



National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE

MANUAL OF CLASSIFICATION FOR AGRICULTURAL AND FORESTRY RESEARCH, EDUCATION, AND EXTENSION

Revision X

Classifications used in the
Research, Education, and Extension
Project Online Reporting Tool (REEport) and
the NIFA Reporting System (NRS)

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Introduction

The ***Manual of Classification for Agricultural and Forestry Research, Education, and Extension*** is the authority for classifying research, education, and extension activities in the [Research, Education, and Extension Project Online Reporting Tool \(REEport\)](#) and the [NIFA Reporting System \(NRS\)](#). It is specifically intended for use when:

- completing the Project Initiation Form in REEport for competitive grant projects
- completing Project Changes in REEport for competitive grant projects
- adding or updating capacity-funded Projects/Programs in NRS

The current version of the classification manual, Version X, maintains the three-dimensional classification scheme.

1. The Knowledge Area (KA) codes classify the project/program work by the overarching research, extension, or education topic(s). In this manual, the KAs are grouped together under broader Topic Areas in Section 1 and then listed individually in Sections 2 and 5.

NOTE: For reference when completing the Plan of Work in NRS, the KAs align with NIFA's nine Science Emphasis Areas (SEAs); for more information on how they align, see the information and crosswalk document available on the [SEA and KA Connection webpage](#).

2. The Subject of Investigation (SOI) codes provide an additional facet for classification. It is generally the object of the research or activity: the class of plant, animal, organism, material, process, procedure, etc., under investigation.
3. The Field of Science (FOS) codes are a modified version of the fields of science used by the National Science Foundation for various government wide reports.

The following updates are included in this version:

- Updates to classifications KA 132 Short Term and Decadal Weather, SOI 0430 Decadal weather patterns, and FOS 2070 Meteorology
- Updates to the descriptions for:
 - KA 125. Agroforestry
 - KA 132. Short Term and Decadal Weather
 - KA 141. Air Resource Protection and Management
 - KA 211. Insects, Mites, and Other Arthropods Affecting Plants
 - KA 214. Vertebrates, Mollusks, and Other Pests Affecting Plants
 - KA 216. Integrated Pest Management Systems
 - KA 306. Environmental Stress in Animals
 - KA 605. Natural Resource and Environmental Economics
 - KA 609. Economic Theory and Methods
 - KA 802. Human Development and Family Well-Being
 - KA 803. Sociological and Technological Change Affecting Individuals, Families, and Communities
 - KA 806. Youth Development
 - KA 807. Disaster Preparedness, Mitigation, Response, and Recovery

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Section 1. Topic Areas

This section is a summary list of the Topic Areas and their associated Knowledge Area (KA) codes. The hyperlinks below will take you to the associated list of KA names and codes in Section 2.

- I. [Natural Resources and Environment](#)
[\(KAs 101-141\)](#)**
- II. [Plants and their Systems](#)
[\(KAs 201-216\)](#)**
- III. [Animals and their Systems](#)
[\(KAs 301-315\)](#)**
- IV. [Agricultural, Natural Resource, and Biological Engineering](#)
[\(KAs 401-405\)](#)**
- V. [Food and Non-Food Products: Development, Processing, Quality, and Delivery](#)
[\(KAs 501-512\)](#)**
- VI. [Economics, Markets, and Policy](#)
[\(KAs 601-611\)](#)**
- VII. [Human Nutrition, Food Safety, and Human Health and Well-Being](#)
[\(KAs 701-724\)](#)**
- VIII. [Families, Youth, and Communities](#)
[\(KAs 801-807\)](#)**
- IX. [Program and Project Support, and Administration, Education, and Communication](#)
[\(KAs 901-903\)](#)**

Section 2. Knowledge Areas

In this section, the Knowledge Area names and codes are organized by their Topic area. The hyperlinks below will take you to the KA descriptions in Section 5 of this document.

Topic I. Natural Resources and Environment

Soil

- 101. Appraisal of Soil Resources
- 102. Soil, Plant, Water, Nutrient Relationships
- 103. Management of Saline and Sodic Soils and Salinity
- 104. Protect Soil from Harmful Effects of Natural Elements

Water

- 111. Conservation and Efficient Use of Water
- 112. Watershed Protection and Management

Forest and Range Resources

- 121. Management of Range Resources
- 122. Management and Control of Forest and Range Fires
- 123. Management and Sustainability of Forest Resources
- 124. Urban Forestry
- 125. Agroforestry

Natural Resources, General

- 131. Alternative Uses of Land
- 132. Short Term and Decadal Weather
- 133. Pollution Prevention and Mitigation
- 134. Outdoor Recreation
- 135. Aquatic and Terrestrial Wildlife
- 136. Conservation of Biological Diversity

Air

- 141. Air Resource Protection and Management

Topic II. Plants and their Systems

Plant Production

- 201. Plant Genome, Genetics, and Genetic Mechanisms
- 202. Plant Genetic Resources
- 203. Plant Biological Efficiency and Abiotic Stresses Affecting Plants

- 204. Plant Product Quality and Utility (Preharvest)
- 205. Plant Management Systems
- 206. Basic Plant Biology

Plant Protection

- 211. Insects, Mites, and Other Arthropods Affecting Plants
- 212. Pathogens and Nematodes Affecting Plants
- 213. Weeds Affecting Plants
- 214. Vertebrates, Mollusks, and Other Pests Affecting Plants
- 215. Biological Control of Pests Affecting Plants
- 216. Integrated Pest Management Systems

Topic III. Animals and their Systems

Animal Production

- 301. Reproductive Performance of Animals
- 302. Nutrient Utilization in Animals
- 303. Genetic Improvement of Animals
- 304. Animal Genome
- 305. Animal Physiological Processes
- 306. Environmental Stress in Animals
- 307. Animal Management Systems
- 308. Improved Animal Products (Before Harvest)

Animal Protection

- 311. Animal Diseases
- 312. External Parasites and Pests of Animals
- 313. Internal Parasites in Animals
- 314. Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
- 315. Animal Welfare/Well-Being and Protection

Topic IV. Agricultural, Natural Resource, and Biological Engineering

- 401. Structures, Facilities, and General Purpose Farm Supplies
- 402. Engineering Systems and Equipment
- 403. Waste Disposal, Recycling, and Reuse
- 404. Instrumentation and Control Systems
- 405. Drainage and Irrigation Systems and Facilities

Topic V. Food and Non-Food Products: Development, Processing, Quality, and Delivery

Food

- 501. New and Improved Food Processing Technologies
- 502. New and Improved Food Products
- 503. Quality Maintenance in Storing and Marketing Food Products
- 504. Home and Commercial Food Service

Non-Food

- 511. New and Improved Non-Food Products and Processes
- 512. Quality Maintenance in Storing and Marketing Non-Food Products

Topic VI. Economics, Markets, and Policy

- 601. Economics of Agricultural Production and Farm Management
- 602. Business Management, Finance, and Taxation
- 603. Market Economics
- 604. Marketing and Distribution Practices
- 605. Natural Resource and Environmental Economics
- 606. International Trade and Development
- 607. Consumer Economics
- 608. Community Resource Planning and Development
- 609. Economic Theory and Methods
- 610. Domestic Policy Analysis
- 611. Foreign Policy and Programs

Topic VII. Human Nutrition, Food Safety, and Human Health and Well-Being

Human Nutrition

- 701. Nutrient Composition of Food
- 702. Requirements and Function of Nutrients and Other Food Components
- 703. Nutrition Education and Behavior
- 704. Nutrition and Hunger in the Population

Food Safety

- 711. Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
- 712. Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Human Health

- 721. Insects and Other Pests Affecting Humans
- 722. Zoonotic Diseases and Parasites Affecting Humans
- 723. Hazards to Human Health and Safety
- 724. Healthy Lifestyle

Topic VIII. Families, Youth, and Communities

- 801. Individual and Family Resource Management
- 802. Human Development and Family Well-Being
- 803. Sociological and Technological Change Affecting Individuals, Families, and Communities
- 804. Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures
- 805. Community Institutions, Health, and Social Services
- 806. Youth Development
- 807. Disaster Preparedness, Mitigation, Response, and Recovery

Topic IX. Program and Project Support, and Administration, Education, and Communication

- 901. Program and Project Design, and Statistics
- 902. Administration of Projects and Programs
- 903. Communication, Education, and Information Delivery

Section 3. Subjects of Investigation

In this section, the Subject of Investigation codes are organized by their Subject Area and Subject. To skip ahead to the listed Subject Area, click on the hyperlinks below.

- [Natural Resources and their Products](#)
- [Plants and their Products](#)
- [Animals, Including Invertebrates, and their Products](#)
- [Microorganisms](#)
- [Food and Manufactured Resources](#)
- [Human Resources, Organizations, and Institutions](#)
- [Other Technologies](#)

Natural Resources and their Products

Code Subject

Soil and Land

0110 Soil
0120 Land
0199 Soil and land, general

Water

0210 Water resources

Watersheds and River Basins

0310 River basins
0320 Watersheds
0330 Wetland and riparian systems
0399 Watersheds and river basins, general

Atmosphere

0410 Air
0420 Weather
0430 Decadal weather patterns
0440 Solar radiation
0499 Atmosphere, general/other

Recreational Resources

- 0510 Wilderness
- 0520 Campgrounds and picnic areas
- 0530 Parks and urban green space
- 0599 Recreational resources, general/other

Trees, Forests, and Forest Products (Excluding Edible Tree Nut Crops)

- 0610 Conifer forests of the North
- 0611 Conifer forests of the South
- 0612 Conifer forests of the West
- 0613 Mixed conifer-broadleaf forests
- 0620 Broadleaf forests of the North
- 0621 Broadleaf forests of the South
- 0622 Broadleaf forests of the West
- 0630 Chaparral and shrub lands
- 0640 Tropical forests
- 0650 Wood and wood products
- 0660 Paper and pulp derived products
- 0670 Short rotation woody crops, including holiday trees
- 0680 Other products of the forest
- 0699 Trees, forests, and forest products, general

Rangelands and Grasslands

- 0710 Desert and semidesert shrub land and shinnery
- 0720 Pinyon-juniper
- 0730 Mountain grasslands, meadow, and alpine
- 0780 Grasslands, other
- 0790 Rangelands, other
- 0799 Rangelands and grasslands, general

Wildlife and Natural Fisheries Management, Endangered Species

- 0810 Finfish
- 0811 Shellfish
- 0812 Fish habitats
- 0819 Natural fisheries, other
- 0820 Wild birds
- 0830 Wild animals
- 0840 Fur-bearing animals
- 0850 Wildlife habitats
- 0860 Endangered species
- 0899 Wildlife and natural fisheries, general/other

Plants and their Products

Code Subject

Citrus

- 0910 Grapefruit
- 0920 Orange
- 0930 Lemon
- 0999 Citrus, general/other

Tropical/Subtropical Fruit

- 1010 Banana
- 1020 Pineapple
- 1030 Papaya
- 1040 Mango
- 1050 Date
- 1060 Kiwi
- 1099 Tropical/subtropical fruit, general/other

Deciduous and Small Fruits

- 1110 Apple
- 1111 Apricot
- 1112 Cherry
- 1113 Nectarine
- 1114 Peach
- 1115 Pear
- 1116 Plum
- 1119 Deciduous tree fruits, general/other
- 1120 Blueberry
- 1121 Cranberry
- 1122 Strawberry
- 1123 Raspberry
- 1129 Berries and cane fruits, general/other
- 1130 Table grapes
- 1131 Wine grapes
- 1132 Raisin grapes
- 1139 Grapes, general/other
- 1199 Deciduous and small fruits, general/other

Edible Tree Nuts

- 1210 Filbert
- 1211 Pecan
- 1212 Almond
- 1213 Walnut
- 1219 Edible tree nuts, general/other

Potato

- 1310 Potato

Vegetables

- 1410 Beans (dry)
- 1411 Beans (fresh, fresh-processed)
- 1412 Peas (dry)
- 1413 Peas (fresh, fresh-processed)
- 1414 Lentil
- 1419 Leguminous vegetables, general/other
- 1420 Melons (includes cantaloupe, muskmelon, watermelon)
- 1421 Cucumber
- 1429 Cucurbits, other (includes pumpkin, squash, gourd)
- 1430 Greens and leafy vegetables (includes endive, lettuce, spinach, turnip- greens, celery, rhubarb, parsley, asparagus)
- 1440 Cole crops (includes cabbage, kale, broccoli, brussels sprouts, cauliflower, kohlrabi)
- 1450 Sweet potato
- 1451 Onion, garlic, leek, shallot
- 1452 Carrot
- 1453 Yam
- 1454 Taro
- 1455 Cassava (or manioc)
- 1459 Rhizomes, tubers, bulbs, and root crops, general/other (for potato use 1310)
- 1460 Tomato
- 1461 Peppers
- 1462 Eggplant
- 1469 Solanaceous and related crops, general/other (for potato use 1310)
- 1470 Mushrooms and other edible fungi
- 1480 Sweetcorn
- 1499 Vegetables, general/other

Grain Crops

- 1510 Corn (for sweetcorn use 1480)
- 1511 Popcorn
- 1520 Grain sorghum
- 1530 Rice
- 1540 Hard red winter wheat
- 1541 Hard red spring wheat
- 1542 Soft red wheat
- 1543 Soft white wheat (includes club, western)
- 1544 Hard white wheat
- 1545 Durum wheat
- 1549 Wheat, general/other
- 1550 Barley
- 1560 Oats
- 1570 Rye
- 1599 Grain crops, general/other (includes buckwheat, millet, triticale)

Pasture and Forage Crops

- 1610 Pasture
- 1620 Warm season perennial grasses (includes dallisgrass, bluestems, bermudagrass)
- 1621 Cool season perennial grasses (includes bluegrass, brome grass, fescue, orchardgrass, perennial ryegrass, timothy, wheatgrass)
- 1629 Perennial grasses, other
- 1630 Summer annual grasses (includes forage sorghums, sudangrass, sorghum-sudangrass hybrids)
- 1631 Winter annual grasses (includes annual ryegrass)
- 1639 Annual grasses, other
- 1640 Alfalfa
- 1641 Trefoil
- 1642 Red clover
- 1643 Crownvetch
- 1644 Winter annual legumes (includes subterranean clover, arrowleaf clover)
- 1649 Forage legumes, general/other
- 1699 Pasture and forage crops, general/other

Fiber Crops

- 1710 Upland cotton
- 1711 Long fiber cotton
- 1719 Cotton, other
- 1720 Kenaf
- 1730 Hemp
- 1740 Ramie
- 1750 Agave
- 1799 Fiber crops, general/other

Oilseed and Oil Crops

- 1810 Cottonseed (for meal, oil, etc.)
- 1820 Soybean
- 1830 Peanut
- 1840 Castor
- 1841 Crambe
- 1842 Flax
- 1843 Safflower
- 1844 Sunflower
- 1845 Jojoba
- 1846 Coconut
- 1847 Palm
- 1848 Canola
- 1849 Cuphea
- 1850 Lesquerella
- 1851 Meadowfoam
- 1852 Rape
- 1853 Sesame
- 1854 Chinese tallow
- 1855 Tung

1899 Oilseed and oil crops, general/other

Tobacco

1910 Flue-cured tobacco
1920 Burley tobacco
1930 Cigar-type tobacco
1999 Tobacco, general/other

Sugar Crops

2010 Sugar beet
2020 Sugar cane
2030 Sweet sorghum
2099 Sugar crops, general/other

Ornamentals and Turf

2110 Ornamental trees and shrubs
2120 Herbaceous perennials and decorative greens
2121 Cut flowers, foliage, and greens
2122 Potted plants
2123 Bedding/garden plants
2129 Florist crops, other
2130 Turf (includes bentgrass, bermudagrass, bluegrass, dichondra, fescue, ryegrass, zoysia)
2140 Ground covers
2150 Aquatic plants
2160 Arboreta and botanical gardens
2199 Ornamentals and turf, general/other (includes cacti)

Miscellaneous and New Crops

2210 Chemurgic crops
2220 Medicinal crops, non-narcotic
2221 Narcotic plants
2230 Hops
2231 Mint
2232 Coffee
2233 Cocoa
2234 Tea
2235 Herbs and spices
2239 Flavoring and beverage plants, general/other
2240 Guayule
2241 Hevea
2242 Gums
2249 Rubber, gum, and resin plants, general/other
2299 Miscellaneous and new crops, general/other

Weeds

2300 Weeds

Plants

- 2410 Cross-commodity research--multiple crops
- 2420 Noncrop plant research
- 2499 Plant research, general

Animals, Including Invertebrates, and their Products

Code Subject

Bees, Honey, and Other Pollinators

- 3010 Honey bees
- 3040 Honey, honey products, and apiary products
- 3085 Other bees (non-Apis bees) - All bees except Apis cerana; includes Bombas, Alfalfa leaf-cutter
- 3095 Other non-bee pollinators, general

Invertebrates

- 3110 Insects
- 3120 Spiders, mites, ticks, and other arthropods
- 3130 Nematodes
- 3199 Invertebrates, general/other

Poultry

- 3210 Egg-type chicken, live animal
- 3220 Meat-type chicken, live animal
- 3230 Turkey, live animal
- 3240 Duck and goose, live animal
- 3250 Ratites (e.g., ostrich, emu, rhea), live animal
- 3260 Poultry meat
- 3270 Eggs
- 3280 Other poultry products
- 3299 Poultry, general/other

Beef Cattle

- 3310 Beef cattle, live animal
- 3320 Meat, beef cattle
- 3330 Other beef cattle products
- 3399 Beef cattle, general/other

Dairy Cattle

- 3410 Dairy cattle, live animal
- 3420 Butter
- 3430 Cheese
- 3440 Meat, dairy cattle
- 3450 Milk
- 3460 Ice cream
- 3470 Other dairy cattle products
- 3499 Dairy cattle, general/other

Swine

- 3510 Swine, live animal
- 3520 Meat, swine
- 3530 Other swine products
- 3599 Swine, general/other

Sheep and Wool

- 3610 Sheep, live animal
- 3620 Meat, sheep
- 3630 Wool fiber
- 3699 Sheep and wool, general/other

Cultured Aquatic Animals

- 3710 Catfish
- 3711 Trout
- 3712 Salmon
- 3713 Striped bass
- 3714 Tilapia
- 3715 Baitfish (minnows and shiners)
- 3716 Ornamental finfish
- 3719 Other cultured finfish
- 3720 Crawfish
- 3721 Marine shrimp
- 3722 Freshwater shrimp
- 3723 Oysters
- 3724 Clams and mussels
- 3725 Ornamental shellfish
- 3729 Other cultured shellfish
- 3799 Cultured aquatic animals, general/other

Other Animals

- 3810 Horses, ponies, and mules
- 3820 Goats, meat and mohair
- 3830 Pets (companion animals)
- 3840 Laboratory animals
- 3899 Other animals, general

Animals

- 3910 Cross-commodity research--multiple animal species
- 3999 Animal research, general

Microorganisms

Code Subject

- 4010 Bacteria
- 4020 Fungi (includes yeast)
- 4030 Viruses
- 4040 Viroids, mycoplasmas, spiroplasmas, etc.
- 4050 Protozoa
- 4099 Microorganisms, general/other

Food and Manufactured Resources

Code Subject

- 5010 Food (not readily associated with specific plant and animal products)

Clothing and Textiles

- 5110 Clothing/apparel
- 5120 Textiles
- 5199 Clothing and textiles, general

Agricultural Supplies

- 5210 Fertilizers
- 5220 Pesticides (includes herbicides, insecticides, fungicides, etc.)
- 5230 Feed and feed additives
- 5240 Seeds and other plant propagules
- 5299 Agricultural supplies, general/other

Structures, Facilities, and Equipment

- 5310 Machinery and equipment
- 5320 Houses (human residences), furniture, household equipment, non-textile furnishings
- 5330 Farm structures and related facilities
- 5340 Nonfarm structures and related facilities, including those used in marketing, storing, processing, and distributing functions, and for recreational uses
- 5350 Domestic and community water supply facilities and systems
- 5360 Drainage and irrigation facilities and systems
- 5370 Sewage and waste disposal facilities and systems
- 5399 Structures, facilities, and equipment, general/other

Human Resources, Organizations, and Institutions

Code Subject

People and Communities

- 6010 Individuals (as workers, consumers, members of society)
- 6020 The family and its members
- 6030 The farm as an enterprise
- 6040 Real estate
- 6050 Communities, areas, and regions, including states and their institutions and organizations
- 6099 People and communities, general/other

Economy

- 6110 Economy of the United States and sectors thereof
- 6120 International economy and sectors thereof
- 6199 Economy, general/other

Marketing

- 6210 Farmer cooperatives
- 6220 Marketing, processing, and supply firms other than cooperatives
- 6230 Marketing systems and sectors thereof
- 6299 Marketing, general/other

Other Technologies

(Use the following classifications only if the research or activity is not targeted at one or more previously listed specific subjects of investigation)

Code Subject

- 7010 Biological Cell Systems
- 7110 Research on research management (not research management per se)

Research Equipment and Methods

- 7210 Remote sensing equipment and technology
- 7220 Sensory evaluation/analysis methods (human senses)
- 7299 Research equipment and methods, general/other

Experimental design and statistical methods

- 7310 Experimental design and statistical methods

General technology

- 7410 General technology

Section 4. Fields of Science

In this section, the Field of Science codes are organized by their subject.

Code Subject

Biological

1000	Biochemistry and biophysics
1010	Nutrition and metabolism
1020	Physiology
1030	Cellular biology
1040	Molecular biology
1050	Developmental biology
1060	Biology (whole systems)
1070	Ecology
1080	Genetics (excludes breeding)
1081	Breeding
1090	Immunology
1100	Bacteriology
1101	Virology
1102	Mycology
1103	Other microbiology (includes protozoology, phycology, etc.)
1110	Parasitology
1120	Nematology
1130	Entomology and acarology
1140	Weed science
1150	Toxicology
1160	Pathology
1170	Epidemiology
1180	Pharmacology
1190	Limnology

Physical

2000	Chemistry
2010	Physics
2020	Engineering
2030	Geology
2040	Mineralogy
2050	Hydrology
2060	Geography
2061	Pedology
2070	Meteorology
2080	Mathematics and computer sciences
2090	Statistics, econometrics, and biometrics

Social and Behavioral

- 3000 Anthropology
- 3010 Economics
- 3020 Education
- 3030 Information and communication
- 3040 History
- 3050 Law
- 3060 Political science
- 3070 Psychology
- 3080 Sociology
- 3090 Sensory science (human senses)
- 3100 Management
- 3110 Art and architecture
- 3111 Landscape architecture

Section 5. Knowledge Area Descriptions

In this section, each KA is described in more detail, including work area examples and exclusions.

Topic I. Natural Resources and Environment

Soil

KA 101. Appraisal of Soil Resources

Work in support of soil mapping is concerned with identifying the important soil parameters for use in crop production, site-specific management, forest and range resource evaluation, housing developments, zoning, waste management, environmental urban planning, and other land uses. Soil surveys can also be used to show soil characteristics such as spatial and temporal variability, susceptibility to frost heave or slippage, depth to water table, depth to rock or other impermeable barriers, bearing strength, flood hazard, and soil erosion potential that affect suitability of a site for specific uses.

Areas of work include but are not limited to:

- Physical, chemical, mechanical, and biological characteristics of soils needed in soil classification and management
- Identification of soil types and their suitability for specific uses
- Appraisal of how soils behave under different levels of management and use such as crop production, logging, grazing, water utilization and yield, and other agricultural, forestry, waste disposal, and non-agricultural uses
- Soil resource description and inventory, including their spatial and temporal variability
- Use of geographic information systems and remote sensing technologies.

Exclude:

- Soil testing for agricultural, forest, and range production (use KA 102).

KA 102. Soil, Plant, Water, and Nutrient Relationships

This knowledge area is concerned with the chemical and physical nature of interrelationships among soils, plants, water, and nutrients. The objective is to improve, maintain, or restore the inherent production capability of soils.

Areas of work include but are not limited to:

- Soil testing and plant analysis
- Resource development, conservation, and management
- Factors that limit root development of plants
- Development of practical methods for ameliorating unfavorable conditions, such as tillage pans, nutrient deficiencies, and improper air-water relationships
- Ways to maintain and improve soil structure by soil amendments and by soil, crop, tillage, and management systems
- The effect of physical, chemical, and biological properties of soils on soil structure, resistance to erosion, availability of plant nutrients, and the general environment for plant roots
- Chemical changes of nutrient elements in different kinds of soils and the factors affecting uptake by

- various crops
- Methods to make beneficial changes in energy dissipation and utilization in the soil- plant-atmosphere relationships
- Interrelationships between soil properties and their impacts on water storage and movement in the soil profile
- Effects and actions of biological organisms on soil and organic matter function and plant relationships
- Use of manures and other organic materials as plant nutrient sources.

Exclude:

- Precision farming methodology (use KA 205 or 402)
- Response of plant species to variables of soil, plant, water, and nutrient conditions (use appropriate KA under PLANTS AND THEIR SYSTEMS or FOREST AND RANGE RESOURCES)
- Effects of erosion, fire, flood, and other natural hazards on the soil resource (use KA 104).

KA 103. Management of Saline and Sodic Soils and Salinity

This area is concerned with injurious accumulations of salts that may occur in the root zone of soil because salts move upward in the soil with water and are left behind as the water evaporates. Work in this area also concerns salts that can be leached downward to the groundwater or to a drainage system as the result of heavy rainfall or irrigation, as well as salinity and brackish water problems that may occur in seaboard areas.

Areas of work include but are not limited to:

- Leaching theory and methods to predict rates and amounts of various qualities of leaching waters and related drainage system requirements to reclaim soils having salt accumulations
- Methods of treating and managing saline irrigation water and leaching effluents
- Management criteria for use of brackish water of various qualities under a wide range of soil, crop, and environmental conditions
- Tillage, crop, soil amendment, leaching, and profile modification practices for crop production on saline and sodic soils
- Interactions of soil structure, dissolved and adsorbed ions, microbial activity, organic matter, and moisture movement in the root zone of salt-affected soils
- Procedures and equipment for determining the salinity status of soils and irrigation waters
- Plants or cropping sequences for managing or improving saline soils
- Breeding and selection of salt-tolerant varieties.

Exclude:

- Effects of human-caused salt pollution such as that from industrial sources (use KA 133).

KA 104. Protect Soil from Harmful Effects of Natural Elements

This work focuses on protection of soils from impairment as a result of natural events.

Areas of work include but are not limited to:

- Effects of wind and water erosion
- Effects of floods
- Effects of landslides
- Effects of wildfire
- Subsidence of organic soils.

Exclude:

- Resource development and conservation management (use KA 102, 112, or 131).

Water

KA 111. Conservation and Efficient Use of Water

Work in this area attempts to increase efficiency in collecting, storing, conveying, using, and reusing available water resources.

Areas of work include but are not limited to:

- Procedures to monitor and improve effectiveness of water storage in the soil profile and underground aquifers
- Improved water conservation practices such as residue management that will be compatible with modern mechanized agricultural practices
- Selection and breeding of plant varieties to make efficient use of water through the various stages of plant growth
- Alternative practical techniques for reducing water loss from plant, soil, and water surfaces
- Practices to enhance water infiltration, transmission, and use by plants
- Methods to conserve, replenish, and effectively use water in underground storage
- Studies or activities designed to control phreatophytes and aquatic weeds to reduce the damage or losses they cause
- Water in wetland and riparian systems
- Wetland construction or renovation.

Exclude:

- Aquatic weeds as a pollutant (use KA 133)
- Economic and policy issues of water (use KA 605 or 610).

KA 112. Watershed Protection and Management

This area is intended to focus on soil and water management problems at whole watershed scales, as opposed to problems of more localized scale. These watersheds include the cropland of the U.S. as well as range and forest lands. Work in this area can encompass one or more of the following: flood prevention systems, sediment control, wind and water erosion control, and management strategies oriented toward water yield and quality.

Areas of work include but are not limited to:

- New concepts and mathematical expressions of the erosion processes by wind and water at the watershed scale
- Procedures for identifying sediment sources, predicting and measuring sediment deposition, and methods for sediment control
- Measures for controlling erosion on watershed lands and stream channel systems in rural and urban environments, and methods for reclaiming eroded lands
- Methods for quantifying the role of soil and vegetation in the hydrologic performance of watersheds and river basins, and the impact of management practices which change topographic and vegetative characteristics
- Improved procedures for use of watersheds and river basins to assure needed agricultural and forest products, keep soil erosion and sedimentation to an acceptable minimum, and supply reliable quantities of good quality water for domestic, agricultural, municipal, and industrial uses
- Alternative land and water management practices including cover manipulation to improve the quality, quantity, and timing of surface and subsurface water yields from watersheds and river basins
- Alternative systems for managing water storage and movement to reduce floods and dispose of excess water, maintain stable stream channels, and provide water for beneficial uses
- Design and implementation of practices for the reclamation of soils that have been drastically disturbed due to construction, surface mining, mineral extraction, and other causes.

Exclude:

- Economic and policy issues of watershed management (use KA 605 or 610).

Forest and Range Resources

KA 121. Management of Range Resources

This area includes work on biological processes and ecological relationships, improved range management techniques, and better appraisals of range conditions for production of livestock forage, water yield, and wildlife habitat.

Areas of work include but are not limited to:

- Improvement of rangeland evaluation methods to reduce costs and increase the usefulness of information obtained, including aerial photography, geographic information systems (GIS), trend projections, and computers for data analysis
- Appraisal to provide up-to-date information on the quality, quantity, and productivity of range resources
- Projecting future demand for range forage and other benefits normally related to the wise use of rangelands

- Physiology and ecology of rangeland plant communities
- Range characteristics, including identification, physiological requirements, and nutritive value of forage plants
- Understanding range ecosystems and their biotic and physical components
- Improvement through breeding and selection of browse plants for forage, protection, and aesthetic purposes
- Revegetation of deteriorated areas by seeding desirable species
- Systems for managing ranges including fertilization, mechanization, grazing pressure, and drainage to increase yields
- Management practices that harmonize grazing with timber growing, wildlife, recreation, and other land uses
- Riparian areas and wetlands associated with rangeland habitats and their importance to these ecosystems
- Forested range management
- Protection against insects and diseases
- Invasive/alien plant deterioration of rangelands.

Exclude:

- Work focused on improvement of wildlife habitat (use KA 135)
- Watershed systems and cumulative effects (use KA 112)
- Protection against fire (use KA 122)
- Agroforestry (use KA 125)
- Economic and policy issues of range management (use KA 605 or 610)
- Use of prescribed fire for maintenance of range ecosystems (use KA 122)
- Biological control of pests (use KA 215)
- Integration of pest control tactics into an integrated pest management (IPM) system (use KA 216).

KA 122. Management and Control of Forest and Range Fires

Work in this area focuses on both wildfire and prescribed fire. It includes the development of new wildfire prevention methods, new technology for fuel hazard reduction, improved systems for wildfire prediction, detection, and effective attack and suppression technologies. Prescribed fire is used to maintain fire-dependent ecosystems without endangering resources and facilities. Work in this area focuses on where, when, and how to utilize prescribed fire.

Areas of work include but are not limited to:

- Fire-related biology and ecology of plants and animals
- Atmospheric and ecosystem dynamics, patterns, and characteristics
- Physics and chemistry of combustion
- Behavior of fire as influenced by fire-starting agents, atmospheric circulation, and local weather, fuels, and topography
- Fire intelligence systems, including electronic methods, remote sensing, automatic measurement of fire environment, and computer integration of these factors into a fire danger rating system
- Reduction of fuel hazards through physical, chemical, and prescribed fire treatments
- Use of fire-resistant plants in home and building landscaping
- Creation of defensible space around homes and buildings
- Aerial and ground procedures for fighting fires

- Integrated prescribed fire control and forest management systems which minimize wildfire losses
- Use of prescribed fire to maintain the integrity and function of range ecosystems.

Exclude:

- Protecting soil from fire damage (use KA 104)
- Protection from pollution (use KA 133 or 141)
- Control of hazards to fire fighting personnel (use KA 723)
- Economic and policy issues of forest and range fire (use KA 605 or 610)
- Development of community fire prevention, attack, and suppression plans and related homeland security activities (use KA 805).

KA 123. Management and Sustainability of Forest Resources

Work in this area focuses on the biology of forest plants and trees; ecology of forest ecosystems; tree breeding; forest nursery practices; silvicultural techniques to improve and regenerate forest stands; and assessing, modeling, monitoring, and forecasting forest ecosystems. Forest resources include both wood and non-wood products, often referred to as non-timber forest products or special forest products. Sustainable forest management criteria and indicators are outlined in international protocols.

Areas of work include but are not limited to:

- Intensive forest management
- Studies of forest ecosystem and community structure and function
- Physiology and ecology of forest trees and plant communities
- Selection and breeding of trees
- Forest health assessments and management practices to protect forests from insect and disease infestations
- Improvement of inventory methods to reduce costs and increase usefulness of information obtained, including emphasis on geographic information systems (GIS), aerial photography, trend projections, and use of computers for data analysis
- Appraisals and inventories for use in development of resource programs
- Seed orchard management, seed harvesting, processing, and storage methods
- Nursery culture, planting, and direct seeding
- Native and non-native invasive species that interfere with forest management objectives
- Techniques that result in natural regeneration
- Planning and modeling techniques for long-term management of forests for timber production in harmony with other uses, including wildlife and recreation
- Theory, instrumentation, and methods of mensuration for estimating timber growth, yield, and quality of products
- Cultural techniques, including spacing, fertilization, liming, and irrigation for the production of timber-related crops from improved strains
- Effects of environment and genetics on wood properties
- Causes and effects of forest fragmentation
- Relation of timber species and quality to wood properties and use
- Management objectives for privately owned forest land
- Forest stewardship practices utilized by private forest landowners.

Exclude:

- Forest watersheds (use KA 112 or 605)
- Protection against wildfire and fire-related biology and ecology of biota (use KA 122)
- Agroforestry (use KA 125)
- Urban forestry (use KA 124)
- Forest recreation (use KA 134)
- Forested range (use KA 121)
- Economic and policy issues of forests and forestry (use KA 605, 610, or 611)
- Biological control of pests (use KA 215)
- Integration of pest control tactics into an integrated pest management (IPM) system (use KA 216)
- Use of prescribed fire and other measures to control competing vegetation, stand composition, and habitat characteristics (use KA 122)
- Land use planning policies and procedures to reduce forest fragmentation and conversion (use KA 605, 610, or 611)
- Forest taxation, estate planning, and intergenerational transfer (use KA 602 or 801)
- Christmas tree production (use KA 205).

KA 124. Urban Forestry

This work concentrates on the use of trees to improve or maintain the quality of urban and suburban environments and to enhance natural beauty through tree plantings. Tree plantings for special purposes include: visual screening, noise suppression, air quality improvement, shade, and beautification. Identification and development of species capable of living under adverse conditions such as smoke, air pollution, compacted soils, deficient or excessive moisture, and other unfavorable conditions associated with urban environments is included in this category.

Areas of work include but are not limited to:

- Selection and breeding of trees for urban environments, shade, and other special characteristics
- Protection of trees from damage by animals, wildfire, floods, insects, diseases, or other harmful agents
- Methods of site preparation and tree establishment appropriate for special-purpose plantings
- Urban tree biology, including culture and maintenance of urban trees and stands
- Soil and site requirements of species needed to improve the environment
- Physical, biological, wildlife, and social benefits of urban trees/forests, including psychological and physical health
- Multiple effects of urban forests such as lowering the "heat island" effect, reduction of air and water pollution, and improvement of property values.

Exclude:

- Commercial products (use KA 123)
- Studies specific to pollution (use KA 133 or 141)
- Agroforestry (use KA 125)
- Economic and policy issues of urban forests (use KA 605 or 610)
- Biological control of pests (use KA 215)
- Integration of pest control tactics into an integrated pest management (IPM) system (use KA 216)
- Suburban/urban shade tree/street tree commissions (use KA 805)
- Management of urban forestry volunteers and programs (use KA 802).

KA 125. Agroforestry

Work in this area focuses on agroforestry practices that intentionally combine trees or shrubs with crop or livestock operations, or use trees at the agriculture/community interface to help create more integrated, diverse, and sustainable farms, non-industrial forests, ranches, and rural communities. Agroforestry practices are designed to incorporate the use of trees into agricultural settings to accomplish social, economic, and environmental objectives. The main types of agroforestry include alley cropping, riparian buffers, forest farming, windbreaks/shelterbelts, and silvopasture. Agroforestry practices often yield non-traditional tree and forest products such as mushrooms, boughs, medicinal plants, vines, and nuts.

Areas of work include but are not limited to:

- Biological interactions created or altered by agroforestry plantings
- Ecological roles of agroforestry systems at the landscape level
- Techniques for establishment, management, and renovation of agroforestry practices
- Enhancing performance of agroforestry plantings for economic, social, and environmental services, and rural development
- Selection and breeding of plant materials for agroforestry
- Protection of trees and shrubs in agroforestry plantings from damage by animals, wildfire, floods, insects, diseases, or other harmful agents
- Identification of new and innovative woody plant species and arrangements to enhance economic returns from agroforestry practices (e.g., specialty crops: medicinal herbs, floral products, Christmas trees, wood products)
- Generating income-producing opportunities from land devoted to conservation-oriented agroforestry
- Integrating agroforestry technologies and plant materials into appropriate conservation or production systems for farms, ranches, communities, and non-industrial forests
- Identifying social and economic constraints to agroforestry adoption
- Land use planning tools to integrate agroforestry practices into watersheds
- Role of agroforestry systems (e.g., crop production, biodiversity) to mitigate hypothesized impacts of decadal weather changes.

Exclude:

- Management of forests (use KA 123)
- Biological control of pests (use KA 215)
- Integration of pest control tactics into an integrated pest management (IPM) system (use KA 216).

Natural Resources, General

KA 131. Alternative Uses of Land

This area is concerned with evaluation of alternative uses of land to determine short- and long- term benefits. Changes in land use in response to population growth, urban and suburban growth, recreational needs, agricultural and other factors affecting the fixed supply of land are included in this area.

Areas of work include but are not limited to:

- Inventory and appraisal of current and potential land uses
- Parameters and models for evaluating benefits
- Appraisal of future land requirements for non-agricultural uses such as forestry, recreation, highway,

- urban, and industrial development
- Conservation and management practices.

Exclude:

- Economic (i.e., cost-benefit analysis) alternative evaluations (use KA 605)
- Economic and policy issues affecting land use (use KA 605 or 610).

KA 132. Short Term and Decadal Weather

Work on the impact of short term and decadal weather on agriculture and natural resources focuses on three tasks: (1) characterize existing weather patterns and propose more effective ways of adjusting to these patterns, (2) specify modifications in management approaches that are desirable to farm, forest, and rangeland managers, and (3) learn how potential modifications affect agriculture or natural ecology.

Areas of work include but are not limited to:

- Understanding the sequences and duration of weather events and the response of relevant biota
- Probabilities of occurrence of weather conditions critical to agricultural operations
- Methods for incorporating decadal weather patterns in the strategies, forecasts, and decision-making tactics of agriculture
- Biological consequences of weather changes
- Drivers of short term and decadal weather
- Mechanisms by which micrometeorology controls the reentry of pesticides, herbicides, and other agricultural chemicals into the atmosphere
- Micro- and meso-climatological conditions regulating the airborne transport of insects, bacteria, fungi, and other particulates
- Mechanisms by which micrometeorology affects gas and water exchange at the plant- atmosphere boundary layer.

Exclude:

- Lightning and other weather-related forest fires (use KA 122)
- Short term and decadal weather data obtained from integrated pest management activity (use KA 216).

KA 133. Pollution Prevention and Mitigation

Work in this area is concerned with preventing, alleviating, and mitigating pollution initiated by agricultural and forestry practices and its detrimental effects on agricultural plants, animals, soil, air, water, and humans. Potential pollutants include: organic pesticides, radionuclides, fertilizer chemicals, growth regulating chemicals, animal and crop wastes, mulching materials, pathogenic microorganisms, heavy metals, salts used on roads for de-icing, and allergens. This work focuses on agricultural production, not on health hazards to humans, which are covered in KA 723, Hazards to Human Health and Safety.

Areas of work include but are not limited to:

- Sources, character, intensity, and causes of pollution from agricultural and forestry practices and frequency of occurrence
- Behavior and fate of pesticides and other pollutants in soil and water
- Tolerance of plants, animals, humans, and insects to pollutants, including low levels of pollutants for

prolonged periods of time

- Breeding and selection of forest and range plants resistant to pollution
- Public policy that would reduce pollution
- New or alternative agricultural and forestry practices and methods of reducing and controlling pollution to levels that are not harmful to natural resources, plants, animals, and humans, or methods that will prevent emission of the pollutant
- Role and use of living organisms in removing pollutants from the environment
- Minimum environmental quality standards for natural resource health and integrity
- Methodology and instrumentation for detection of pollutants and methods of analysis
- Methods of monitoring water, soil, and other media for pollutants and maintenance of networks that conduct this monitoring
- Methods and equipment for protecting plants and animals from pollutants
- Protection against radiation, noise, and other hazards
- Remediation of polluted areas
- Aquatic weeds as a pollutant
- Modeling pollutant load and delivery to soil and water resources.

Exclude:

- Trees to enhance urban and suburban environments (use KA 124)
- Protecting humans from harmful effects of microorganisms and naturally occurring toxins (use KA 712)
- Collecting, moving, storing, recycling, or disposing of plant, animal, and radioactive or industrial wastes (use KA 403)
- Measurement, monitoring, and mitigation of airborne particulates, dust, ozone, odors, volatile organic compounds, gases, combustion products, smoke, and smog (use KA 141)
- Effects and remedial measures related to atmospheric deposition (use KA 141)
- Safe methods for disposing of pesticides or other agricultural chemicals (use KA 403 or 723)
- Methods and equipment to protect humans from pollutants (use KA 723)
- Protection of humans from non-food allergens and toxins, and poisonous plants (use KA 723)
- Protection of humans from radiation (use KA 723)
- Mitigation of odors, dust, and noise hazardous to humans (use KA 723).

KA 134. Outdoor Recreation

Work on outdoor recreation focuses on the management of lands for recreation and the coordination of this use with other land resources. It involves problems in management of physical resources, as well as socioeconomic relationships of users of the resources.

Areas of work include but are not limited to:

- Determining the demand for outdoor recreation
- Criteria for selecting sites that will attract and support heavy recreation use
- Developing practical methods to maintain existing recreation sites and restoring those depleted by heavy use
- Requirements for aesthetic landscapes and means for producing and maintaining them
- Methods for the protection, management, and recreational use of wilderness-type historical and archeological areas and scenic landscapes

- Management systems and special equipment and facilities that will minimize dangers from fire, avalanches, and other natural hazards
- Understanding of visitor preferences and attitudes regarding outdoor recreation opportunities.

Exclude:

- Economic evaluation of recreation and recreation resources (use KA 605)
- Recreation policy (use KA 610).

KA 135. Aquatic and Terrestrial Wildlife

This area focuses on invertebrate and vertebrate animal species that occur naturally in forest, range, and agricultural lands and waters, and marine environments. Work includes determining biological and ecological requirements of species, factors influencing population dynamics, interspecific relationships, methods for maintaining and enhancing habitats, and management approaches for sustaining wildlife harvests while maintaining population, species, and community viability.

Areas of work include but are not limited to:

- Life histories and population dynamics of wildlife, including non-game and threatened or endangered species
- Ecological and physiological requirements of fish and wildlife, including other organisms and plants that provide food and shelter
- Improving terrestrial wildlife habitat through such measures as seeding, planting, prescribed burning, spraying, fertilizing, and manipulation of native vegetation
- Improving fish habitat and food supplies through management and restoration of riparian and aquatic vegetation, and lake and stream physical and chemical habitat features
- Breeding and feeding habits, movement patterns, and other behavior of wildlife
- Interspecific relationships such as competition and predation that affect the well-being of wildlife populations
- Protection of wildlife from arthropods, parasites and diseases, invasive non-native organisms, and other hazards, except pollutants
- Effects of agricultural, forest, and rangeland management practices on wildlife communities
- Management approaches for achieving balance between society's and wildlife's need and use of land and water resources.

Exclude:

- Pollution prevention and mitigation (use KA 133 or 141)
- New and improved animal products (use KA 308, 502, or 511)
- Farm-raised fish, shellfish, game and fur-bearing animals, and other wildlife (use appropriate KA under ANIMALS AND THEIR SYSTEMS)
- Economics and monetary valuing of wildlife (use KA 605)
- Protection of crops from vertebrate pests (use KA 214)
- Protection of livestock from vertebrate pests (use KA 314)
- Protection of humans from diseases transmitted from wildlife (use KA 722)
- Wildlife policy (use KA 610).

KA 136. Conservation of Biological Diversity

In a natural resources context, work on biological diversity (biodiversity) conservation focuses on the description, measurement, assessment, and management of plant and animal variation in nature. It includes diversity at the genetic, species, and ecosystem levels in forest, range, and agriculturally influenced ecosystems. The objective is to preserve, enhance, and restore natural biodiversity to levels compatible with societal uses of natural resources.

Areas of work include but are not limited to:

- Biodiversity inventories of public and private lands and waters
- Comparisons of biodiversity between habitats, ecoregions, and natural and culturally impacted areas
- Mechanisms that influence biodiversity
- The role of biodiversity in ecosystem function, stability, and resilience
- Impacts of agricultural, forestry, and rangeland management practices on biodiversity
- Effects of non-native invasive species on biodiversity
- Management approaches for conserving and restoring biodiversity.

Exclude:

- Genetic diversity of agriculturally important plants (use KA 202)
- Genetic diversity of agriculturally important animals (use KA 303).

Air

KA 141. Air Resource Protection and Management

This knowledge area focuses on investigations that quantify emissions, fate and transport, and practices to mitigate emissions of particulate matter and gases from agriculture and forestry practices. Work includes emissions from animal feeding operations, controlled burning, and tillage, and volatilization/transport to the atmosphere of naturally occurring or anthropogenic chemical compounds.

Areas of work include but are not limited to:

- Short and long-range transport of particulates and gases by wind through the atmosphere
- Procedures for measuring and monitoring of particulates, gases, and odors, as well as precursors to the formation of atmospheric particulates and ozone
- Effects and remedial measures related to atmospheric deposition
- Emissions to the atmosphere from land application of animal wastes, animal housing, and edge of field boundaries
- Inventories of emission factors to help agriculture and forestry comply with regulatory requirements
- Management practices that reduce or mitigate particulates, gases, and odors from agriculture and forestry production practices released to the atmosphere.

Exclude:

- Mitigation of odors, dust, and noise hazardous to humans (use KA 723)
- Indoor air quality (use KA 804).

Topic II. Plants and their Systems

Plant Production

KA 201. Plant Genome, Genetics, and Genetic Mechanisms

This area focuses on development and dissemination of fundamental information in plant genetics and plant breeding technology with the purpose of making plant breeding more efficient and productive, and includes related technologies such as genomic database management.

Areas of work include but are not limited to:

- Genome sequencing and mapping
- Genetic structure, organization, and function
- Comparative and translational genomics
- Gene identification and manipulation
- Genetic markers and marker-assisted selection for breeding
- Quantitative Trait Loci (QTL) analysis
- Genetic structures and mechanisms
- Inheritance of traits
- Bioinformatics and databases.

Exclude:

- Breeding for specific traits with direct purpose of releasing a crop variety or breeding line, even when using molecular tools such as molecular markers, expressed sequence tags, and QTL (use KA 203, 204, or 211-214)
- Use of genomic technology to characterize or evaluate germplasm (use KA 202)
- Population genetics associated with germplasm preservation (use KA 202)
- Forest and range plants (use KA 121, 123, 124, or 125).

KA 202. Plant Genetic Resources

This area focuses on discovery, acquisition, preservation, characterization, and development of plant genetic resources for plant production or protection. Both in-situ and ex-situ preservation methods are included, as well as preservation of species and within-species variation.

Areas of work include but are not limited to:

- Acquisition and preservation of genetic resources
- Germplasm characterization and evaluation, including screening for diversity or specific traits for production or protection
- Biosystematics/taxonomy
- Population genetics associated with germplasm preservation
- Gene pool enrichment and pre-breeding activities such as interspecific crosses, introgression of traits into breeding lines, increasing frequencies of desirable within-crop gene pools, and adaptation of material to day length or other cultural requirements
- Long-term storage of genetic materials, including seeds and vegetatively propagated materials.

Exclude:

- Breeding for specific traits, including the use of molecular tools such as molecular markers, expressed sequence tags, and Quantitative Trait Loci (use KA 203, 204, or 211-214)
- Seed processing for short-term storage or commercial use (use KA 512)
- Forest and range plants (use KA 121, 123, 124, or 125)
- Natural resources biodiversity (use KA 136).

KA 203. Plant Biological Efficiency and Abiotic Stresses Affecting Plants

This area focuses on understanding and improving plant productivity and quality affected by reduced inputs or abiotic stresses such as water, temperature, or nutrients.

Areas of work include but are not limited to:

- Biological mechanisms that affect actual or potential yields
- Biological mechanisms related to water use and survival of water stresses (e.g., drought, flooding)
- Biological mechanisms related to the use of nutrients and survival of nutrient stress
- Biological mechanisms related to survival of temperature stress (including freezing, chilling, and heat)
- Breeding (including genetic engineering) for biological efficiency or stress tolerance
- Cultural practices to improve biological efficiency or stress tolerance.

Exclude:

- Basic plant biology (use KA 206)
- Integration into production management systems (use KA 205)
- Breeding (including genetic engineering) for quality improvement (use KA 204)
- Breeding (including genetic engineering) for host plant resistance (use KA 211, 212, or 214)
- Breeding (including genetic engineering) for crop-weed management (use KA 213)
- Evaluation of germplasm for variation in biological efficiency or stress tolerance (use KA 202)
- Effects of abiotic factors on pests (use KA 211-214)
- Effects of pollution stress on plants (use KA 133)
- Forest and range plants (use KA 121, 123, 124, 125, or 133).

KA 204. Plant Product Quality and Utility (Preharvest)

This area focuses on maintaining or improving specific quality or utility parameters within biological material before harvest.

Areas of work include but are not limited to:

- Biological processes that affect product quality and utility
- Breeding (including genetic engineering) for product quality and utility
- Cultural practices that affect product quality and utility
- Maintenance of seed quality.

Exclude:

- Basic plant biology (use KA 206)
- Postharvest quality and utility (use KA 502, 503, 511, 711, or 712)
- Integration of education, research, and extension results into production management systems (use KA 205)

- Evaluation of germplasm for variation in specific quality or utility parameters (use KA 202)
- Fundamental areas of genetics (use KA 201)
- Seed processing technology (use KA 512)
- Forest and range plants (use KA 121, 123, 124, or 125)
- Nutrient composition of plant products (use KA 701).

KA 205. Plant Management Systems

This area focuses on integration of production practices into an integrated system for managing annual and perennial plant population densities, fertility, irrigation, precision agriculture, and other cultural practices in an efficient and effective manner.

Areas of work include but are not limited to:

- Application of remote sensing and other automated sampling methodologies in managing plant population densities, fertility, irrigation, and other cultural practices
- Modeling and decision support systems for use in managing plant population densities, fertility, irrigation, and cultural practices
- Evaluation of integrated production management systems
- Organic agriculture – plant production management systems
- Sustainable agriculture – plant production systems
- Scale (size) related plant production systems that may affect farm viability
- Biosecurity in plant production systems
- Gardening and Master Gardening programs.

Exclude:

- Development of integrated pest management systems (use KA 216)
- Application of remote sensing and other automated sampling methodologies for pest management (use KA 211-216)
- Modeling and decision support systems for pest management (use KA 216)
- Basic studies and information related to improving, maintaining, or restoring the inherent production capability of soils (use KA 102)
- Forest and range plants (use KA 121, 123, 124, or 125)
- Biodiversity in plant production systems (use KA 202).

KA 206. Basic Plant Biology

This area focuses on inquiry into fundamental processes and mechanisms in plants and model organisms basic to the life of the plant.

Areas of work include but are not limited to:

- Characterization of structure-function relationships and metabolic pathways
- Mechanisms of energy transduction, conversion, and dissipation
- Mechanisms of uptake, transport, and storage of nutrients and gases
- Mechanisms of response to and transduction of biotic and abiotic factors
- Processes in endophytic or free-living microorganisms related to basic processes in plants
- Processes related to seed development, respiration, and germination
- Mechanisms of cell division, expansion, and differentiation

- Processes related to the development of vegetative and reproductive structures.

Exclude:

- Genetic structures and mechanisms (use KA 201)
- Plant population genetics (use KA 202)
- Biological mechanisms that affect actual or potential yields (use KA 203)
- Biological mechanisms related to biotic stress (use KA 211-214)
- Forest and range plants (use KA 121, 123, 124, or 125).

Plant Protection

KA 211. Insects, Mites, and Other Arthropods Affecting Plants

This area focuses on yield and quality affected by indigenous and exotic insects, mites, and other arthropods (including bees and other pollinators).

Areas of work include but are not limited to:

- Population dynamics, ecology, and behavior
- Biosystematics/taxonomy
- Impact of decadal weather and other abiotic factors on pest biology and behavior
- Cultural practices to reduce infestations or effects
- Mechanisms of host plant resistance
- Breeding (including genetic engineering) for host plant resistance
- Pest resistance to control methods or strategies
- Efficacy, product performance, application technology, and population management with conventional pesticides and biopesticides (including pheromones and growth regulators)
- Development of sampling protocols (including economic injury levels, action thresholds, and remote sensing and other automated sampling methodologies) and predictive models for single pests
- Population and molecular genetics (e.g., physical linkage maps, gene expression, regulation, proteomics, mutagenesis, gene discovery)
- Nutrition, management, and productivity of bees and other pollinators
- Biosecurity measures to limit invasive insects, mites, and other arthropods in plant management systems.

Exclude:

- Integration of control tactics into systems for managing single pests or pest complexes (use KA 216)
- Development of sampling protocols or predictive models for pest complexes (use KA 216)
- Biological control (use KA 215)
- Development of remote sensing instruments (use KA 404)
- Evaluation of germplasm for genetic variation in resistance to pests (use KA 202)
- Forest insects when work is not at the IPM systems level (use KA 121, 123, 124, or 125)
- The role of insects, mites, and other arthropods in disease transmission (use KA 212)
- Insect pests affecting humans (use KA 721 or 722)
- Movement and dispersal resulting from airborne transport of pests (use KA 132 or 133).

KA 212. Pathogens and Nematodes Affecting Plants

This area focuses on yield and quality affected by indigenous and exotic bacteria, fungi, nematodes, viruses, and other pathogens.

Areas of work include but are not limited to:

- Mechanisms of infection, reproduction, systemic spread, and pathogenesis
- Epidemiology, ecology, and behavior
- Biosystematics/taxonomy
- Mechanisms of host plant resistance
- Breeding (including genetic engineering) for host plant resistance
- Cultural practices to reduce incidence, severity, or impacts
- The role of insects, mites, and other arthropods in pathogen transmission
- Efficacy, product performance, application technology, and population management with conventional pesticides and biopesticides (including pheromones and growth regulators)
- Pathogen resistance to control methods and strategies
- Development of sampling protocols (including economic injury levels, action thresholds, and remote sensing and other automated sampling methodologies) and predictive models for pathogen or nematode species
- Population and molecular genetics of nematodes (e.g., sequencing, proteomics, gene expression, regulation)
- Biosecurity measures to limit invasive pathogens and nematodes in plant management systems.

Exclude:

- Integration of control tactics into systems for managing pathogen or nematode species complexes (use KA 216)
- Development of sampling protocols and predictive models for pathogen or nematode species complexes (use KA 216)
- Biological control (use KA 215)
- Development of remote sensing instruments (use KA 404)
- Evaluation of germplasm for genetic variation in resistance to pathogens or nematodes (use KA 202)
- Fundamental areas of plant genetics (use KA 201)
- Movement and dispersal resulting from airborne transport of pathogens or nematodes (use KA 132 or 133).

KA 213. Weeds Affecting Plants

This area focuses on yield and quality affected by competition from indigenous and exotic weeds, including aquatic weeds and parasitic plants.

Areas of work include but are not limited to:

- Population dynamics and ecology
- Biosystematics/taxonomy
- Effects of abiotic factors such as temperature, water, or nutrients
- Weed seed studies, including dormancy, survival, and depredation
- Cultural practices (including solar sterilization) to reduce weed populations or effects
- Breeding (including genetic engineering) for crop-weed management

- Efficacy, product performance, application technology, and population management with conventional pesticides and biopesticides (including growth regulators)
- Pest resistance to weed control methods and strategies
- Development of sampling protocols (including economic injury levels and remote sensing and other automated sampling methodologies) and predictive models for weeds
- Biosecurity measures to limit invasive weeds in plant management systems.

Exclude:

- Integration of control tactics into systems for managing single weed species or weed complexes (use KA 216)
- Biological control (use KA 215)
- Breeding (including genetic engineering) for biological efficiency (use KA 203)
- Control of competing vegetation in urban forestry and agroforestry (use KA 124 or 125)
- Protection of wildlife and natural resources from aquatic weeds (use KA 135)
- Development of sampling protocols and predictive models for weed complexes (use KA 216)
- Development of remote sensing instruments (use KA 404)
- Toxic effects of weeds on animals (use KA 314)
- Effects of weeds on human health, including allergies and toxicity (use KA 723)
- Fundamental areas of plant genetics (use KA 201)
- Movement and dispersal resulting from airborne transport of weeds (use KA 132 or 133).

KA 214. Vertebrates, Mollusks, and Other Pests Affecting Plants

This area focuses on yield and quality affected by indigenous and exotic vertebrate pests (including birds and mammals), mollusks (including slugs and snails), and other plant pests.

Areas of work include but are not limited to:

- Population dynamics and ecology
- Biosystematics/taxonomy
- Breeding (including genetic engineering) for host plant resistance
- Impact of decadal weather and other abiotic factors on pest management
- Cultural practices to reduce infestations or effects
- Efficacy, product performance, application technology, and population management with conventional pesticides and biopesticides (including pheromones and growth regulators)
- Pest resistance to control methods or strategies
- Development of sampling protocols (including economic injury levels, action thresholds, and remote sensing and other automated sampling methodologies) and predictive models for an individual species
- Biosecurity measures to limit invasive vertebrates, mollusks, and other pests in plant management systems.

Exclude:

- Integration of control tactics into systems for managing single pests or pest complexes (use KA 216)
- Biological control (use KA 215)
- Evaluation of germplasm for genetic variation in resistance to pests (use KA 202)
- Development of sampling protocols and predictive models for pest complexes (use KA 216)
- Development of remote sensing instruments (use KA 404)

- Fundamental areas of plant genetics (use KA 201)
- Management of vertebrate pests in rangeland and forest systems, including agroforests and urban forests (use KA 121, 123, 124, or 125)
- Management of vertebrate pests to protect property, endangered species, and community well-being (use KA 135).

KA 215. Biological Control of Pests Affecting Plants

This area focuses on classical, augmentative, or inundative use of natural enemies (including microbial biological control agents) to manage plant pests (pathogens, insects, mites, nematodes, weeds, vertebrates, etc.).

Areas of work include but are not limited to:

- Basic biology and genetic improvement of natural enemies
- Ecology and conservation of natural enemies
- Population dynamic-epidemiologic-multitrophic interactions among natural enemies
- Collection and discovery of natural enemies
- Biosystematics/taxonomy
- Maintenance, mass production, quality control, and delivery systems for natural enemies
- Development of sampling protocols (including remote sensing and other automated sampling methodologies) and predictive models for natural enemies.

Exclude:

- Management of plant pests using methods other than biological control, including chemical, cultural, physical, and host plant resistance (use KA 211-214)
- Integration of control tactics into systems for managing single pest species or pest complexes (use KA 216)
- Development of sampling protocols and predictive models for pest management complexes (use KA 216)
- Development of remote sensing instruments (use KA 404).

KA 216. Integrated Pest Management Systems

This area focuses on the integration of one or more control tactics into a system for managing single plant pests or pest complexes in an economically, socially, and environmentally sound manner.

Areas of work include but are not limited to:

- Understanding the biology of crop-pest-beneficial interactions (system ecology)
- Interactions among pest control tactics (may include cultural, mechanical, biological, and pesticide application tactics) and impacts on crop productivity
- Implementation of new knowledge and technologies on an area-wide or regional scale
- Impact of decadal weather and other abiotic factors on pest management systems
- Determination of environmental impacts resulting from the use of IPM systems
- Development of sampling protocols (including economic injury levels, action thresholds, and remote sensing and other automated sampling methodologies) and predictive models for use in managing pest complexes and natural enemy populations
- Pest management problem specification in affected communities including growers/producers,

- processors, marketers, and consumers
- Determination of constraints to adoption of IPM methods, barriers to progress along the IPM continuum, and impacts
- Acceptance of pest management systems.

Exclude:

- Single pest control tactics (use KA 121, 123, 124, 125, or 211-215)
- Evaluation of germplasm for genetic variation in resistance to pests (use KA 202)
- Application of remote sensing and other automatic sampling methodologies in managing plant population densities, fertility, irrigation, and other cultural practices (use KA 205)
- Development of sampling protocols and predictive models for single pests or natural enemies (use KA 121, 123, 124, 125, or 211-215)
- Movement and dispersal resulting from airborne transport of pests (use KA 132)
- Development of remote sensing instruments (use KA 404)
- Determination of economic and social impacts of IPM systems (use KA 601, 605, or 803)
- Impacts of pest management policies (use KA 610)
- Consumer economics, including response to product labeling (use KA 607).

Topic III. Animals and their Systems

Animal Production

KA 301. Reproductive Performance of Animals

Work to enhance reproductive performance of agriculturally important animals involves factors that control reproduction or provide methodologies to improve reproductive efficiency, including efforts to control puberty, ovarian function and cycles, gamete formation and maturation, fertilization, establishment and maintenance of pregnancy, placental function, fetal development and growth, and parturition.

Areas of work include but are not limited to:

- Reducing the age of first breeding in females
- Improving libido and reducing physical and psychological barriers to mating
- Methods to control estrus and ovulation
- Semen metabolism and preservation, and artificial insemination techniques
- Effects of stress factors on reproductive performance
- Controlling sex of offspring through sperm separation and other means
- Increasing the fertilization and conception rate of available ova
- Increasing the number of potentially fertilizable ova
- Reducing prenatal, natal, and postnatal mortality
- Improving mothering ability
- Methods for early diagnosis of pregnancy
- Fundamental studies to determine molecular, cellular, and metabolic mechanisms regulating reproduction
- Development of reproductive technologies
- Methods to improve spawning efficiency in fish and shellfish
- Methods to enhance larval rearing in fish and shellfish.

Exclude:

- Nonfarm-raised fish and shellfish, game and fur-bearing animals, and other wildlife (use KA 135)
- Genetic studies to improve reproductive performance (use KA 303)
- Identification of genes that have an effect on reproduction and how they are controlled or regulated (use KA 304).

KA 302. Nutrient Utilization in Animals

Work in this area focuses on efforts to enhance the efficiency of nutrient utilization for improving animal productivity, including molecular and cellular biology of nutrient utilization, digestion, metabolic processes, and feed processing technology.

Areas of work include but are not limited to:

- Digestion and metabolism
- Nutrients required for specific life processes and longevity
- Hormone and nutrient interactions for maintenance, growth, lactation, and other productivity functions
- Composition and biological availability of nutrients of animal feed
- Effects of processing and feeding system on nutritive values of animal feed
- Alternate sources of nutrients, including forages and agricultural byproducts.

Exclude:

- Reduction of waste carcass fat and proportion of low meat yield cuts (use KA 308).

KA 303. Genetic Improvement of Animals

Work in this area focuses on improving production efficiency of agriculturally important animal species through more effective genetic improvement programs utilizing the development and application of expanded genetic information and technology encompassing molecular, quantitative, and statistical genetics.

Areas of work include but are not limited to:

- Estimation of genetic parameters (e.g., heritability, genetic variances and covariances, heterosis, and breeding values)
- Selection studies
- Breed evaluation studies
- Mating systems
- Development of breeding goals and strategies
- Identification of genetic defects
- Incorporation of molecular and genomic information into applied genetic improvement programs
- Acquisition and preservation of genetic resources
- Maintenance of genetic diversity.

Exclude:

- Reduction of waste carcass fat and proportion of low meat yield cuts (use KA 308)
- Gene mapping and fundamental molecular genetic and genomic information (use KA 304)
- Gene identification, regulation, and control (use KA 304)

- Natural resources biodiversity (use KA 136).

KA 304. Animal Genome

Work in this area involves the application of new developments in molecular biology to map and understand the genome of agriculturally important animal species.

Areas of work include but are not limited to:

- Gene mapping, including linkage and physical mapping
- Gene identification, function repetition, and control
- Genetic engineering and gene manipulation
- DNA cloning and sequencing
- Quantitative Trait Loci (QTL) identification and development of marker-assisted selection procedures.

Exclude:

- Application of marker-assisted selection in applied breeding programs (use KA 303).

KA 305. Animal Physiological Processes

This area includes work on the fundamental physiological processes within the animal at the organismal, organ system, cellular, and molecular level.

Areas of work include but are not limited to:

- Chemical and structural organization of animal cells and their specialized properties and functions, including enzymatic machinery and biochemical conversions
- Organization, structure, and function of organ systems, including endocrine, circulatory/vascular, urinary, nervous, muscular, and skeletal systems, the sense organs, the common integument and its derivatives, and body fluids
- Physiology of vital life processes and mechanisms of function and control
- Neural, hormonal, or other chemical messengers that serve as regulators of physiologic processes and perform integrative functions in the animal
- Prenatal, neonatal, and postnatal development and growth of animals, including genetic control mechanisms and accretion, deposition, and degradation of proteins and fats in animal tissues
- Lactation physiology, including alveolar development and involution, milk synthesis, secretion and ejection, milk composition, and patterns of lactation.

Exclude:

- Physiology of reproduction and reproductive processes (use KA 301).

KA 306. Environmental Stress in Animals

Work in this area involves stresses from the effects of weather, handling, and other environmental factors that decrease productivity, including extremes in temperature (including heat stress), humidity, air movement, and noise that may lead to lower reproduction, reduced feed efficiency, anorexia, reduced disease resistance, and increased mortality.

Areas of work include but are not limited to:

- Environmental factors that reduce productivity
- Facilities and equipment that reduce environmental stress
- Management techniques that enable animals to adapt to stress conditions.

Exclude:

- Stress factors that affect reproductive performance (use KA 301)
- Nonfarm-raised fish, shellfish, game and fur-bearing animals, and other wildlife (use KA 135)
- Genetic factors of animal response or adaptability to environmental stress (use KA 303)
- Physiological responses to environmental stress (use KA 305)
- Behavioral responses to environmental stress (use KA 315).

KA 307. Animal Management Systems

Work in this area focuses on the development and application of management systems, including computer technology/models and analytic methods, to improve management decisions and enhance animal production systems.

Areas of work include but are not limited to:

- Animal-based studies that compare production systems or segments of production systems, including systems with emphasis on organic farming or small farms
- Animal-based studies that emphasize sustainable agriculture
- Computer simulation models of animal production systems that allow comparisons of various alternative management components and decisions.

Exclude:

- Nonfarm-raised fish, shellfish, game and fur-bearing animals, and other wildlife (use KA 135).

KA 308. Improved Animal Products (Before Harvest)

This area includes work to improve the composition and quality of animal products to reflect consumer preferences.

Areas of work include but are not limited to:

- Physiology and biochemistry of fats, proteins, and flavor components of animal products
- Factors responsible for development of flavor and other components of product quality
- Reduction in undesired fat in animal products
- Improving wool, hides, and other non-food animal products
- Determination of consumer preferences and factors influencing product acceptability.

Exclude:

- Bees and honey (use KA 211)
- Processing techniques for improvement or development of food and non-food products from animals (use KA 502 or 511)
- Nutrient composition of animal products (use KA 701).

Animal Protection

KA 311. Animal Diseases

This area includes work on animal diseases that represent a threat to the production of an adequate and wholesome supply of animal products from livestock, poultry, and fish.

Areas of work include but are not limited to:

- Disease management for biosecurity purposes
- The nature of causative agents involved in animal diseases
- Mechanisms of disease resistance and immunity
- Interrelationships among environment, genetics, and infectious agents in the etiology of diseases
- Methods of diagnosis, prevention, treatment, control, and eradication of diseases, including development of equipment
- Methods for risk assessment, surveillance, and prevention of foreign animal disease threats
- Evaluation of alternative control methods
- Understanding mechanisms involved in transmission of diseases to animals, including the role of vectors such as insects, ticks, and mites
- Integrated control systems for animal diseases.

Exclude:

- Disorders due to improper nutrition (use KA 302)
- Disorders resulting from pollution (use KA 133)
- Bloat and disorders due to ingestion of toxic plants, etc. (use KA 314)
- Disorders due to environmental stress (use KA 306)
- Nonfarm-raised fish, shellfish, game and fur-bearing animals, and other wildlife (use KA 135).

KA 312. External Parasites and Pests of Animals

This area includes work on pests and external parasites, including insects, ticks, mites, and other parasitic organisms that reduce animal productivity. This area also includes work on more cost-effective methods of control.

Areas of work include but are not limited to:

- Biology and life history of pests
- Biosystematics/taxonomy
- Use and development of irradiation, chemosterilants, attractants, repellents, and other non-insecticidal approaches to insect control
- Absorption, metabolism, and excretion of insecticides by insects feeding on or in animals
- Biological control of insects
- The nature of insect resistance to chemical controls
- Evaluation of alternative control methods
- Development of methods and equipment for applying or using control materials
- Integrated control systems for external parasites.

Exclude:

- The role of insects, mites, and other arthropods in disease transmission (use KA 311)

- Nonfarm-raised fish, shellfish, game and fur-bearing animals, and other wildlife (use KA 135).

KA 313. Internal Parasites in Animals

This area includes work on internal parasites such as various kinds of worms, flukes, and protozoa. Emphasis is on reducing losses, including those due to mortality, reduced yield and condemnation of meat, feed wastage, and cost of drugs.

Areas of work include but are not limited to:

- Biotic relationships in parasitism
- Biosystematics/taxonomy
- Biocontrol and management practices that minimize reliance on chemicals
- Safe chemical means including systemics for combating parasites
- Effective means of diagnosing parasitic infestation
- Evaluation and development of control methods and equipment
- Study of heritable traits, breeding, and selection to improve resistance to parasites
- Integrated control systems for internal parasites.

Exclude:

- Nonfarm-raised fish, shellfish, game and fur-bearing animals, and other wildlife (use KA 135)
- Insects, ticks, leeches, and mites (use KA 312).

KA 314. Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals

This area focuses on reduction of losses in productivity in livestock, poultry, and fish operations due to toxic chemicals, pesticides, poisonous plants, predators, ingestion of metal and other foreign bodies, and other hazards.

Areas of work include but are not limited to:

- Determining the specific sites and mechanisms of poisoning, bloat, and other disorders to learn the bases of these phenomena
- Toxicology and safe levels of residues of pesticides and other chemicals, natural or synthetic, used directly on or ingested by livestock and poultry
- Methods of reducing ingestion of pesticides or other chemicals in or on animal feeds
- Reasons for inter-species differences in detoxification mechanisms and sensitivity to poisoning by pesticides and other chemicals
- Developing animal management practices that minimize use of pesticides and other chemicals that leave toxic residues or that reduce the level of residues
- Prevention or alleviation of "hardware disease," and effects of plants that cause bloat, poisoning, or deformities of livestock
- Developing methods for combating nuclear radiation hazards to livestock
- Methods for reducing animal losses from predators.

Exclude:

- Breeding and selection of feed crops for reduced content of toxic components (use KA 203)
- Pesticides and other toxic substances applied to or ingested by livestock and poultry when the

- emphasis is clearly on reduction of the toxic content of foods consumed by humans (use KA 711)
- Disorders resulting from pollution (use KA 133)
- Nonfarm-raised fish, shellfish, game and fur-bearing animals, and other wildlife (use KA 135).

KA 315. Animal Welfare/Well-Being and Protection

Work in this area focuses on developing effective animal care and use programs, and information related to and contributing to the welfare, well-being, and proper stewardship of food animals.

Areas of work include but are not limited to:

- Fundamental studies related to the assessment of animal well-being, including measures of adaptation and adaptiveness, measures of social behavior and spacing, physiological measures, and measures of cognition and motivation
- Management/confinement production systems related to animal welfare/well-being
- Controlled environments and environmental factors, including temperature, relative humidity, ventilation, lighting, and sound related to animal welfare/well-being
- Housing and equipment design; pen/cage design and densities; feeding, watering, and bedding practices related to animal welfare/well-being
- Handling, restraint, transport, and husbandry practices, such as castration, tail docking, debeaking, and others related to animal welfare/well-being
- Humane slaughter, euthanasia, and analgesia related to animal welfare/well-being
- Behavior patterns related to animal welfare/well-being
- Disease prevention techniques and practices, including management practices, disease detection and surveillance, assessing disease risks, vaccine development, parasite control, and others specifically related to animal welfare/well-being.

Exclude:

- Etiology of disease, disease agents, internal and external parasites, and toxic hazards (use KA 311-314)
- Genetics of disease resistance (use KA 303 or 304)
- Production management systems as related to production efficiency and economic viability (use KA 307)
- Nonfarm-raised fish, shellfish, game and fur-bearing animals, and other wildlife (use KA 135).

Topic IV. Agricultural, Natural Resource, and Biological Engineering

KA 401. Structures, Facilities, and General Purpose Farm Supplies

Work includes the design, construction, and cost of facilities for animals, agricultural products, agricultural inputs, equipment, and other materials. The properties and behavior of animals, products, equipment, and materials while in various facilities and during transport or processing is a part of this work.

Areas of work include but are not limited to:

- Engineering aspects of design and construction of structures and facilities
- Physical, chemical, and biological aspects of the production of fertilizers, pesticides, feeds, and hormones
- Engineering aspects of materials handling, transport, land use, and storage of crop, forest, and range products

- Biological, chemical, and physical properties of materials
- Behavior of chemical and biological materials in storage systems
- Determining costs and benefits of construction or engineered systems
- Determining maintenance needs and costs of agricultural systems
- Facilities for handling, processing, and storing new food and fiber products, animal feeds, forage, and bedding
- Structures and facilities for housing and handling animals
- Facilities for handling and storing fuel, fertilizers, pesticides, and other farm supplies
- Environmental control of structures for animals, plants, or agricultural products
- Energy conservation relative to structures and facilities.

Exclude:

- Safe handling and use of materials and equipment (use KA 723)
- Facilities that reduce environmental stress in animals (use KA 306).

KA 402. Engineering Systems and Equipment

This work includes mechanization to increase efficiency and decrease labor requirements in agricultural and forestry production such as: grain, fruit and vegetable crops, timber, livestock, poultry, fish, and other animals. This includes machinery and power units for the pre- and post-harvest of various animal and plant products.

Areas of work include but are not limited to:

- Tillage, planting, chemical application, and harvesting systems for agricultural and range systems
- Harvesting systems for forestry, including roads, transportation, and access for in-woods processing
- Systems for establishment and regeneration of crop, forest, and range systems
- Handling methods for animals and animal products
- Design and evaluation of equipment used in production of agricultural, forest, and range systems
- Application of sensors and robotics
- Application of pesticides and crop nutrients
- Energy conservation relative to systems and equipment.

Exclude:

- Structures and facilities (use KA 401)
- Irrigation and drainage systems (use KA 405)
- Safety of humans (use KA 723)
- Equipment that reduces environmental stress in animals (use KA 306)
- Food bioengineering and food process engineering (use KA 501).

KA 403. Waste Disposal, Recycling, and Reuse

Work in this area includes all aspects of collecting, storing, transporting, treating, recycling, and utilizing waste products from agriculture, forestry, and other origins. The development of value-added or alternative products from waste products is included.

Areas of work include but are not limited to:

- Methods of collecting, storing, moving, treating, and disposing of animal, plant, food processing,

- municipal, and industrial wastes
- Development of products from waste materials, including biofuels
- Engineering and analysis of projected and existing waste disposal systems and pesticide containers
- Recycling pre- and post-consumer wastes
- Improved methods for mitigating environmental impacts and biosecurity risks from agricultural, forestry, municipal, and industrial wastes.

Exclude:

- Pollution prevention and mitigation of soil and water resources (use KA 133)
- Pollution prevention and mitigation of air resources (use KA 141)
- First use of under-utilized co-products (use KA 502 or 511).

KA 404. Instrumentation and Control Systems

This work includes instrumentation and information systems that are important elements in all aspects of pre- and post-production agriculture. Sensors for detecting, monitoring, and processing of collected data and those that can provide improved control of the production and processing of biological materials, non-biological materials, and biohazards are included in this area.

Areas of work include but are not limited to:

- Development of instruments, technologies, and procedures that enhance agricultural efforts
- Determining accurate and precise standards of measurement
- Development of sensors, image processing techniques, automation, decision support systems, controls, and models
- Development of global imaging systems and global positioning systems (GPS) to enhance agricultural efforts.

Exclude:

- Experimental design and statistics (use KA 901).

KA 405. Drainage and Irrigation Systems and Facilities

Water management, to include surface and subsurface drainage and all irrigation systems, is part of this work. Equipment, system design, theory, modeling, installation, operation, and maintenance of drainage and irrigation systems for more efficient use of land, water, and capital resources are included.

Areas of work include but are not limited to:

- Theory of water flow for more efficient water management system design
- Methods of automating water management systems to reduce labor and increase efficiency
- New concepts and improved design of drainage systems for more efficient production and environmental improvement
- New materials, systems, equipment, and installation techniques to reduce construction and maintenance costs of drainage and irrigation systems
- Use of solar energy and air turbulence to speed drying of poorly drained soils
- Methods for combining irrigation, drainage, and tailwater return flow systems to increase efficiency of water and system use
- Improved design of water management systems to reduce planning and construction costs and

- assure public safety
- Methods for determining irrigation water requirements giving consideration to water use by plants, effective rainfall, and water losses during and following application
- Equipment for uniform distribution of irrigation water with particular emphases on overhead and subsurface systems
- Improved technology to measure and control losses of agrochemicals from irrigated lands.

Exclude:

- Drainage related to controlling salinity (use KA 103).

Topic V. Food and Non-Food Products: Development, Processing, Quality, and Delivery

Food

KA 501. New and Improved Food Processing Technologies

Work in this area focuses on development or improvement of methods, techniques, or processes to maintain or improve quality or functionality, stabilize or preserve foods, or prepare foods for further processing.

Areas of work include but are not limited to:

- Food physical processes (i.e., thermal and non-thermal pasteurization/ preservation, size reduction, separation, concentration)
- Food bioprocesses (i.e., enzyme and microbial applications, fermentation, genetic engineering of foods and food ingredients)
- Food chemical processes (i.e., salt, sugar, acid, preservatives, colorants, antioxidants, chemical modification)
- Food processing efficiencies (i.e., management of energy, water, wastes)
- Improved or new food packaging technologies
- Food process modeling, automation, and sensors
- Processing technologies for new food uses of agricultural products
- Food bioengineering and food process engineering
- Maintaining or enhancing bioactive components in food and food ingredients.

Exclude:

- Utilization of food processing wastes (use KA 403)
- Economics of food processing (use KA 603)
- Nutrient composition of foods (use KA 701)
- Nutrient requirements and bioavailability (use KA 702).

KA 502. New and Improved Food Products

This area includes work to improve or develop new food products. Work also includes development of knowledge to influence quality and functionality of foods in complex food systems.

Areas of work include but are not limited to:

- Chemical and biochemical reactions in foods
- Measuring/characterizing food components and functions

- Identifying, characterizing, and measuring chemical, physical, and sensory properties of foods
- Determining relationships among the chemistry, structure, and quality parameters of food components and their functionality and end use properties in foods
- Designing and formulating foods for improved human nutrition or for enhancement of human health (i.e., nutraceuticals, functional foods, and medicinal plants)
- Quality and safety parameters affecting development of new and improved food products
- Developing new food products from process stream co-products
- Sensory physiology and sensory evaluation
- New food uses for agricultural products.

Exclude:

- Live food plants and animals to improve food quality or functionality (i.e., breeding, feeding, cultural, or production management practices) (use KA 204 or 308)
- Development of foreign markets (use KA 606)
- Quality maintenance during storing and marketing of food products (use KA 503)
- Utilization of food processing wastes (use KA 403)
- Nutrient composition of foods (use KA 701)
- Nutrient requirements and function (use KA 702).

KA 503. Quality Maintenance in Storing and Marketing Food Products

Work in this area includes understanding and minimizing food quality losses during preservation, storage, distribution, and marketing to enhance the quantity and quality of foods delivered to consumers, minimize food costs, and enhance profitability for food producers and marketers.

Areas of work include but are not limited to:

- Chemical and biochemical changes after harvest/slaughter or during handling and storage
- Effective ways to reduce physiological deterioration and losses due to insects, spoilage microorganisms, rodents, and other pests
- Effects and means of controlling temperature, humidity, and atmosphere in storage and transportation
- Containerization/packaging or storage and handling methods to maintain optimum conditions for quality maintenance
- Relationships among variables of handling and storage and loss in quality
- Segregation/identity preservation and handling systems.

Exclude:

- Prevention, reduction, or elimination of pathogenic microorganisms, mycotoxins, and naturally occurring toxins in foods (use KA 712)
- Characterization of quality parameters and their interactions for new and improved food products (use KA 502)
- Quality maintenance of non-food agricultural and forest products (use KA 512).

KA 504. Home and Commercial Food Service

This area of work focuses on development of guidelines to ensure the wholesomeness, nutritional value, taste, and appearance of commercially and home prepared foods. Work also includes development of approaches to improve preparation, handling, and storage of food that reduce waste, assure quality, and increase consumer appeal.

Areas of work include but are not limited to:

- Factors affecting quality of food prepared at home or commercially
- Improving methods of preparing, handling, holding, and serving food, including automation and/or computerization
- Development of methods to provide effective, efficient management in institutional and commercial food services
- Product labeling to improve consumer information about product quality, preparation and handling, storage, nutritional values, and unit cost of foods for home and commercial use.

Exclude:

- Safety of commercially and home prepared foods (use KA 711 or 712)
- Nutrient composition of food and diets (use KA 701 or 703).

Non-Food

KA 511. New and Improved Non-Food Products and Processes

Work in this area includes agricultural commodities used in consumer products such as paper, textiles, biofuels, adhesives, paints, and other biobased products. This area also includes work on animal byproducts as raw materials for the textile, leather, soap, feed, pharmaceutical, and other industries. Work also includes alternate, non-food uses for agricultural commodities and timber products to expand markets for these products, yielding new, improved, or less expensive consumer products and providing additional sources of income to producers, processors, and marketers.

Areas of work include but are not limited to:

- Developing new non-food products from agricultural and forest resources
- Developing ethanol and biofuels from agricultural materials
- Identifying, characterizing, and measuring chemical, physical, and sensory properties of non-food products
- Determining the relationships among the chemistry, structure, and quality parameters of raw materials and their functionality and end use properties in non-food products
- Development or improvement of applications for non-food products to enhance utilization, including structural wood engineering, performance evaluations, and environmental impacts
- Development or improvement of methods, techniques, or processes to produce or manufacture non-food products
- Efficiency in converting agricultural and forest commodities to new and improved non-food products (i.e., management of energy, water, wastes)
- New non-food products from underutilized co-products from process streams
- New non-food uses for agricultural products.

Exclude:

- Improvements in products through production practices or breeding (use KA 204 or 308)
- Evaluation and utilization of textiles and textile products (use KA 804)
- Utilization of waste materials (use KA 403)
- Development of foreign markets (use KA 606).

KA 512. Quality Maintenance in Storing and Marketing Non-Food Products

This area of work focuses on maintenance of quality of feeds, seeds, and other non-food agricultural and forest products during handling, storage, and marketing.

Areas of work include but are not limited to:

- Chemical and biochemical changes after harvest/slaughter or during storage
- Reducing physiological deterioration and losses due to insects, spoilage microorganisms, rodents, and other pests
- Effects and means of controlling temperature, humidity, and atmosphere in storage and transportation
- Containerization/packaging or storage and handling methods to maintain optimum conditions for quality maintenance
- Relationship among variables of handling and storage and loss in quality
- Seed processing technology, including seed separation, cleaning, storage, and treatment.

Exclude:

- Quality maintenance of food products (use KA 503).

Topic VI. Economics, Markets, and Policy

KA 601. Economics of Agricultural Production and Farm Management

This work focuses on economic choices farmers and ranchers make to access and allocate resources for the production of commodities, services, and products. These resources help farmers and ranchers to minimize production risk and optimize farm income.

Areas of work include but are not limited to:

- Farm production economics
- Farm management
- Sustainable agriculture
- Farm and firm growth, including economies of size and scale
- Agricultural profitability.

Exclude:

- Production and management studies not related to economics (use appropriate KA)
- Real estate, and land values and prices (use KA 602)
- Farm financial management (use KA 602)
- Economics of environmental risk and impacts (use KA 605)
- Financial risk (use KA 602)
- Regional production and markets (use KA 608).

KA 602. Business Management, Finance, and Taxation

This work focuses on the management and administrative techniques applied to farming, agricultural business, and other businesses and enterprises to enhance planning, decision making, and resource use. These techniques help businesses make effective financial decisions, stay in the marketplace over the long term, and increase profitability. It includes the analysis of effects of taxation on profitability.

Areas of work include but are not limited to:

- Business administration
- Business skills for entrepreneurs
- Managerial economics
- Capital and investment markets
- Household assets as business capital
- Decision analysis, including expert systems
- Financial risk management
- Insurance
- Human resource management
- Business transfer and succession planning
- Economics of financial markets, financial management, and lending institutions
- Real estate values and prices
- Taxation.

Exclude:

- Estate planning (use KA 801)
- Economics of production (use KA 601)
- Production risk management (use KA 601)
- Markets and marketing (use KA 603 or 604)
- Policy (use KA 610 or 611)
- Farm family financial management (use KA 801)
- Personal and family finance (use KA 801).

KA 603. Market Economics

This work focuses on activities that foster understanding of markets, productivity, agricultural competitiveness, and interregional trade, and give insight to the role and function of markets and their regulation primarily from the macroeconomic (industry) perspective.

Areas of work include but are not limited to:

- Market performance
- Productivity analysis
- Economics of processing, storage, and transportation
- Economics of regulation and protection of markets, including firm- and processor-level impacts
- Local, regional, and national trade patterns
- Economics of marketing and pricing systems, and institutions
- Regulation of markets
- Economics of supply and demand
- Economics of grades and standards.

Exclude:

- International trade and development, including foreign market development (use KA 606)
- Economics of food assistance, welfare, and poverty (use KA 607)
- Economics of consumer-level food and production regulation and protection (use KA 607)
- Regional economics, except trade patterns (use KA 608)
- Policy (use KA 610 or 611).

KA 604. Marketing and Distribution Practices

This work concerns the distribution of products, goods, and services, the practices of buying and selling, and the development and improvement of markets primarily from the microeconomic (firm) perspective.

Areas of work include but are not limited to:

- Economic studies to determine and measure quality characteristics desired by processors
- Effectiveness of group action
- Institutional devices for bargaining and negotiation
- Effectiveness of marketing structures, including cooperatives
- Improvements in the marketing and distribution of products, goods, and services
- Marketing orders
- Futures and options markets, cash and forward contracts, and other marketing and pricing arrangements
- Development of domestic markets
- Direct marketing, alternative markets, and niche marketing
- Electronic commerce options for producers
- Local marketing of local produce.

Exclude:

- Economics of markets (use KA 603)
- Economics of supply and demand (use KA 603)
- Economics of pricing systems (use KA 603)
- Commodity analysis and projections (use KA 603)
- Foreign market development (use KA 606 or 611)
- Policy (use KA 610 or 611).

KA 605. Natural Resource and Environmental Economics

This work focuses on understanding economic relationships, decisions, and impacts relating to the management and use of public and private natural resources, and the environment. Work in this area also focuses on the economics of improving the efficiency of agricultural, forest, and rangeland use while minimizing negative impacts on the environment.

Areas of work include but are not limited to the economics of:

- Water resources
- Forestry
- Recreation, leisure, and tourism
- Land resources, use, and management

- Wildlife and fisheries
- Agrochemical management
- Waste management, including animal wastes
- Mineral resources and energy
- Environment
- Short term and decadal weather
- Market and non-market value of natural resources.

Exclude:

- Financial aspects of real estate (use KA 602)
- Land use planning or zoning (use KA 608)
- Policy (use KA 610 or 611)
- Conflict resolution (use KA 803).

KA 606. International Trade and Development

This work focuses on the economic components of international trade and development, trade performance of sectors of the U.S. economy and that of other countries, globalization, barriers to trade, and trade and development impacts, especially as it relates to policy decisions. There is a strong focus on the global market economy, specifically the interaction between domestic and international market economies.

Areas of work include but are not limited to:

- Economics of international trade and development programs
- Global and international commodity analysis and projections
- Country, regional, and sector analysis
- International economic growth and development
- Foreign market development.

Exclude:

- Domestic commodity analysis and projections (use KA 603)
- U.S. economic growth and development, including community development (use KA 608)
- Policy (use KA 610 or 611).

KA 607. Consumer Economics

This work provides insight and understanding into the demands, preferences, behavioral responses, and needs of individuals and consumers. This work provides insight and understanding about how consumer choice drives market economies, and how consumer policy, advertising, and other market forces influence consumer demand.

Areas of work include but are not limited to:

- Consumer demand
- Consumer level-food and production regulation and protection, and food safety
- Poverty, welfare, and assistance, including food assistance
- Consumer response to biotechnology, organic products, and labeling.

Exclude:

- Economics of production technologies (use KA 601)
- Finance and estate planning (use KA 602 or 801)
- Dietary and nutritional aspects of food choices and food assistance (use KA 703)
- Physical fitness (use KA 724)
- Human resource economics (use KA 602)
- Economics of farm-, firm-, and processor-level impacts of food and production regulation and protection (use KA 603)
- Economics of product quality characteristics desired by consumers (use KA 604)
- Policy (use KA 610)
- Family economics (use KA 801)
- Aspects of consumer economics related to nutrition and hunger (use KA 704)
- Physical protection of food (use KA 711 or 712).

KA 608. Community Resource Planning and Development

This work provides understanding about community needs and preferences by providing local leaders and organizations the information, skills, and decision-making tools to help understand problems, identify opportunities, and plan for renewal and growth.

Areas of work include but are not limited to:

- Economic planning, development, and industrialization
- Jobs and employment
- Regional economics and sector analysis
- Land use planning and zoning
- Entrepreneurship
- Public administration
- Small business and home-based business
- Community planning and development.

Exclude:

- Natural resource and environmental issues (use KA 605)
- Poverty and welfare programs, including food assistance (use KA 607 or 703)
- Consumer issues (use KA 607)
- Policy (use KA 610)
- Family issues (use KA 801)
- Public services (use KA 805)
- Sociological and technological change affecting communities (use KA 803)
- Measuring the adequacy, quality, and cost of public services (use KA 805)
- Community and civic engagement (use KA 805)
- Conflict resolution (use KA 803).

KA 609. Economic Theory and Methods

This work includes the development of economic theory and methodology to improve the knowledge base in a variety of topics.

Areas of work include but are not limited to:

- Property rights, including intellectual property rights
- Public choice
- Labor economics
- Welfare economics
- Location and decision theory
- Trade adjustment alternatives
- Econometrics and simulation
- Mathematics and statistics for economic research
- Data collection and research methodology for economic research
- Economic history and philosophy.

Exclude:

- Applied economics (use KA 601-608)
- Farmworkers and related social issues in local communities (use KA 803).

KA 610. Domestic Policy Analysis

This work focuses on the economic and social impacts of domestic programs and policies, including the effect of government actions on the U.S. The work in this area analyzes the long- term effects of government actions, which influences how the U.S. develops and implements policies.

Areas of work include but are not limited to:

- Agricultural production, price, and income policy, including commodity programs
- Natural resource, agri-environmental policy
- Antitrust and market policy
- Rural development policy
- Science, research, and education policy
- Consumer policy
- Public policy
- Impacts and implications of macroeconomic policies
- Public policy education, including methodology
- Evaluation of policy effectiveness, impacts, and outcomes.

Exclude:

- Risk management (use KA 601 or 602)
- Taxation (use KA 602)
- Conflict resolution (use KA 803)
- Food security related to nutrition and hunger (use KA 704)
- Family policy (use KA 802)
- Youth policy (use KA 806).

KA 611. Foreign Policy and Programs

This work focuses on U.S. foreign policy goals, assessing the effectiveness and impacts of implemented policies and the interactions between foreign and domestic policies, and global implications.

Areas of work include but are not limited to:

- Trade policy
- Effects of policy on foreign market development
- Foreign assistance policy, projects, and impacts
- Interactions between foreign and domestic policies and global implications.

Exclude:

- International trade and development (use KA 606).

Topic VII. Human Nutrition, Food Safety, and Human Health and Well-Being

Human Nutrition

KA 701. Nutrient Composition of Food

This area is concerned with the determination of the quantities of nutrients and other food components in food; development of analytical methods; development and maintenance of data banks of information on food composition; development of software and other systems to facilitate use of data on food composition, including recipe calculations; development and evaluation of educational materials and strategies on food composition; and dissemination of information on food composition for professionals, students, and the public.

Areas of work include but are not limited to:

- Composition of food, including nutrients and other food components
- Databank development and utilization systems
- Analytical methods
- Development, evaluation, and dissemination of educational strategies and information on food composition.

Exclude:

- Development of foods for improved health, e.g., nutraceuticals, functional foods (use KA 502)
- Production of improved food plants and animals (use KA 204 or 308).

KA 702. Requirements and Function of Nutrients and Other Food Components

This area concerns fundamental knowledge about relationships of food eaten by people to their physical development, physical activity, and mental status, and to the maintenance of optimal health. It is concerned with defining nutrient requirements and functions throughout the life span and in response to the environment. Functions include cellular and molecular regulation of gene expression by specific nutrients. This area is also concerned with development of methods to quantify relationships of nutritional status to well-being to provide a scientific basis for establishing Dietary Reference Intakes and Dietary Guidelines. Programs on nutrient requirements and function are concerned with the development and evaluation of

education activities, strategies, and materials, and with the dissemination of related information for professionals, students, and the public.

Areas of work include but are not limited to:

- Functions of nutrients and other food components
- Relationship of nutrients and other food components (such as phytochemicals) to gene expression, health, physical and mental development, performance, and longevity
- Requirements for energy, fat, protein, amino acids, fatty acids, minerals, and vitamins related to age, sex, and life stage, including maternal and infant nutrition, physical activity, and physiological, psychological, and environmental conditions
- Interrelationships among nutrients and non-nutrient components of food as they affect absorption, metabolism, growth, and maintenance requirements
- Methods of evaluating nutritional status
- Development, evaluation, and dissemination of education programs, strategies, and information on nutrient requirements and function.

Exclude:

- Development of foods for improved health; e.g., nutraceuticals, functional foods (use KA 502)
- Aspects of health unrelated to food and nutrition (use KA 724).

KA 703. Nutrition Education and Behavior

This area is concerned with assessment of food intake and dietary patterns, the factors that influence food intake and dietary patterns, the interrelationships among these factors, and with the assessment of food and nutrient intake in relation to nutrient requirements, dietary guidance, and food plans. The focus is frequently on population groups at nutritional risk and on the factors that promote or hinder healthful food choices in these groups. Programs on dietary standards, guidance, food guides, and behavior change are concerned with the development, evaluation, and dissemination of education activities and strategies for professionals, students, and the public.

Areas of work include but are not limited to:

- Food consumption, use, patterns, and analytical methods
- Nutrition monitoring and surveillance
- Development of dietary standards, dietary guidance, and food guides to meet nutritional needs of the general population and population subgroups with special needs
- Dietary status assessments, e.g., comparisons to standards
- Factors that influence dietary status and behavior change including food accessibility and affordability
- Development and evaluation of education, communication, and food assistance strategies, programs, and policies that affect dietary status
- Development and evaluation of education programs and strategies on dietary standards, guidance, food guides, and behavior change, and the dissemination of related information for professionals, students, and the public.

Exclude:

- Consumer economics, including food assistance, where the focus is not on the healthfulness of diets (use KA 607)

- Community resource management, where the focus is not on the healthfulness of diets (use KA 608)
- Aspects of health education unrelated to food and nutrition (use KA 724)
- General education and information delivery, where the focus is not on the healthfulness of diets (use KA 903)
- Family resource management, where the focus is not on the healthfulness of diets (use KA 801)
- Home and commercial food service, where the focus is not on the healthfulness of diets (use KA 504).

KA 704. Nutrition and Hunger in the Population

This area is concerned with food insecurity, insufficiency, and hunger in the population. Included are the development of analytical methods and proactive attempts at hunger reduction through food banks, communities organizing to gain farmers markets, community gardens, gardening, food buying clubs, food recovery, and gleaning.

Areas of work include but are not limited to:

- Assessments of food sufficiency in the population
- Development and evaluation of strategies for addressing food insufficiency.

Exclude:

- Aspects of poverty, welfare, and food assistance programs unrelated to nutrition and hunger (use KA 607 or 610)
- Local marketing of local produce (use KA 604).

Food Safety

KA 711. Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources

Work on toxic residues of agricultural origin is conducted to determine the levels and circumstances under which chemicals may be safely used in production of plant and animal food products. There is widespread public concern over the potential hazards created by the use or introduction of chemicals in the production of farm products. The focus of work under this KA is on human health.

Areas of work include but are not limited to:

- Safe or acceptable levels of residues and environmental contaminants on or in farm products for human consumption
- Behavior and fate of pesticides, antibiotics, hormones, and other applied chemicals and environmental contaminants, on or in food plants and animals and their products
- Methods to remove or mitigate the effects of chemicals harmful to human health
- Rapid, accurate methods for monitoring pesticide residue, antibiotic, environmental, or other contaminants on or in food plants and animals and their products
- Assessing risk to human health from harmful chemicals in food plants and animals and their products
- Determining consumer attitudes and developing techniques to communicate relative risks of harmful chemicals in food plants and animals and their products
- Hazard analysis and critical control points (HACCP).

Exclude:

- Work focusing on food plant or animal productivity or economics, animal health, or fates and effects of chemicals on the environment (use appropriate KA under PLANTS AND THEIR SYSTEMS or ANIMALS AND THEIR SYSTEMS)
- Economics of food safety (use KA 603, 604, or 607).

KA 712. Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

This area includes work on pathogenic foodborne microorganisms and parasites in raw, minimally processed, or inadequately processed and preserved foods. Work on mycotoxins and natural and induced toxicants in foods—including allergens and seafood toxins—is also included. The focus of work under this KA is on human health.

Areas of work include but are not limited to:

- Production of food animals and crops free of microorganisms, parasites, natural toxins, or other biological agents harmful to humans
- Prevention of transmission of pathogenic microorganisms and parasites from human carriers to livestock and food systems
- Maintenance of food security in handling, processing, packaging, and distributing food products
- Improved methods of food handling, processing, storage, and preparation for greater food security
- Methods for preventing or eliminating mycotoxins in peanuts and other field crops
- Methods for preventing, removing, or controlling naturally occurring and induced toxins and allergens in agricultural products
- Assessing risk to human health from pathogenic microorganisms and natural toxins in food animals and crops and their products
- Determining consumer attitudes and developing techniques to communicate relative risks of pathogenic microorganisms and natural toxins
- Basic work on growth and mechanisms of pathogenesis of foodborne microbial pathogens
- Education on safe food handling.

Exclude:

- Work focusing on animal health (use KA 311 or 314)
- Prevention of transmission of non-foodborne parasites to humans through food animals (use KA 722)
- Control of pests in food plants that is not focused on safeguarding human health (use appropriate KA under PLANTS AND THEIR SYSTEMS)
- Economics of food safety (use KA 603, 604, or 607).

Human Health

KA 721. Insects and Other Pests Affecting Humans

This area includes work on insects, ticks, mites, and other pests that are an annoyance to humans. The emphasis is on developing safe, effective, and economical ways of controlling these pests.

Areas of work include but are not limited to:

- Biology of insects, ticks, and mites affecting humans, including those important in forensic studies

- Developing attractants and repellents
- Developing and improving methods of pest control.

Exclude:

- The role of insects, ticks, and mites in disease transmission (use KA 722)
- Management of insects affecting livestock and pets (use KA 312)
- Management of insects affecting stored food products (use KA 503)
- Management of insects affecting wood products (use KA 512)
- Protection of residential structures from insects and other pests (use KA 804)
- Apparel and textiles to protect against insects (use KA 804).

KA 722. Zoonotic Diseases and Parasites Affecting Humans

Work in this area concerns animal diseases and parasites such as anthrax, encephalitis, leptospirosis, and rabies that pose potential threats to human health. Included are studies on epidemiology, risk assessment, biosecurity, and evaluation of efficacy of control programs for disease vectors.

Areas of work include but are not limited to:

- Understanding mechanisms involved in transmission of diseases to humans, including the role of insects, ticks, and mites
- Developing control programs to reduce animal reservoirs of zoonotic agents
- Developing means of preventing transmission of zoonotic diseases and parasites from animals to humans.

Exclude:

- Animal diseases and parasites where the concern is the protection of the animal itself (use KA 311, 312, or 313)
- Transmission of parasites and pathogenic microorganisms in animal food products consumed by humans (use KA 712).

KA 723. Hazards to Human Health and Safety

Work in this area is concerned with reducing hazards to the health, safety, and biosecurity of people involved in the production, processing, and distribution of agricultural and forest products. This area includes safety aspects of agricultural injuries and illnesses and methods for effective intervention. The emphasis is on immediate hazards to humans.

Areas of work include but are not limited to:

- Developing worker safety procedures for people handling agricultural products, supplies, and livestock
- Developing methods for safe handling of agricultural chemicals, fuels, and other products
- Determining health impact of pesticides on farm workers
- Determining need for and developing protective devices and procedures for safe usage and transportation of farm and forest machinery and equipment
- Determining nature, frequency, and causes of agricultural injury and occupational illness
- Developing methods to reduce fire risks and improve fire control measures for storage facilities, barns, and other farm structures or equipment

- Characterizing, measuring, or mitigating potentially harmful compounds derived from agricultural products such as tobacco that have pharmacologic actions
- Protection of humans against non-food allergens and toxins, and poisonous plants
- Mitigation of pollutants such as pesticides, radionuclides, heavy metals, excess fertilizer chemicals, growth regulating chemicals, airborne particulates, dust, ozone, odors, volatile compounds, combustion products, and smog
- Measuring and mitigating exposure to noise, vibration, sun, ergonomic, and other occupational hazards in agriculture
- Equipment and techniques for fire-fighter safety and survival.

Exclude:

- Agricultural and forestry practices to achieve safe levels of pollutants (use KA 133 or 141)
- Disposal of pesticide rinsate and surplus pesticides (use KA 403)
- Toxic residues on or in food products (use KA 711)
- Pathogenic microorganisms and naturally occurring toxins, including allergens, in food (use KA 712)
- Transmission of parasites and zoonotic diseases to humans (use KA 722)
- Development and evaluation of textiles and textile products for their protective properties (use KA 804)
- Methods to reduce fire risks and to improve fire control measures for range and forests (use KA 122).

KA 724. Healthy Lifestyle

This area concerns activities related to healthy lifestyles, including maintenance of social, emotional, and physical health. The focus is on physical activity, exercise, stress management, and health-related practices including screening, immunization, and preventive care. The work in this area frequently involves population groups at risk and the factors that promote or hinder healthy lifestyles in these groups. Work is also concerned with development of a theoretical basis for behavior related to healthy lifestyles. Education and extension programs on healthy lifestyles and behavior change are concerned with the development, evaluation, and dissemination of education programs and strategies for professionals, students, and the public.

Areas of work include but are not limited to:

- Assessment of the healthfulness of lifestyles and analytical methods
- Factors that influence the healthfulness of lifestyles
- Development of standards and guidance on healthy lifestyles
- Development and evaluation of education programs and strategies on healthy lifestyles and the dissemination of related information for professionals, students, and the public.

Exclude:

- Aspects of health related to nutrition (use KA 701, 702, or 703)
- Insects and other pests affecting humans (use KA 721)
- Zoonotic diseases and parasites affecting humans (use KA 722)
- Hazards to human health and safety (use KA 723)
- Human development and family well-being (use KA 802)
- Community institutions and health and social services (use KA 805)
- Healthy lifestyle programs that focus on youth (use KA 806).

Topic VIII. Families, Youth, and Communities

KA 801. Individual and Family Resource Management

Work in this area provides an understanding of how individuals and families obtain and use resources of time, money, and human capital to achieve their standard of living and overall quality of life. This area is also concerned with factors affecting the decision-making process, such as availability of resources, life events, living patterns, values, goals, interests, and attitudes of families, and external forces such as public issues, policies, and programs.

Areas of work include but are not limited to:

- Resource management, including time, money, and human capital
- Interrelationships between society and households to improve family well-being
- Improvement of basic occupational skills
- Development of financial management skills
- Families and work/business relationships
- Retirement planning for individuals and families
- Supplemental income strategies
- Asset building, management, protection, and transfer
- Financial security or planning
- Predatory lending and consumer fraud
- Debt management
- Saving and investing
- Estate planning.

Exclude:

- Consumer economics (use KA 607)
- Community economic development (use KA 608)
- Poverty and economic analysis of welfare programs (use KA 607)
- Dietary status (use KA 703)
- Entrepreneurship (use KA 608).

KA 802. Human Development and Family Well-Being

Work on family and human development provides an understanding of the social, cognitive, emotional, and physical development of individuals and families over the human lifespan. The focus is on family and life cycle studies. Work in this area also provides a better understanding of family systems, family performance, and well-being.

Areas of work include but are not limited to:

- Human (child, adolescent, adult) development throughout the life cycle
- Parenting, parent-child relationships, and grandparents/relatives as caregivers
- Child care, dependent care, and after-school programs
- Aging and intergenerational issues, including elder care
- Care giving across the life cycle
- Family-focused prevention and intervention programs
- Family strengths/resiliency

- Family policy
- Individual communication and family interactions
- Character/ethics education
- Children, youth, and families at risk
- Marriage/couples relationships
- High-risk, fragile individuals and families
- Volunteer recruitment, development, and management
- Workforce preparation (including school-to-work, welfare-to-work, work-to-work retooling)
- Training and development of youth workers
- Professional development.

Exclude:

- Family economics and resource management (use KA 801)
- Social impacts on families (use KA 803)
- Physical fitness (use KA 724)
- Human development activities that focus on youth (use KA 806).

KA 803. Sociological and Technological Change Affecting Individuals, Families, and Communities

Work in this area provides an understanding of the technological, demographic, and social changes occurring in society. Work also provides an understanding of the current and historic ways in which individuals, families, and communities cope with sociological and technological change, and includes activities that extend this knowledge to the population.

Areas of work include but are not limited to:

- Composition and trends in population
- Sociology/psychology of the farm family and other aspects of rural life and living conditions
- Social aspects of agrarian reform
- Migration patterns of farm and rural populations
- Farmworkers and related social issues in local communities
- Impact of cultural trends and technology on society
- Cultural awareness and respect
- Impact of change on communities
- Community development, asset building, civic engagement, and leadership
- Social and educational factors affecting poverty
- Social impact of environmental change
- Public lands/private lands conflicts
- Private lands/public benefits
- Conflict resolution and conflict management
- Political movements
- Social aspects for planning and development of healthy communities.

Exclude:

- Land use (use KA 131)
- Acceptance of pest management systems (use KA 216)
- Community planning and development (use KA 608)
- Policy analysis (use KA 610)

- Rural, agro- or eco-tourism (use KA 605)
- Character/ethics education (use KA 802)
- Community services (use KA 805)
- Social and emotional development of youth (use KA 806)
- Leadership development and leadership opportunities for youth (use KA 806).

KA 804. Human Environmental Issues Concerning Apparel, Textiles, and Residential and Commercial Structures

Work on social, aesthetic, and functional aspects of apparel and textiles provides a better understanding of the interface among producers, retailers, and consumers. This area also provides knowledge about the products of agriculture used in apparel and textiles and on factors that affect consumer choice. Work includes the social, economic, and design aspects of housing and other structures.

Areas of work include but are not limited to:

- Developing and evaluating textile products for superior functional characteristics to meet consumer needs, aesthetics, and preferences
- Determining properties of fibers that affect consumer satisfaction
- Textiles and apparel for special physical needs
- Preservation and storage of artifacts
- Effect of textiles and apparel on human development
- Development of textile products for production
- Availability of goods, services, and product information to the producer, retailer, and consumer
- Protection of residential and commercial structures and apparel from pests
- Determining family housing requirements on the basis of selected characteristics such as age, income, size, stage in the life cycle, health, occupation, and ethnic background
- Determining community, regional, and national needs for housing on the basis of user needs
- Effect of housing environment on quality of life issues
- Determining costs and benefits of construction systems and materials, giving special attention to consumer needs
- Improved design, technology, materials, and construction methods for renovation, pest control, and construction
- Housing environmental issues, including indoor air quality and "green" design
- Reviewing and developing building codes and other legal requirements based on life safety issues, health, and welfare of users of a built environment.

Exclude:

- Improvements in agricultural practices to enhance raw materials (use KA 204 or 308)
- Functioning of markets, including capital markets, related to real estate (use KA 602)
- Development of new textiles (use KA 511)
- Agricultural structures and facilities construction (use KA 401)
- Health and safety hazards such as pesticides, fire, and sun exposure (use KA 723)
- Disposal, recycling, and new development of textiles from waste products (use KA 403)
- Market economics and practices related to apparel and textiles (use KA 603 or 604).

KA 805. Community Institutions, Health, and Social Services

This work addresses the development, quality, and functioning of community institutions and social services. Work in this area enhances the scope, scale, and effectiveness of public and private community institutions and services, including emergency preparedness and response, and public safety.

Areas of work include but are not limited to:

- Development, coordination, and adaptation of agencies and organizations
- Provision of social services
- Measuring the adequacy, quality, and cost of public services
- Organizational and operational efficiency of government agencies and units
- Community service institutions, including volunteer organizations, non-profit groups, and centers
- Development of community fire prevention, attack, and suppression plans
- Delivery of health services, including telemedicine centers
- Community and civic engagement.

Exclude:

- Dietary status (use KA 703)
- Public administration (use KA 608)
- Policy analysis (use KA 610)
- Workforce preparation (use KA 802)
- Outdoor recreation (use KA 134 or 605)
- Community-related hunger, nutrition, and food programs (use KA 704)
- Activities and programs that focus on youth development (use KA 806)
- Entrepreneurship (use KA 608)
- Homeland security and emergency management processes, including disaster preparedness, mitigation, response, and recovery for individuals, youth, families, and communities (use KA 807).

KA 806. Youth Development

Work in this area includes programs and activities that promote youth development, including 4-H. These activities extend knowledge to youth and convey a sense of belonging, teach life skills, and provide opportunities for mastery, competence, and independence. This work also includes a focus on the social and emotional development of program participants.

Areas of work include but are not limited to:

- Literacy, communication, problem solving, and other life skills
- Self-confidence and self-esteem
- Interaction and relationships with adults and peer groups
- Civic engagement (connecting youth to government and institutions)
- Leadership development and leadership opportunities for youth
- Sense of belonging/sense of safety
- Youth initiatives in non-formal science, engineering, and technology
- Volunteerism and community service for youth
- Youth policy.

Exclude:

- Policy analysis (use KA 610)
- Entrepreneurship (use KA 608)
- Development of financial management skills (use KA 801)
- Human development activities that focus on families (use KA 802)
- Early childhood development (use KA 802)
- Cultural awareness and respect (use KA 803).

KA 807. Disaster Preparedness, Mitigation, Response, and Recovery

Work in this area focuses on accepted homeland security and emergency management processes, including disaster preparedness, mitigation, response, and recovery for individuals, youth, families, and communities. Mitigation may include but is not limited to disaster-related human hazards, disaster-related animal and plant hazards, and disaster-related costs.

This Knowledge Area engages individuals, youth, families, and communities to help people become more resilient and mitigate the impact of disasters caused by natural and man-made hazards by making informed personal decisions in all phases of any disaster. Disaster outreach work is done in an all-hazards approach, including homeland and agricultural biosecurity where the focus is on best management practices and preventative measures.

Areas of work include but are not limited to:

- Community emergency and disaster planning
- Community coalition-building across local governments, NGOs, faith-based groups, businesses, and institutions of higher education
- Training and exercises
- Risk and crisis communication
- Damage assessment activities
- Disaster risk assessment for individuals and communities
- Roles in incident command structure in Emergency Support Function #11
- Volunteerism before, during, and after emergencies and disasters
- Agricultural biosecurity research, education, and outreach activities
- Incident-specific activities focused on response, short-term recovery, and long-term recovery.

Exclude:

- Hazards to human health and safety (use KA 723)
- Methods to reduce fire risks and to improve fire control measures for range and forests (use KA 122)
- Drivers of short term and decadal weather (use KA 132)
- Risk assessment for foreign animal diseases (use KA 311) and zoonotic diseases (use KA 722)
- Enhancements to the scope, scale, and effectiveness of public and private community institutions and services, including emergency preparedness and response, public health emergency preparedness, and public safety (use KA 805).

Topic IX. Program and Project Support, and Administration, Education and Communication

KA 901. Project and Program Design, and Statistics

This work focuses on program and project design and evaluation, experimental design, surveys, sampling, and statistical analysis.

Areas of work include but are not limited to:

- Program planning, design, and evaluation
- Methods to measure productivity of educators and researchers, and teaching, research, and extension organizations
- Criteria and techniques for evaluating proposals and accomplishments
- Design of experiments and statistical analysis of data
- Improvement in statistical methodology
- Development of education, research, and extension technologies and procedures
- Sampling, and design of survey instruments
- Data gathering, management, and analysis.

Exclude:

- Development of instrumentation (use KA 404 or 903)
- Standards of measurement (use KA 404)
- Development of economic techniques (use KA 609)
- Evaluation of education, communication, and food assistance strategies, programs, and policies that affect dietary status (use KA 703)
- Criteria and techniques for evaluating proposals (use KA 902)
- Studies on administration of teaching, research, and extension (use KA 902).

KA 902. Administration of Projects and Programs

This work is focused on efficiency and effectiveness of research, education, and extension methods and proposals. Included in this is work on maximizing researcher, educator, and facility productivity, and on coordinating teaching, research, and extension efforts among scientists and educators throughout the nation.

Areas of work include but are not limited to:

- Promotion of teaching, research, and extension creativity and productivity
- Developing and maintaining the proficiency of educators and researchers
- Relationships among teaching, research, and extension
- Communication among researchers and educators, and dissemination of research results
- Roles of cooperation and competition among scientists, educators, and organizations.

Exclude:

- Development of instrumentation (use KA 404 or 903)
- Experimental design and statistics (use KA 901)
- Evaluation and assessment (use KA 901).

KA 903. Communication, Education, and Information Delivery

This area of work focuses on educational processes, needs, and methods to achieve educational goals. Work includes development, use, and assessment of communication, information delivery, and technology transfer methods and systems. List topic- or discipline- specific education under the appropriate KA.

Areas of work include but are not limited to:

- Techniques, procedures, and processes of education
- The science of teaching, learning, and cognition
- Curriculum design and educational instrumentation (applications of technology and media in teaching and learning)
- Teacher preparation and improvement
- Communication and information systems and delivery, including electronic networks and distance education
- Technology transfer
- Educational psychology and human motivation.

Exclude:

- Education policy (use KA 610)
- Public policy education, including methodology (use KA 610)
- Communication, education, information delivery related to human nutrition (use KA 701, 702, 703, or 704)
- Education on safe food handling (use KA 712)
- Education or information dissemination pertaining to healthy lifestyles (use KA 724)
- Character/ethics education (use KA 802)
- Educational factors affecting poverty (use KA 803)
- Conflict resolution (use KA 803)
- Public services (use KA 805)
- Education and training related to youth development activities (use KA 806)
- Assessment and evaluation of communication and education systems (use KA 901).