean production in the United States is growing annually due to the industrial potential of the soybean seed. Research continues to discover new uses and products from this "miracle crop" by using its main component, the seed or bean, in three ways: (1) whole beans, (2) as an oil, or (3) as

a meal or protein product. By explaining the intensive processing of the soybean seed, it is easy to see how many different uses can be made of this crop component.

Whole beans are initially hulled and rolled into full fat flakes that may be ground at this stage and used in animal feed or processed into full fat flour for commercial use. This flaking process is necessary to produce soy oil, a major use of the crop. Crude oil is extracted from the fat flakes in a three-step process. First the flakes are bathed in a solvent. Next, they are degummed, a process in which lecithin (a useable by-product) is removed. Finally, the flakes are crushed to remove the oil. This oil is further refined, or processed, into its main use as cooking oil or made into margarine and shortening. The pressed flakes that are left are recycled by removing the solvent and dried to create oil-free "defatted soy flakes." These defatted flakes are the basis of all soy protein products. The flakes are mainly ground into meal for animal feed or can be ground into soy flour that is 50% protein. Soy flour is further processed into higher protein concentrates for use in protein drinks, soup bases, or gravies. Flakes can also be chemically processed into soy isolates (90% protein), such as the chief component of many dairylike products including soy-based cheese and soy milk. Figure 1.1 lists numerous products produced from soybeans.

Components of corn include the seed or kernel, parts of the seed, the immature or green plant, and the stalks. The kernel is mainly used as a livestock energy feed source. It is generally fed in the form of cracked, rolled, or ground corn. When refined, the corn seed is divided into two groups: primary products and co-products. Primary products are the starches, syrups, and dextrose (sugar) generated from the endosperm (starch) of the corn seed. They are used in foods, industrial products, and drugs. Co-products are made from solubles (dissolved carbohydrates in water-processing solution), gluten (protein) and hulls, and from the germ (oil) of the kernel. Co-products are used in drugs, livestock feed, and foods. See Figure 1.2 for uses of primary products and co-products of corn, courtesy of The National Corn Growers Association. The green corn plant can be harvested as silage and stored in silos, pits, or bunkers. Silage is used as a forage livestock feed, particularly for dairy cows. Corn stalks remaining in harvested fields are sometimes used as a winter feed supplement for cattle.

From grain sorghum, the kernel, the green plant, and the endosperm of the seed are the main components used. The kernel is chiefly used as livestock feed. However, additional processing is required to enhance the feed efficiency of this very hard grain. Like corn, the green sorghum plant can be cut as silage for livestock feed.

Wheat is raised mainly for two components, the seed and stem. The endosperm in the wheat seed is the source for all flour manufacturing. Other parts of the seed, bran (outer coat) and germ are by-products from white flour milling and are used separately or included in whole-wheat flour. Two other by-products from flour manufacturing called middlings and shorts (the discarded waste including germ, fine bran, and some flour), are processed into livestock feed. The stem, or wheat stubble, of the wheat plant left after the grain is harvested can be cut, dried, and baled into straw for use as livestock bedding or ground cover and mulch. Wheat stubble, if not baled, is left on fields to prevent soil erosion and to add moisture and nutrients back to the soil. The immature or green plant can also be harvested as silage and used as livestock forage feed.

In hay production, the main components used are the stem, leaves, and the seed head of the grass or legume crop. The plant is cut, dried, and baled to be used as a livestock roughage feed source. All parts of the plant, except the roots, are used. However, the roots of legume hay crops play an important role in replacing nitrogen in the soil. This will be discussed in Unit II.

Fiber and seed are the components of the cotton plant used the most. The fiber, formed within the cotton boll or dried flower, is processed into thread to be woven into fabric and textiles for clothing and home furnishings such as towels and sheets. Cottonseed, also found in the boll, provides oil and meal used for food products, livestock feed, and flour. Foots, or the remains from cotton seed oil refining, are processed into fatty acids for industrial products. The hulls from the cottonseed are used separately and in combination with cottonseed meal for livestock, poultry, and fish feed or as fertilizer.

Figure 1.1 - Soybeans' Many Uses

WHOLE SOYBEAN PRODUCTS

OIL PRODUCTS

REFINED SOYOIL

Edible Uses
Coffee creamers
Cooking Oils
Filled Milks
Margarine
Mayonnaise
Pharmaceuticals
Salad Dressing
Salad Oils
Sandwich Spreads
Shortenings

Technical Uses
Anti-Corrosion Agents
Anti-Static Agents
Caulking Compounds
Core Oils
Diesel Fuel
Disinfectants
Dust Control Agents
Electrical Insulation
Epoxys
Fungicides
Inks-Printing
Linoleum Backing
Metal - Casting/Working
Oiled Fabrics
Paints
Pesticides
Plasticizers
Protective Coatings
Putty
Soap/Shampoo/Detergents
Vinyl Plastics
Wallboard
Waterproof Cement

SOYBEAN LECITHIN

Edible Uses
Emulsifying Agents
Bakery Products
Candy/Chocolate Coatings
Pharmaceuticals
Nutritional Uses
Dietary
Medical

Technical Uses
Anti-Foam Agents
Alcohol
Yeast
Anti-Spattering Agent
Margarine
Dispersing Agents
Paint
Inks
Insecticides
Rubber
Stabilizing Agents
Shortening
Wetting Agents
Calf milk replacers
Cosmetics

GLYCEROL
FATTY ACIDS
STEROLS

SOYBEAN PROTEIN PRODUCTS

SOYBEAN MEAL

Feed Uses
Aquaculture
Bee Foods
Calf Milk
Replacers
Cattle Feeds
Dairy Feeds
Fish Food
Fox & Mink Feeds
Pet Foods
Poultry Feeds
Protein Concentrates
Swine Feeds

HULLS
Dairy Feed
Filter Materials
High Fiber Breads

SOY FLOUR CONCENTRATES & ISOLATES

Edible Uses
Alimentary Pastes
Baby Food
Bakery Ingredients
Beer & Ale
Candy Products
Diet Food Products
Food Drinks
Grits
Hypo-Allergenic Milk
Meat Products
Noodles
Prepared Mixes
Sausage Casings
Yeast

Technical Uses
Adhesives
Analytical Reagents
Antibiotics
Asphalt Emulsions
Binders - Wood/Resin
Cleansing Materials
Cosmetics
Fermentation Aids/Nutrients
Films for Packaging
Inks
Leather Substitutes
Paints - Water Based
Particle Board
Plastics
Polyesters
Pharmaceuticals
Pesticides/Fungicides
Textiles

Edible Uses
Seed
Stock Feeds
Soy Sprouts
Baked Soybeans
Full Fat Soy Flour
Bread
Candy
Doughnut Mix
Frozen Dessert
Instant Milk Drinks
Low-cost Gruels
Pancake Flour
Pan Grease Extender
Pie Crust
Sweet Goods
Roasted Soybeans
Candies/Confections
Cookie Ingredient/Topping
Crackers
Dietary Items
Fountain Toppings
Soynut Butter
Soy Coffee
Traditional Soyfoods
Miso
Soymilk
Soy Sauce
Tofu
Tempeh

Source: American Soybean Association

Figure 1.2 - Primary Products and Co-Products of Corn

PRIMARY PRODUCTS

STARCHES

CORNSTARCH

Industrial Uses
Abrasive Paper & Cloth
Adhesives
Binder or Binding Agents
Bookbinding
Briquettes
Cardboard
Ceiling Tiles
Chemicals
Coatings on Wood, Metal & Paper
Color Carrier (in printing)
Cork Products
Crayon & Chalk Binder
Detergents
Drilling Mud for Oil-Wells
Dry Cell Batteries
Fermentation Processes
Fiberboard
Fiberglass size
Fireworks
Insecticide Powders
Insulating Material
Latex & Poster Paints
Lubricating Agents
Oilcloth
Paper & Paper Products
Plastics (molded)
Plywood (interior)
Rubber Tires
Surgical Dressings
Textiles Sizing
Wallboard & Wallpaper

Food, Drug, or Cosmetic Uses
Antibiotics
Aspirin
Baby Foods
Bakery Products (bread, rolls, cakes, pies, crackers and cookies)
Baking Powder
Brewed Beverages (beer, ale)
Canned Vegetables
Chewing Gum
Chocolate Drinks
Confectionery
Cosmetics
Desserts (puddings, custards)
Drugs
Food & Drug Coatings
Gravies & Sauces
Meat Products
Pie Filling
Powdered Sugar
Precooked Frozen Meals
Prepared Mixes (pancake, waffle, cake, candy)
Prepared Mustard
Salad Dressing
Soaps & Cleaners
Soups

DEXTRINS

Industrial Uses
Adhesives
Bookbinding
Briquettes
Candles
Ceramics
Cork Products
Crayon & Chalk Binder
Dyes
Envelopes
Fiberglass Insulation
Fireworks
Insecticides
Labels
Leather
Linoleum
Magazines
Matches (head and box side)
Oil-well Drilling
Plastics (molding)
Plywood
Poster Paints
Printing Inks
Sandpaper
Shoe Polish
Silvering Compounds
Soaps
Straws (drinking)

SYRUPS

CORN SYRUP

Industrial Uses
Adhesives
Chemicals
Dyes & Inks
Explosives
Leather Tanning
Metal Plating
Paper (glassine, parchment)
Plasticizer
Rayon
Shoe Polish
Textiles
Theatrical Makeup
Tobacco & Tobacco Products

Food & Drug Uses
Baby Foods
Bakery Products (bread, rolls, biscuits, doughnuts, pies, cakes, cookies, pretzels)
Beverages (soft drinks, beer, ale)
Breakfast Foods
Catsup, Chili & Tomato Sauce
Cereals
Cheese Spreads & Foods
Chewing Gum
Chocolate Products
Coffee Whiteners
Condensed Milk (sweetened)
Desserts
Drugs
Eggs (frozen, dried)
Extracts & Flavors
Frostings & Icings
Fruit Butters, Juices & Drinks
Fruits (canned, candied, fillings, frozen)
Ice Cream & Sherbet
Jams, Jellies, Marmalades & Preserves
Licorice
Malted Products
Marshmallows

HIGH FRUCTOSE CORN SYRUP

Food Uses
Bakery Products
Canned Fruits & Juices
Condiments
Confectionery Products
Frozen Desserts
Jams, Jellies & Preserves
Soft Drinks
Wine
Yeast

MALTODEXTRINS

Food Uses
Bakery Mixes
Beverage Powders
Condiments
Dehydrated Foods
Dry Soup Mixes
Gum Confections
Icings & Glazes
Instant Teas
Instant Breakfast Foods
Low Calorie Sweeteners
Marshmallows
Nougats
Meat Products (bacon, bologna, hams, sausage, frankfurters, mincemeat)
Peanut Butter
Prepared Mixes (cakes, infant foods, pie fillings, puddings, powdered drink mixes, ice cream)
Pickles
Salad Dressing
Seafood (frozen)
Soups (dehydrated)
Syrups (table, chocolate, cocoa, fruit, medicinal, soda fountain)
Toppings
Vinegar

DEXTROSE

DEXTROSE

Industrial Uses
Adhesives
Amino Acids
Chemicals
Citric Acid
Dyes
Electroplating & Galvanizing
Enzymes
Lactic Acid Polymers
Leather Tanning
Lysine
Mannitol
Paper Manufacturing
Rubber (cold process)
Sizing Materials
Sorbitol
Textiles (dyeing, finishing)
Threonine
Tryptophan

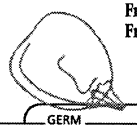
Food, Drug, or Personal Uses
Antibiotics
Baby Foods
Bakery Products (biscuits, bread, crackers, fillings, icings, macaroons, pretzels, cookies, crackers, wafers)
Berries (canned, frozen)
Beverages (soft drinks, beer, ale)
Breakfast Foods
Caramel Color
Cheese Foods & Spreads
Chewing Gum
Chocolate Products
Citric Acid
Condensed Milk
Cream (frozen)
Dairy Products
Desserts
Dietetic Preparations
Distillation Products
Doughnuts
Drugs (fermentation process)
Eggs (frozen, or dried)
Fish (pickled)
Flavoring Extracts
Food Coloring
Fruit Juices
Fruits & Vegetables (canned, candied, frozen)
Gelatin Desserts
Ice Cream & Sherbet
Jams, Jellies, Marmalades & Preserves
Lactic Acid
Meat Products (bacon, bologna, hams, sausage, frankfurters, mincemeat)
Medicinal Preparations & Intravenous (injections, pills, tablets, drugs)
Mouthwash
Peanut Butter
Peas, Canned
Pectin, Fruit
Pickles
Prepared Mixes (cakes, infant foods, pie fillings, puddings, powdered drink mixes, ice cream)
Sauces (catsup, tomato)
Seasoning Mixes (dry)

ETHANOL

Alcoholic Beverages
Industrial Alcohol
Octane Enhancer
Oxygenate in Motor Fuels

HYDROL

(Corn Sugar Molasses)
Leather Tanning
Livestock Field
Organic Acids
Organic Solvents
Tobacco



CO-PRODUCTS

CORN OIL, REFINED

Industrial
Chemicals & Insecticides
Lecithin (for pharmaceuticals, cosmetics, linoleum, printing inks)
Paint & Varnish
Rubber Substitutes
Rust Preventative (surface coatings)
Soap
Soluble Oil (leather, tanning use)
Textiles

CORN OIL & FREE FATTY ACIDS

Food & Drug Uses
Carriers for Vitamins and Medicines (capsule form)
Cooking Oil
Margarine
Mayonnaise
Potato Chips
Salad Dressing
Seasoning Sauces
Shortening
Soaps

SOLUBLES

(Steepwater)
Antibiotics
Chemicals
Pharmaceuticals
Yeast

GLUTEN & HULLS

Feed Uses
Corn Germ Meal
Corn Gluten Feed
Corn Gluten Meal
Corn Oil By-products
Corn Sugar (crude & refined)
Hydrol
Steepwater for Feed

Other Uses
Amino Acids
Fur Cleaner
Zein & Other Protein Products

The rice seed, seed hulls, and plant stems are all used components of the rice plant. The hull is removed from the rice seed leaving a bran layer surrounding the kernel. This brown rice is edible, but most rice is milled or further processed, removing the bran to make white or "polished" rice that most consumers prefer. White rice is mainly cooked and eaten whole, but is also processed into cereals, rice cakes, or starch used in other food products. The bran and germ from the rice seed can be processed into rice oil, which is a very fine cooking oil with no cholesterol. Rice seed hulls are often used for poultry bedding. Similar to wheat, the stem of the rice plant can be cut, dried, and baled as straw and used for livestock feed and bedding.

Alternative Uses of the Major Crops

All of the major crops can be grown for seed production, but additional care in planting, crop management, and harvesting must be taken in order to produce a quality, marketable product. With a global emphasis on using renewable resources and increasing production costs, producers and manufacturers are always looking for new or alternative uses for crops.

As previously shown in Figure 1.1, soybeans have more alternative uses than most other crops. This is only a small listing of current products developed from soybeans. Products of the future include hand and baby lotion, low-fat soy oil, and cytosol (a biosolvent used to clean up oil spills on shorelines). The United Soybean Board estimates the largest growth in products made with soybeans will be in solvents and cleaners, requiring an increase in production of more than 40 million bushels of soybeans by the year 2005.

Corn's alternative uses include industrial products such as starch, ethanol (a gas supplement), high fructose corn syrup, gluten feed, meal, and oil. As seen previously in Figure 1.2, the products made from primary and co-products are numerous. Corn can be found in everything from peanut butter to shoe polish and new uses are being discovered almost daily. Some of the newest uses for corn include plastics and antifreeze.

Although it originated as a food source, only 3% of Missouri's grain sorghum is processed into anything other than livestock feed. Ethanol is the only major by-product produced from grain sorghum starch, but currently most ethanol is generated from cornstarch.

Wheat straw can be fed as a roughage feed source to livestock when hay supplies are low. Before feeding, the straw is injected with anhydrous ammonia to give it a greater usable nutritional value. Some alternative uses for wheat include breakfast food, beer, whiskey, alcohol, and coffee substitutes. The future could see more use of wheat in building materials such as straw used in plywood or wheat starch mixed with concrete. These types of products are being tested to develop lighter, less expensive, and better building materials from renewable crop resources.

Old grass hay can be used as livestock bedding if the nutritional value has deteriorated and no mold is present. In addition, current ethanol research is experimenting with using hays, grasses, and even yard clippings as a possible source for this growing fuel product.

An alternative use of cotton fiber is lint, the term used for fiber after the seeds have been removed at the gin. Lint is used for padding in furniture, mattresses, and car seats. It is also used in the production of other cellulose products. Additional alternative uses of the cotton plant include cardboard, plastics, and U.S. paper currency. Most present-day research on cotton is done in an effort to improve the quality of the fiber, which in turn improves the quality of cotton products consumers may purchase. Cotton waste, or the remains of the milling process, is currently recycled into new products.

The by-products of rice, including the meal, bran, and rice polish, are used in livestock feed. From the milling process, broken kernels (less than three-fourths of the whole kernel) are used to brew beer and are ground for rice flour. Continued research is looking into using rice stems as another possible source for ethanol. Rice hulls can be used for livestock feed.

Other Important Crops Grown in Missouri

Variations in the topography and climate in the state contribute to production of many other crops in Missouri. Often considered "alternative" crops, the production of tobacco, vegetables, and fruits is very prominent in select areas of the state. These

crops make an important contribution to the state's economy.

Although only 3,000 acres of tobacco were harvested in 1997, this crop was valued at more than $13 million to Missouri producers. It is grown primarily in the fertile soils of the Missouri River bottoms along the northwestern state border and through central Missouri. Platte and Buchanan counties between St. Joseph and Kansas City produce more than 80% of the state's crop.

Most harvested vegetables are sold at farmers' markets, roadside stands, and pick-your-own farms throughout the state. Farmers' markets have become popular because consumers demand less processed and more natural foods. In 1998, potato and watermelon production brought in $9.7 and $6.1 million, respectively, for state vegetable producers. Although watermelon is really a fruit, it is classified as a vegetable commodity due to how it is grown. This traditional summertime treat ranked Missouri ninth among all other states in 1998.

Likewise, many orchards and vineyards maintain seasonal marketing stands to promote and sell their products. Apples, peaches, and grapes are used to make some of Missouri's finest jellies, jams, and wines as stated in the University of Missouri publication *Best of Missouri Farms*. This 1988 booklet lists more than 30 families in rural Missouri who produce everything from soup to nuts including 15 wineries in operation since the 1840s. Some of these businesses and many new ones have continued to grow across the state. A comprehensive directory is maintained by the Missouri Department of Agriculture, listing many farmer markets, roadside stands, and pick-your-own operations. The *AgriMissouri Buyer's Guide* can be viewed on the Internet at <http://www.mda.state.mo.us/bguide/htm>.

Companies That Use Major Crops or Crop Components

Many companies throughout Missouri and the United States use crops and crop components. These companies can be grain merchandisers at local elevators; international exporters; large livestock producers or feed mills; or processors of food, feed, or industrial products.

Grain merchandisers purchase grains from producers or other merchandisers. At local or terminal elevators, grain crops are dried, stored, and conditioned for resale. These grains are sold to feed mills; feed, food, or industrial processors; or exported to other grain merchandisers around the world. Grain merchandisers are often called "middlemen" because they make the market connection between producers and consumers. With current technology and marketing strategies, many producers can bypass the grain merchandiser and sell directly to feedlots, feed mills, or grain processors. MFA Incorporated, Cargill, ADM Milling, and Farmland are examples of companies that buy, process, or sell major crops or crop components.

MFA Incorporated, based in Columbia, Missouri, is a regional farm supply and marketing cooperative serving farmer/members in Missouri and adjacent states. A manufacturer, distributor, and supplier, MFA focuses on production of feed, grain sales, sales of seed, fertilizer, and crop protection chemicals.

Cargill Inc. is the largest grain company, employing more than 80,000 agricultural employees throughout the world. Based in Minneapolis, Minnesota, the corporation focuses on international marketing, processing, and distribution of agricultural food. This company maintains divisions in several areas of crop production including grain processing and seed and fertilizer production. The grain division is the largest grain-trading business in the country with enough wheat purchases annually to bake nearly 8.6 million 1-pound loaves of bread.

Archer Daniels Midland Company, based in Decatur, Illinois, has a network of over 205 domestic and internationally based plants. ADM focuses on processing cereal grains and oilseeds. As the link between producers and the food manufacturer, ADM provides a market for the producers' crops and, in turn, supplies feed ingredients for their animals. ADM processes corn, cottonseed, rice, soybeans, wheat, barley, canola, cocoa, peanuts, and sunflower seeds into value-added products.

Farmland, headquartered in Kansas City, Missouri, is the largest farmer-owned cooperative in North America. More than 600,000 independent family farmers own the 1,500 local cooperatives that encompass the Farmland Cooperative System.

Overview

Farmland does business in all 50 states and more than 80 countries. The company owns grain elevators, feed mills, beef and pork processing plants, fertilizer plants, and petroleum refineries. They provide crop production and crop protection products, livestock feed, petroleum, grain processing and marketing, and the processing and marketing of pork and beef products.

Large livestock producers mostly purchase feed grains or meal made from crops such as soybeans or cottonseed to be used in animal feeding rations. Livestock producers include Koch Industries, a large multifaceted company, headquartered in Wichita, Kansas, which is involved in several areas of agricultural production. Koch specializes in using crops or crop components to feed cattle at their company-owned ranches and feedlots. Koch also has business interests in animal feed processing and distribution; value-added seed genetics; producing, trading, and distributing fertilizer and other agricultural chemicals; grain storage and merchandising; and the milling and processing of oil seed grain and feed.

Food and industrial processors may purchase crops in a harvested or preprocessed state depending on what products they are manufacturing. For example, Nestle USA, a food processing plant in Trenton, Missouri, purchases corn sweeteners and starches, soy products, and flour from grain processors to add to the various food products they manufacture. Grain processing facilities include mills, elevators, and gins such those owned and operated by Ralston/Purina in St. Louis.

ConAgra, Inc. of Omaha, Nebraska, is the third largest diversified international food company. ConAgra, like Cargill and Koch, has a large stake in merchandising grain. Other large food processors such as RJ Reynolds, Nabisco and Sara Lee produce many popular brands of cookies, crackers, cakes, cereal, condiments, candy, and other food products made from crops or crop components. General Mills, Quaker Oats, and Pillsbury are other highly recognized food processors. Missouri is home to some of the nation's most famous food processors including the Colonial Baking Company and Kraft Foods in Springfield. St. Louis is home to Ralcorp Holdings, Inc., which produces breakfast cereals, and Frito-Lay, Inc., makers of chips and snack foods.

Summary

Major agricultural crops produced in Missouri include soybeans, corn, grain sorghum, wheat, hay, cotton, and rice. Soybeans are a primary provider of protein and oil. Livestock feed is the primary product produced from corn and grain sorghum. Wheat is used primarily for the production of flour. The major use of hay is for a livestock roughage feed source. Cotton production results in cotton fiber that is used for clothing and textiles for home furnishings. Rice is almost entirely used for human consumption.

Parts of the plants that undergo separate or additional processing are referred to as crop components. These components contribute to many other uses. There are also uses for crops that are referred to as alternative uses. Ongoing research is developing alternative uses for crops such as solvents, cleaners, and ethanol. Additional high-yielding crops in Missouri are tobacco, vegetables, and fruits.

Grain merchandisers in Missouri that purchase grains from producers and develop products for consumer use include MFA, Cargill, Archer Daniels Midland Company, Farmland, Koch Industries, and ConAgra, Inc. Many other large food processors also use Missouri crops to produce food for consumer use in the United States and internationally.

Credits

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Lesson 2: The Economic Importance of Crops

Missouri agriculture is very diversified and not dependent on any one or two crops. Over 20 crops are produced in the state, resulting in over half the state's agricultural receipts. For marketing purposes, crops grown in Missouri are categorized into five types: oil crops, feed crops, food grains, cotton, and miscellaneous. Although production acres of some crops are limited in the state such as cotton and rice, they still generate millions of dollars in cash receipts annually.

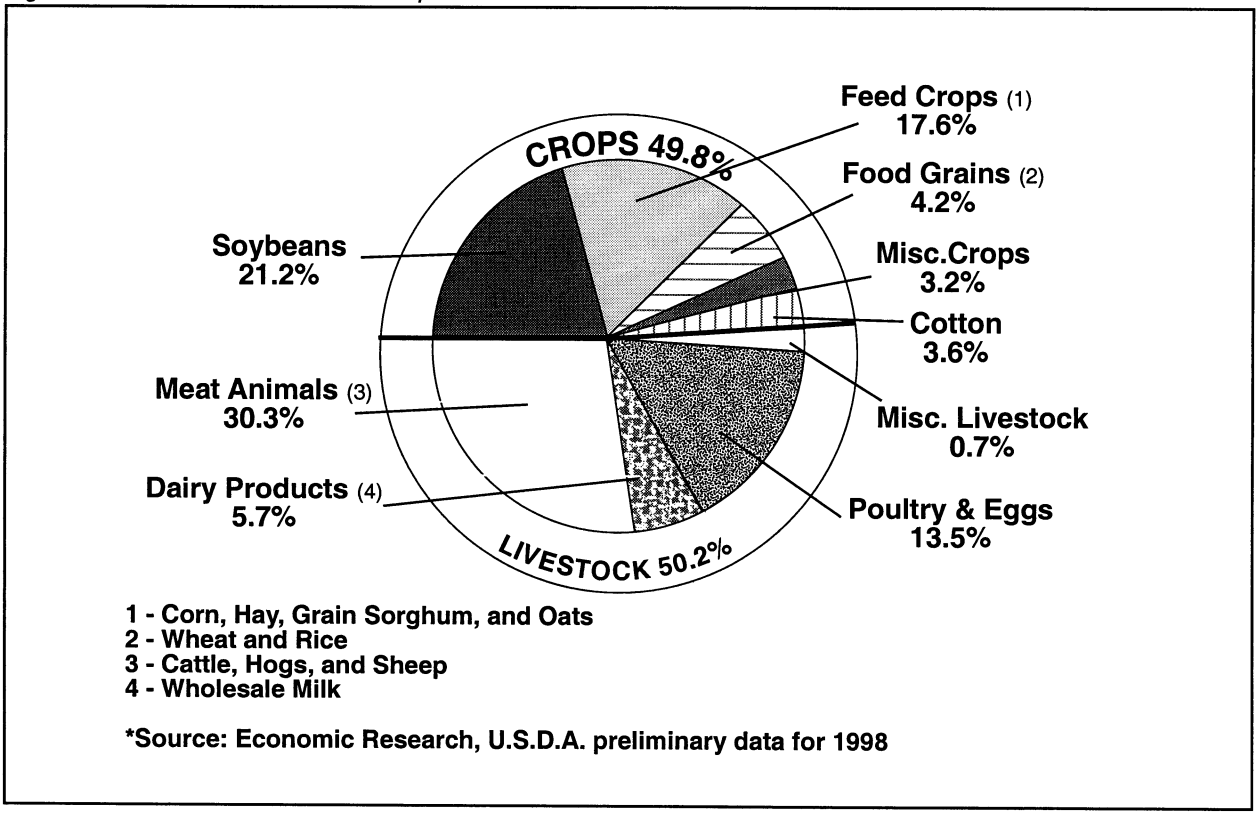
Economic Importance of Crops in Missouri

Missouri's agricultural industry is a key part of the state's economy, accounting for billions of dollars in cash receipts annually. In 1998, cash receipts totaled more than $4.68 billion, with crops making up almost half (49.8%) of sales as shown in Figure 2.1. The oil crop soybeans, Missouri's largest cash crop, accounted for 21.2%, over 1/5, of all cash receipts. Feed crops (corn, hay, oats, and grain sorghum) added 17.6% to the total. Food grains (rice and wheat), cotton, and miscellaneous crops made up the remaining crop cash receipts at 11%. These totals brought the value of crop production for Missouri in 1998 to $2.27 billion. Missouri agriculture employs 15% of the state's labor force, which translates to over 400,000 workers. Our state is home to over 2,000 agribusinesses. Missouri is also very prominent in the international marketplace and exported over $1.38 billion worth of farm goods in 1998 alone. In the same year, Missouri was the leading state in hay production (excluding alfalfa), 6th in the nation in the production of soybeans and rice, 10th in corn, 11th in winter wheat production, and 12th in cotton. Missouri grew 6% of all U.S. soybeans and grain sorghum.

Economic Importance of Crops in the United States

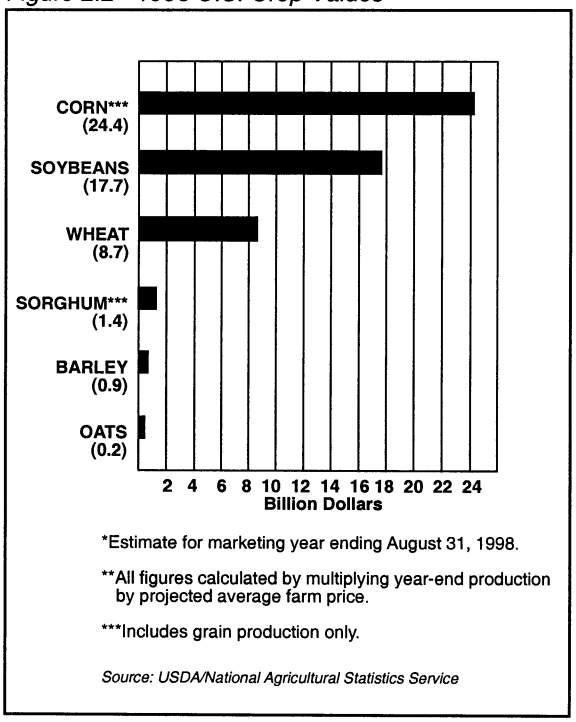
Crop production is not only important in Missouri, but just as important to our nation's economy. In 1998, the value of all crops produced in the United States totaled $98 billion dollars. This represented over 48% of the $196.8 billion for all farm cash receipts.

Figure 2.1 - 1998 Missouri Cash Receipts



Corn is America's largest crop. In 1998, corn production totaled 9.76 billion bushels with an annual average price reported at $2.43 per bushel. This crop alone added $24.4 billion to our nation's economy as is shown in Figure 2.2. Other leading crops in the United States based on cash receipts include soybeans at $17.7 billion, wheat at $8.7 billion, cotton at $5.9 billion, and hay at $13.3 billion. These figures illustrate that crop production in the United States is an integral part of our country's economy.

Figure 2.2 - 1998 U.S. Crop Values



*Estimate for marketing year ending August 31, 1998.

**All figures calculated by multiplying year-end production by projected average farm price.

***Includes grain production only.

Source: USDA/National Agricultural Statistics Service

Economic Importance of Crops in the World

As the population of the world increases and there are more mouths to feed, the need for world grain production continues to increase. In 1997 there were 5.6 billion people in the world, with the population increasing at a rate of 1.7% per year. Most of the protein received by people in underdeveloped countries comes from the grain they may be able to raise or receive from imports from countries such as the United States. Protein from grain is the most efficient way of satisfying that nutritional need. Most of the underdeveloped countries have difficulty meeting the grain needs of their populations due to several factors. These include a lack of knowledge of grain production; lack of funds for equipment and seeds; climate and weather disasters; as well as problems with their lack of infrastructure such as transportation, processing, and storage.

The production efficiency of the American farmer is increasing each year. At the end of the 20th century, one American farmer could produce enough food to feed approximately 150 people. The United States accounts for the largest percentage of the total crops produced. In corn production alone, the United States produces 46% of the 500 million metric tons grown worldwide. In 1997, the United States also produced 50% of the world's soybean supply, a total of 2.73 billion bushels. Other major grain-producing countries include Brazil, China, Argentina, Canada, and Australia.

Crop production uses only 1/5, or 382 million acres, of the nation's land. With this efficiency, it is apparent why the United States and Missouri crop producers play such powerful and important roles in world agriculture.

Major Grain Exporting Countries in the World

The United States is the world's leading agricultural exporter, with yearly exports valued at $69.7 billion in 1998. Grains accounted for the following amounts: corn - $9.3 billion, wheat - $6.9 billion, soybeans - $6.3 billion, and cotton - $3 billion. These grains are purchased by importing countries to meet the nutritional needs of their people. The other major grain exporters in the world include China, Argentina, Brazil, Canada, and Australia. The largest oil crop (soybeans) exporters in the world are the United States, Brazil, and Argentina. The United States competes against all of these countries worldwide in the export of whole or unprocessed grains such as corn and wheat. Improved production technologies in these countries are reducing the amount of exports from the United States.

Major Importing Countries of U.S. Crops

Importing countries generally lack crop production technology and usually do not have the required land area to produce the crops needed to feed their people and livestock. These countries depend on the United States and the other major crop exporters to produce and fairly market needed grains, often doing so in return for

products or raw materials from the importing countries. The major grain importers in the world include Japan, Mexico, Korea, Taiwan, and Middle Eastern countries.

The United States also imports crops that are either not produced in the United States or not available in sufficient quantities to meet public demand. U.S. imports include crops such as bananas, coffee beans, and cocoa beans.

Marketing Principles That Affect Crop Economics

As with all agricultural commodities, the law of supply and demand plays the major role in the economics of crop production. No one is more aware of this principle than the American crop producer. Surplus grains can cause prices to fall, leaving little or no margins. With communication developments, the American producer must deal with a global economy as never before.

The Chicago Board of Trade plays the major role in price discovery and determination for grains in the United States and the world. Established in 1848 (over 150 years ago), the CBOT was located at the base of the Great Lakes to bring some order to a chaotic marketing situation that existed at that time. Problems with storage, transportation, and supply and demand led to its establishment. Today the Board of Trade is the center for grain marketing. Here buyers and sellers come together through brokers to negotiate prices of commodities. Prices are affected daily with news from around the world concerning climate changes, agribusiness mergers, or grain orders from governments of other countries. This causes the producer to definitely develop a marketing plan for economic survival.

A successful marketing plan is a three-step process. The first step involves determining a cost of production and expected break-even price per unit of that commodity. All production activities involving the use of inputs and services must be listed. A good cost of production worksheet should be very detailed. In the absence of the producer's own cost estimates, a publication such as the *Missouri Farm Financial Outlook* available from the University Outreach and Extension is consulted.

The second step, developing the marketing plan, requires the producer to estimate the outcome of different pricing alternatives and to determine a target price and quantity to market. These pricing alternatives would include cash marketing, forward contracting, and using the futures and options market. One strategy may be to market the grain using more than one of these marketing options.

The last step is to develop a follow-through plan to determine when to market the grain. A key to this is to develop a method of following or tracking the markets. This may to done by securing grain prices daily through the use of the media (radio, Internet, etc.) or by giving one's broker or elevator manager the authority to conduct the trade. Economists agree that one key to success is to stick to an established plan.

Summary

The incredible production abilities of Missouri allow the state to play an important role in the import-export market. With continued crop prosperity and variety, Missouri can expect to retain its role as a major U.S. producer into the future. In subsequent lessons we will discuss the role and importance of fertilizers and assorted soil management techniques in keeping the state at its current levels of production and importance.

Credits

1997 Missouri Farm Facts. Missouri Agricultural Statistics Service: Columbia, MO.

1998 Missouri Farm Facts. Missouri Agricultural Statistics Service. Columbia, MO. Current copies are available by telephone (573-876-0950) or can be accessed on the Internet at <http://www.ext.missouri.edu/agebb/moass/farmfact/index.htm>.

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Lesson 3: Careers in Crop Science

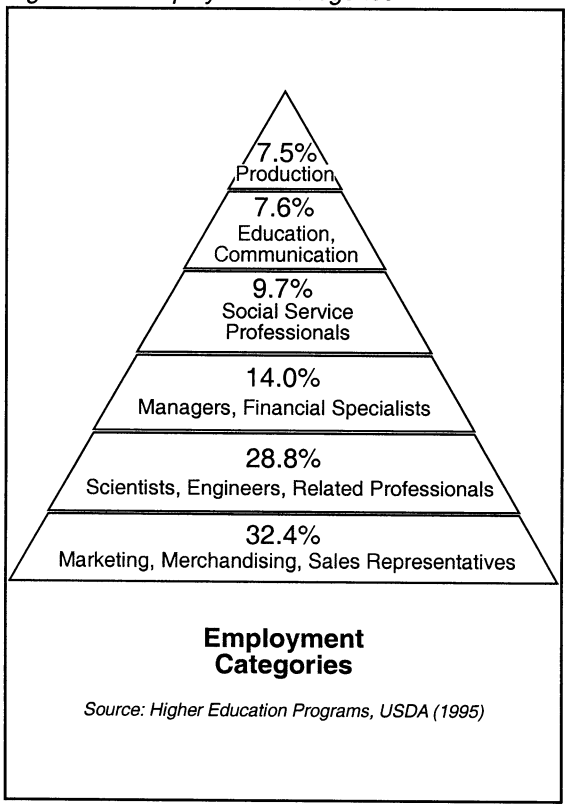
Employing nearly 25 million Americans, agriculture has a large impact in the United States. More than 20% of the jobs in today's market are related to agriculture. Farm exports alone generate nearly 800,000 American jobs. Since plants are the basis of all agriculture, there are career opportunities in crop science or crop-related agribusiness.

Career Opportunities

Agriculture jobs can be separated into six major employment areas: (1) marketing, merchandising, and sales, (2) science and engineering, (3) management and finance, (4) social service professionals, (5) education and communication, and (6) production. Figure 3.1 illustrates the employment categories and the percentage of jobs available in each.

Marketing, merchandising, and sales make up the largest percentage of people employed in agricultural jobs at 32.4%. People in these jobs work with producers and consumers to meet the daily demands for agricultural products. If a person is interested in sales and helping people find the goods or services needed, a career in agribusiness or agricultural marketing might be appealing.

Figure 3.1 - Employment Categories



Scientists, engineers, and related professionals comprise 28.8% of the available jobs. This is the fastest growing area within the industry. Careers in these fields are on the leading edge of agriculture. Crop science and crop-related agribusiness jobs require extensive knowledge of plant science. A college education and possibly additional research work and education are necessary in these careers.

Managers and financial specialists are often considered key to the sound operation of today's agricultural industry. Comprising 14% of the available jobs, these careers demand good business skills and extensive knowledge and understanding of agriculture.

At 9.7% of available jobs, social service professionals safeguard the public and assist people with individual, community, or world needs. An understanding of agriculture, especially crop science, is key to the success of nutrition counselors and Peace Corps representatives in teaching others about food use or food production. These jobs fill an important role in maintaining human health and well-being worldwide.

In this technological age, the agricultural industry needs to actively communicate with the rest of the world. Sharing news and information about agriculture is the main focus of careers in education and communication. This job sector represents 7.6% of available jobs. Careers as technical writers or editors for agricultural publications and agriculture instructors and trainers are always needed to keep the industry current.

Jobs in production represent the smallest percentage of available positions at 7.5% and they vary extensively from one job to the other. Many production jobs require knowledge and development of multiple skills such as operating various machines and equipment, handling chemicals safely, and understanding marketing strategies.

Overview

The following sections give examples with more specific information about careers in each employment category.

Marketing, Merchandising, and Sales

Field sales representatives can work in several areas of the agribusiness community. These areas include animal and feed products, mechanics and equipment, chemicals and pharmaceuticals, or crop production. This occupation requires knowledge of agriculture in general, knowledge of the product being sold, and good communication skills. It may be necessary for a person in this occupation to travel, act as a troubleshooter, understand computers, and be creative. A college degree is preferred but not always required.

A farmer's market or produce stand manager is a multifaceted job. The manager is usually both the producer of the product and the merchandiser. This job does not require a college education although bookkeeping skills may be useful for those individuals who own the produce stand. A knowledge of the produce sold, including which pesticides and herbicides were used, is as important as people skills, organization, and sales and marketing abilities.

<u>Marketing, Merchandising, and Sales</u>
Aerial Crop Duster
Agricultural Advertising Manager
Agricultural Association Executive
Agricultural Chemical Dealer
Agricultural Computer Software Salesperson
Agricultural Equipment Dealer
Biotechnology Documentation Specialist
Biotechnology Patent Administrator
Biotechnology Patent Agent
Chemical Distributor
Crop Insurance Agent
Diesel Mechanic
Farm Real Estate Broker
Feed Mill Operator
Feed or Fertilizer Truck Driver
Field Sales Representative, Animal and Feed Products
Field Sales Representative, Agriculture Mechanics
Field Sales Representative, Chemicals and Pharmaceuticals
Field Sales Representative, Crop Production
Food Broker
Food Processing Plant Technician
Fruit Distributor
Grain Buyer
Grain Elevator Operator
Grain Merchandiser
Groundskeeper
Insurance Agent
Landscape Architect or Contractor
Lawn and Garden Equipment Mechanic
Machinist
Pest Control Technician
Produce Buyer
Produce Stand Operator
Tobacco Buyer

Science and Engineering

An agronomist is an example of a career option in agriscience. Agronomists study soil and crops to gain knowledge of how to grow more productive crops. They usually specialize in a particular aspect of crops and soil, for example, the effects of vitamin C on various plants or how calcium deficiencies affect plants and soil. This career usually requires a master's or doctorate degree in agronomy or plant pathology. Agronomists are employed by private agricultural businesses, government entities, or they can be self-employed consultants.

Another occupation may be working with environmental management. Skills include observation, analysis, and interpretation. Environmental management jobs work with waste management, pollution, and wastewater treatment, just to name a few. These occupations involve people from all educational levels ranging from a high school education to a doctorate degree. Individuals in these careers may work indoors or outdoors and in an urban or a rural environment.

An agricultural machinery design technician designs machines and equipment that fulfill a variety of needs for the agriscience industry. This occupation requires working closely with agricultural engineers, crop producers, and equipment manufacturers to develop and test new designs. An agricultural machinery design technician should be experienced in the operation of agricultural machinery and knowledgeable of how the parts of the machine work together. Most technicians have a college degree and a good understanding of physics and mechanics.

Soil conservationists work with planning, conserving, and managing soil and water resources. They develop and implement land use practices to prevent erosion and protect the soil.

A soil conservationist should have a degree in agronomy, horticulture, or agricultural education. Many have master's or doctorate degrees. Soil conservationists typically work for governmental agencies, agribusinesses, or universities.

Scientists, Engineers, and Related Professionals
Agricultural Construction Engineer
Agricultural Equipment Designer
Agricultural Engineer
Agricultural Safety Engineer
Agricultural Engineer
Agricultural Statistician
Agriculturalist
Agronomist
Bacteriologist
Biochemist
Biophysicist
Biotechnology Manufacturing Technician
Biotechnology Product Development Engineer
Biotechnology Quality Control Engineer
Biotechnology Research Assistant or Associate
Biotechnology Validation Engineer or Technician
Botanist
Cell Biologist
Crop Consultant
Dairy Nutrition Specialist
Entomologist
Environmental Conservationist
Environmental Scientist
Feed Ration Developer
Food Chemist
Food Engineer
Food Scientist
Ground Water Geologist
Irrigation Engineer
Microbiologist
Molecular Biologist
Natural Resource Scientist
Nematologist
Organic Chemist
Parasitologist
Pharmaceutical Chemist
Plant Breeder
Plant Cytologist
Plant Ecologist
Plant Geneticist
Plant Nutritionist
Plant Pathologist
Plant Scientist
Plant Taxonomist
Range Conservationist
Rangeland Scientist
Research Engineer or Technician
Soil Conservationist
Soil Scientist
Toxicologist
Tree Surgeon
Virologist
Waste Management Specialist
Water Quality Specialist
Weed Scientist

Management and Finance

Nearly every career in the management and finance category requires at least a 4-year college education. An agricultural economist must be trained in both agricultural issues and economic issues. It is important to understand the role agriculture plays in the economy and its effect on agricultural prices and profits. Agriculture economists must be able to explain complicated economic issues to producers and address any concerns.

A winery supervisor must be capable of organizing employees and, in many cases, handling the bookkeeping duties of the winery. Winery supervisors may also be responsible for conducting tours of the facilities. They must be knowledgeable of the methods used in making the wine and of public relations techniques.

Managers and Financial Specialists
Agricultural Consultant
Agricultural Corporation Executive
Agricultural Credit Analyst
Agricultural Economist
Agricultural Financial Analyst
Agricultural Loan Officer
Agricultural Market Analyst
Biotechnology Regulatory Affairs Specialist
Commodity Broker
Export Sales Manager
Farm Investment Manager
Fertilizer Plant Supervisor
Financial Analyst
Food Processing Supervisor
Food Service Manager
Golf Course Superintendent
Land Bank Branch Manager
Produce Commission Agent
Quality Control Supervisor
Research Economist
Turf Manager
Water Resources Manager
Winery Supervisor

Overview

Social Service Professionals

The social service side of agriculture usually involves working for a governmental agency to ensure that produce is healthy and safe to eat. Many inspectors for areas as canning, preserving, and grain must have some college and technical training from the agency in which they are employed.

A Peace Corps representative is a job usually limited to individuals who have a great deal of experience in a specific area of expertise. Peace Corps workers usually travel to a foreign country and teach individuals in a country how to grow nutritious food and care for themselves and their children.

Social Service Professionals
Canning and Preserving Inspector
Christmas Tree Grader
Cotton Grader
Farm Appraiser
Federal Grain Inspector
Fiber Inspector
Food and Drug Inspector
Food Inspector
Fruit and Vegetable Grader
Game Warden
Insect and Disease Inspector
Land Surveyor
Park Manager
Peace Corps Representative
Safety Inspector
Weights and Measure Official
Wildlife Manager

Education and Communication

Journalists should be strong writers with a background in agriculture. Depending on the specialty area, skills in photography, graphics, broadcasting, and computer skills may be necessary. Opportunities exist in magazine publishing, newspaper editing, radio broadcasting, or television production. An agricultural journalist needs at least a community college education with a 4-year degree preferable.

A horticulture instructor must be knowledgeable of growing fruits, vegetables, and ornamental plants. This career requires a 4-year degree and teacher certification. Additional education is recommended. Individuals wishing to go into this field should enjoy working with students and talking about horticultural topics with others.

Education and Communication
Agricultural Computer Software Designer
Agricultural Educator/FFA Advisor
Agricultural Extension Agent
Agricultural Extension Specialist/ 4-H Leader
Agricultural Journalist
Agricultural Lawyer
Agricultural Mechanics Teacher
Agricultural News Director
Cooperative Extension Agent
Editor
Farm Auctioneer
Farm Broadcaster
Horticulture Instructor
Information Specialist/Crop Forecaster
International Trade Specialist
Public Relations Representative
Radio/TV Broadcaster

Production

A soybean producer is responsible for all activities involved in growing a successful crop of soybeans. He or she must decide how to prepare the land, what variety to plant, when to plant, and when to harvest. The actual day-to-day activities of the job depend on the season and the weather. Educational requirements vary; some producers have a high school education, others have up to 4 or more years of college. Important skills are familiarity with soybeans and experience with working on a soybean farm. Many soybean producers attend seminars and workshops to keep current with new production practices.

Cotton gin operators are responsible for a wide range of duties including managing the gin operation, hiring employees, and working with growers when the seed is delivered. Individuals in this job need mechanical skills, bookkeeping abilities, and skills in human relations. An operator usually begins as a gin worker and advances to a management position. Operators may have high school diplomas or 2- or 4-year college degrees.

A greenhouse manager/designer has the opportunity to work both indoors and outdoors. Greenhouse managers make sure the plants are growing according to schedule. A designer may either design greenhouses or arrange the plants according to the best growing location. Education

needed for the field varies depending on the technical level of the job.

Production
Certified Seed Grower
Custom Harvester
Custom Operator
Diversified Crop Producer
Farm Manager
Fruit Producer
Greenhouse Manager
Mushroom Producer
Nursery Operator
Nut Orchardist
Orchard Supervisor
Tree Producer
Turf Producer
Vegetable Producer

Educational Requirements

Most jobs in crop science require some type of education beyond high school. Although there are individuals who have obtained jobs without a high school diploma, this is becoming less common. With continuing advancements in precision agriculture, the demand for highly trained and educated individuals will increase. Anyone wishing to increase his/her chances of securing a job in crop science or a crop-related agribusiness should plan for and obtain the needed education.

An informal education (learning by observing) in crop science can be obtained from knowledge acquired growing up on a farm, working in production agriculture, or in an agribusiness environment. Formal education, or structured learning in a school setting, includes taking high school agriculture courses, vocational or technical training, or a required course of study to obtain a specific degree at a college or university.

Depending upon the career choice, a high school diploma, a certificate of vocational or technical training, or an associate, bachelor's, master's, or even a doctorate degree may be required. Table 3.1 lists the different levels of education and the name of the degree earned upon their successful completion. A major difference between a certificate program and a degree program is that a certificate program usually consists of a single course or several courses focusing upon a specific subject area, such as horticulture. A degree program is longer and includes general education classes along with course work in a specific subject area. Both types of education are classified as postsecondary education, or education that a person pursues after graduating from high school. Additional education and training are usually required to obtain a job in an advanced crop science career. For example, to become a crop physiologist, crop geneticist, or seed technician, one would need to obtain a master's degree in crop science.

Table 3.1 – Levels of Education

Level of Education	Certificate/ Degree Earned
Senior High School	Diploma
Postsecondary Education	
Technical School	Certificate
Community College	Associate's Degree
College/University	
4 years of study	Bachelor's Degree
5 to 6 years of study	Master's Degree
7 to 10 years of study	Doctorate Degree

Summary

Careers in crop science provide rewarding challenges in maintaining food, fiber, feed, and other crop production systems; protecting the quality of the environment; and conserving vital soil and water resources. Individuals in these positions can improve our communities, country, and world. Education requirements are varied depending on the career path chosen. Crop science or crop-related agribusiness jobs offer tremendous diversity and exciting challenges and pay salaries comparable to others in the job market.

Credits

Herren, Ray V. *The Science of Agriculture: A Biological Approach.* Albany, NY: Delmar Publishers, 1997.

Lee, Jasper S. et al. *The Earth and AgriScience.* AgriScience and Technology Series. Danville, IL: Interstate Publishers, Inc., 1995.

Lesson 4: Government Influence and Current Trends

The relationship between government programs and trade agreements to U.S. agriculture can be very complicated. This lesson will discuss what these programs are and provide some information on how they affect the production of crops in the United States. New trends in crop production that are playing a role in what farmers produce and how these items are produced will also be examined.

Government Programs and Trade Agreements

GATT (General Agreement on Tariffs and Trade), an international trade organization, started as an agreement among 23 nations in 1948. GATT members worked to minimize tariffs, quotas, preferential trade agreements between countries, and other barriers to international trade. During the organization's existence, GATT members sponsored eight separate rounds of trade negotiations. The last round ended in 1994, when GATT members and seven other nations signed a pact that will eventually cut tariffs and reduce or eliminate other obstacles to trade. This pact initiated the formation of the World Trade Organization (WTO), which took over GATT's functions. The WTO has stronger power to enforce agreements, including the authority to issue trade sanctions against a country that refuses to revoke an offending law or practice.

Before 1994 and the establishment of the WTO, there were many "holes" in the GATT agreement regarding trade restrictions on agricultural products. A significant accomplishment of the 1994 policy change was to close some of these holes by imposing disciplines on agricultural trade barriers and trade-distorting domestic farm policies. The United States is expected to experience a tremendous gain in trade in this global free trade environment due to its trade diversity.

NAFTA (North American Free Trade Agreement) is an agreement reached on January 1, 1994, among Canada, the United States, and Mexico. NAFTA is designed to foster increased trade and investment among its partners. It contains an ambitious schedule for tariff elimination and reduction of nontariff barriers between these three countries. As of January 1, 1998, nearly all tariffs on U.S.-Canada trade in originating goods were eliminated. Some tariffs remain in place for certain products in Canada's supply-managed sectors (e.g., dairy and poultry), as well as sugar, dairy, peanuts, and cotton in the United States. These tariffs are scheduled to be eliminated by January 1, 2003. Trade and investment between Canada, the United States, and Mexico have increased substantially since the NAFTA was initiated. Approximately $1.5 billion in goods and services now crosses the Canadian-U.S. border each day.

The development of an organized farm policy began in 1933 with the signing of the Agricultural Adjustment Act. This Act was designed to address the "farm problem" - low prices, supply surpluses, and low incomes in farm and rural communities. This legislation introduced commodity programs that included production and marketing controls and price and income support for many of the most important agricultural commodities. Farm policy legislation has seen several changes over the years but in 1996 major new legislation was introduced in the 1996 Federal Agricultural Improvement and Reform Act (FAIR).

FAIR, in effect until 2002, is a landmark in U.S. farm policy. First, it takes a major step toward phasing out commodity programs that have been in existence in some form since the 1930s. Second, it takes the United States to an almost fully market-oriented farm policy. This is designed to gradually reduce the government's influence in the agricultural sector through commodity programs.

With this new change, farm income could become more variable from year to year in response to supply and demand shocks. Marketing alternatives to manage risk will become more important for many producers. Increased planting flexibility and the elimination of annual supply management policies permit producers to alter production practices to more fully respond to changes in demand.

Another government program is the Conservation Reserve Program (CRP). CRP is a long-term, land retirement program designed to offset agriculture's adverse effects on the environment. When originally established in 1985, its purpose was to conserve and improve soil, water, and

wildlife resources. This was done by establishing cover on highly erodible and other environmentally sensitive land through 10- and 15-year leases. This program has been continued through 1990, 1995, and the new 1996 Federal Agricultural Improvement and Reform Act. The current renewal gave the Secretary of Agriculture the authority to conduct sign-ups through 2002 with a 36.4 million-acre cap on enrollment.

The two largest benefits of the CRP are the increases in the value of market sales of farm commodities and the reduction of commodity deficiency payments from the Commodity Credit Corporation (CCC). These effects are the result of higher market prices caused by the idling of formerly cultivated farmland. In addition to these effects on agricultural income, there have been benefits to the public sector of the economy and those individuals living off the farm. The CRP program has benefitted these individuals through improved water quality and improved wildlife species habitat, resulting in better hunting and fishing.

Current Trends in Crop Production

During the last decade, crop producers have witnessed several major changes in agriculture. New technologies and trends have developed. Some of these include the development of organic farming, the use of genetically modified crops, alternative or sustainable agricultural programs, the use of precision farming techniques, and the further development of Integrated Pest Management systems.

Organic Foods

The organic foods movement was developed by some crop producers to promote healthier foods and to protect the environment. This is being done by encouraging producers to use agricultural methods that neither deplete the soil nor hurt environmental systems or farm workers. Organic farming also promotes biological diversity and the recycling of resources through such methods as crop rotation, rotational grazing, planting of cover crops, intercropping, animal and plant waste recycling, tilling, and adding minerals to crops.

The National Organic Standards Board defined "certified organic" at its meeting in April 1995. They stated that organic is a labeling term that denotes products produced under the authority of the Organic Foods Production Act. The principal guidelines for organic production are to use materials and practices that enhance the ecological balance of natural systems and that integrate the parts of the farming system into an ecological whole.

Organic agricultural practices cannot ensure that products are completely free of residues; however, methods are used to minimize pollution for air, soil, and water. Organic food handlers, processors, and retailers follow standards that maintain the integrity of organic agricultural products. Much controversy has developed in trying to define those standards.

The USDA first proposed a set of national organic standards in 1997. They were withdrawn after producers and others in the organic industry strongly objected to provisions that could have allowed the use of sewage sludge as fertilizer and genetically engineered and irradiated ingredients.

In March 2000, the USDA released new national standards for growing and processing organic food that will prohibit the use of genetic engineering or irradiation. They will also prohibit the use of antibiotics in livestock production and require the use of organic feed. The Secretary of Agriculture said the new standards are the most comprehensive and the strictest organic rules in the world. The rules allow products that meet these standards to carry a seal of approval that says "USDA Certified Organic." The new rules will replace a mixture of state and private standards. Enforcement of the new standards will be left up to states and private certifying agencies.

Genetically Modified Crops

One of the most controversial subjects to arise in agriculture in the last few years involves the development of genetically modified organisms, or GMOs. Genetic research with crops is not new. For many years, new strains of wheat, corn, and other agricultural crops have been developed through selective plant breeding. However, agricultural scientists now have the ability, through sophisticated biotechnology techniques, to split genes, alter genes, and recombine plant DNA to make drastic changes to plants.

Possibilities for genetic engineering are endless. It remains to be seen how many visions scientists

have for our future will become commonly accepted practice but there is no doubt that genetic engineering is here to stay. Genetic engineering will help the world meet the challenges of a growing, hungry population.

In 1998, 15 years after the first gene was deliberately inserted into a plant and just 1 year after large-scale introduction, genetically engineered seeds are germinating on 65 million acres of prime farmland. Two of the most talked about outcomes of genetic engineering, Bt corn and herbicide-resistant soybeans, have initiated much debate worldwide as to the ethics of this technology. Bt corn can control the corn borer insect by creating a substance that is toxic to the worm when it attacks the corn plant. The herbicide resistance of soybeans allows for better control of weeds, improving soybean yields.

Genetic engineering and biotechnology have the potential for improving proteins, fat, and vitamins in crops grown for livestock feeds. It also has the potential to increase resistance to drought, frost, and bacterial damage to plants, which will result in an increased food supply for the world.

Critics contend that genetically modified seeds are a vast, uncontrolled experiment being carried out on millions of acres. They are concerned that transgenic seeds will benefit the large corporations selling the new seeds. These critics warn that large producers may benefit for a time, but organic farmers, the environment, and the consumer may suffer long-term damage. Those who oppose GMOs cite the possibility of Bt corn pollen being deadly on monarch butterflies. Some researchers report natural insecticides produce a toxin for nontarget species like the caterpillars that become the monarch butterflies. Other opponents say the long-term consequences for human health and the environment of these new technologies are unknown.

Alternative or Sustainable Agriculture

Alternative or sustainable agricultural practices are receiving more attention in the agricultural community. Many producers are adding or changing over to other sources of agricultural income. The raising of elk, bison, or other nontraditional animals for meat is becoming popular. New crops such as one of the many varieties of berries or shiitake mushrooms are being produced with excellent results.

These new agricultural alternatives require investigation into their production methods and a changing of marketing strategies. Each year, more producers are developing these new cropping methods to a large degree of success.

Precision Farming

Precision farming means carefully tailoring soil and crop management to fit the different conditions found in each field. Precision farming is sometimes known as "prescription farming," "site-specific farming," or "variable rate farming." It has created new uses for technologies such as remote sensing, geographic information systems (GIS), and global positioning systems (GPS). The costs of obtaining and using these technologies have been the biggest deterrent in their regular use.

The real value for the producer is that seeding rates can be adjusted, crop protection programs can be planned more accurately, tillage can be done in a more timely fashion, and yield variation within a field can be determined. These benefits will enhance the overall cost-effectiveness of the crop production. Producers are able to record observations during the growing season such as weed growth, unusual plant stress or coloring, and growth conditions. This information can be used to guide crop producers in operations like spraying, fertilizing, and irrigating.

Precision farming will make a strong impact on the way producers manage their farm operations in the future. There is expected to be a tremendous growth in the use of these technologies as a way to "farm by the inch."

Integrated Pest Management

Integrated Pest Management (IPM) is an approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that reduces economic, health, and environmental risks. IPM is a systematic approach to pest suppression and management that uses increased information and improved decision making to reduce reliance on purchased inputs and to improve crop yield and quality. Integrated Pest Management decisions are based on ecological and economic principles.

Traditionally, a pest means any organism that interferes with the production of a crop. Generally, that includes insects, diseases, and weeds. There are many other types of pests including nematodes, arthropods other than insects, and vertebrates.

IPM includes pest management tactics such as biological control or the use of beneficial organisms (predators, parasites, diseases) to suppress pest organisms. Cultural control includes the use of crop rotations, cultivation, sanitation, and other farm practices that reduce persistent pest problems. Physical controls involve the use of barriers, traps, or the adjustment of planting location or timing to evade or diminish pest pressure. IPM may include the use of plant-resistant materials to avoid pest problems and includes the use of conventional pesticides, biopesticides, and other chemicals to prevent or suppress a pest outbreak.

IPM requires a grower to understand how the crop grows, how different pest populations develop, what control options are available in each specific management case, and what the return on investment is in relationship to the potential impact on the environment or health of consumers. This means that producers and their consultants will spend more time observing and interpreting the potential impact of pest populations.

Summary

Agricultural production has changed greatly during this last century. Government policy has also experienced these changes. These policies have been initiated to assist the agricultural producers through problems with production and marketing, and with marketing locally as well as in a global economy. The interaction and trade between countries are very complicated because many variables play a role in trade policies. New methods used in agricultural production are emerging. The use of Integrated Pest Management, alternative farming programs, the use of satellites for precision farming, and developing genetically modified crops is causing excitement as well as concern in the agricultural world.

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