

# **FY2000 ANNUAL REPORT OF ACCOMPLISHMENTS AND RESULTS**

## **West Virginia Agricultural & Forestry Experiment Station College of Agriculture, Forestry and Consumer Sciences West Virginia University**

### **Plan of Work for 2000-2004**

#### **A. Report of Accomplishments and Results**

**Program 1(Goal 1):** Develop and support globally competitive agricultural and forestry production systems.

#### **Overview**

With few exceptions, the industries of agriculture and forestry in West Virginia are dominated by relatively small operations (approximately 90% of farms have less than \$10,000 gross sales; nearly 85% of state timber land is individually owned; etc.). The ability to remain competitive while lacking the efficiencies of large size typically requires alternative advantages, such as opportunities to compete in specific or niche markets, or an ability to capitalize on resources unique to one's production/marketing environment. Lack of size additionally places high value on integrated approaches to the production, processing, and marketing of goods or services.

A principle goal of research conducted in the West Virginia Agricultural and Forestry Experiment Station is to contribute to economic development in the state and thereby to the economic well-being of West Virginia citizens. Research programs conducted by Station faculty therefore focus on economic activities for which West Virginia conditions offer some degree of competitive advantage. Examples of state resources which could or do provide competitive advantage include the state's exceptional hardwood forests, a topography, soil and climate extremely well suited to production of forages and/or livestock on pasture, a rich history, scenic beauty, wildlife populations and recreational opportunities which are highly attractive to tourists, abundant water resources well suited to the production of food fish, and a proximity (primarily northern and eastern counties) to large urban markets for standard and/or niche (e.g., organic) agricultural or forest products.

West Virginia's forests and grasslands are among the state's most unique and valuable natural resources. Recent research conducted in the West Virginia Agricultural and Forestry Experiment Station, partially supported by McIntire Stennis or Hatch funding and focused on hardwood forests, has defined "sustainability" for diameter-limit timber harvesting, has specified expected species composition of forest regeneration, and has developed an accurate digital imaging system for cover typing in Appalachian hardwood forests. Trials have been initiated to determine the efficacy of a hypovirus in controlling chestnut blight and the safety of a biological insecticide used to combat gypsy moth infestations. Greater use of neglected hardwood species in the manufacture of wood

products is an expected result of research assessing orthotropic mechanical properties of three Appalachian hardwoods.

Hatch supported research to encourage use of state grasslands for the production of forage or livestock has identified cultivars of switchgrass which excel in annual production of biomass and has indicated harvest frequency and nitrogen fertilization levels for maximum yield. Related research has developed both genetic and detoxification and/or binding strategies to limit accumulation of ergopeptines toxic to animals in fungi associated with pasture grasses. Additionally the value of pasture systems for the production of livestock has been enhanced significantly by reproductive management research which has developed systems to 1) shift estrus activity in pasture bred sheep to capture higher, out of season market prices, and 2) allow timed-by appointment artificial breeding of pasture raised beef cattle.

Growth in poultry consumption and proximity to large, urban markets has made broiler production the largest agricultural activity in West Virginia. Hatch supported Station research has identified methods of increasing feed efficiency, growth rate, and percent of growth in breast and legs; determined the cost-benefits of transporting poultry litter from high to low areas of animal concentration; and quantitated impacts on broiler breeder egg production from housing in a two-tiered colony cage system.

The opportunity to supply a growing northeastern urban market demand for organically produced food products has motivated a major shift in Station research toward organic production methods. Focusing initially on the organic production of tree fruit, Station research has identified new apple cultivars most resistant to 13 arthropod pests and the bitter rot pathogen, *C. acutatum*; completed an economic analysis of conventional and alternative (oil, Bt, CaCl + fungicides early season) IPM programs for arthropods and disease control in apples used for processing, and is evaluating endophyte infected fescue cover crops for controlling nematodes in apple orchards.

West Virginia has the natural and human resources to support strong food and recreational fish industries. The Aquaculture Food and Market Development Project is a multi-disciplinary, multi-institutional and highly integrated effort. Research supported by Hatch and Special Research Grant funding has developed marketing strategies for both fee fishing and processed food fish (mostly trout and other cool water species), prepared farm-level enterprise budgets for trout production, assessed effects of excessive CO<sub>2</sub> on trout filet quality, and launched an extensive technology development and delivery program for trout production and processing, and for recreational fishing.

West Virginia University and USDA-ARS are jointly conducting a rainbow trout genome mapping project that is an integral part of the overall effort in the genetic improvement of the species. The focus of the research is to identify and sequence genes involved in regulating growth and other productive traits to aid breeding programs designed to produce fish that more efficiently convert feed nutrients into meat, are more disease resistant, reproduce more efficiently, and possess quality characteristics demanded by consumers.

Excellent progress has been made toward achieving the objective of Program 1 (national Goal 1) from the Station Plan of Work. Of particular note are results of the efforts to establish a state aquaculture (fish for food or recreation) and to take full advantage of West Virginia's grassland resources. Projects centered around organic production of agricultural products are relatively new and we expect significant additional results from these projects in the coming year or two.

### **Expenditures and SY for Program 1 (Goal 1)**

<b>Source</b>	<b>\$ or SY</b>
Formula	1,187,768
State Funding	2,281,898
SY's	15.7

### **Key Theme – Forestry**

- a) Description – Research to enhance sustainable logging, value added wood product manufacturing and tourism.
- b) Impacts – Diameter-limit cuts of <30cm dbh were found to be non-sustainable over five growing seasons. Additionally, species composition of Appalachian hardwood forest regeneration was dominated by black cherry and red maple even though the previous overstory was primarily oak and poplar.

A system using airborne digital imaging was developed which allows accurate assessment of hardwood species from .5m resolution images.

Greater use of neglected hardwood species in structural composite manufacturing is expected as a result of research assessing orthotropic mechanical properties of three Appalachian hardwoods (red oak, yellow poplar and aspen). Simulation models using these data are being developed to predict flexural properties of structural composites manufactured from these hardwood species. An additional study found negligible environmental impact from organic compounds produced during the kiln drying of red oak lumber.

Large scale trials have been initiated to test a promising hypovirus as a biological control agent for chestnut blight which has virtually destroyed a species that comprised more than 25% of Appalachian forests at the turn of the 20<sup>th</sup> century. Additional research found no adverse effect on songbird and salamander populations from use of the biological insecticide, *Bacillus thuringiensis*, to control gypsy moth infestations.

- c) Funding: Hatch, McIntire Stennis, and State
- d) Scope of Impact – Multi-state Research

CT, MA, MD, NJ, NY-G, NY-I, PA

### **Key Theme – Grazing**

- a) Description – Fully utilize state grasslands for cost effective production of forage and livestock.
- b) Impacts – Lowland cultivars of switchgrass exceeded upland cultivars for total biomass by about 10%; for harvested forage, a single cutting per year and N fertilization of no more than 50 mg/ha in spring were optimum for total yield.

A knockout mutation which yields an ergopeptine deficient endophyte fungus (not toxic to grazing animals) has been developed; three fungi capable of degrading or binding the commercial ergopeptine, ergotamine, have been identified.

Progesterone vaginal inserts, with or without FSH, were very effective in inducing estrus and increasing prolificacy in anestrous ewes; FSH tended to increase prolificacy. Similar treatment applied to beef cattle is expected to increase conception rates to timed/by appointment artificial insemination by about 25%.

An economic analysis showed contract grazing to offer higher profits and lower risks than conventional cow-calf operations.

- c) Funding – Hatch, State
- d) Scope of Impact – multi-state integrated research and extension  
CA-B, CA-O, CO, CT-NH, FL, GA, IN, KS, MA, MD, MN, NV, NY-G, NY-I, OR, PA, RI, SD, UT, VA, WA, WI, USDA

### **Key Theme – Agricultural Competitiveness**

- a) Description – Support economic development in the state with focus on activities offering competitive advantage to state producers.
- b) Impacts – *in ovo* treatment with chicken growth hormone increased feed efficiency in broilers approximately 5 % with a 20% faster growth rate which occurred mostly in breast and leg muscles. Egg production and fertility of breeding broilers were lower in a two-tiered colony cage system than in birds maintained on a conventional floor, apparently due to feet problems among roosters. A follow-up trial is evaluating a modified cage bottom.

Mating disruption technology provided control of oriental fruit moth in peaches comparable to a four-spray chemical program; Sprayable insect pheromones provided insect control comparable to conventional insecticide treatments; Golden Delicious and Yakata were found to be most resistant, among 23 new apple cultivars, to 13 arthropod pests; the same cultivars were moderately resistant and moderately susceptible, respectively, to bitter rot pathogen.

Endophyte infected fescue has shown promise, as a cover crop, to control nematode infestations in apple orchards.

- c) Funding – Hatch, State
- d) Scope of Impact – Multi-state research

CT-NH, MA, ME, NH, NJ, NY-G, NY-I, PA, VT

**Key Theme – Aquaculture**

- a) Description – Support development of profitable, sustainable food and recreational fish industries.
- b) Impacts – Farm-level enterprise budgets for raceway production of trout in West Virginia ranged between \$.90 and \$.98 per pound for systems producing 20,000 to 100,000 lbs./year. This allows a reasonable profit margin if present market prices in the range of \$1.15 to \$1.30/lb persist.

Fish exposed to high CO<sub>2</sub> levels had significantly less weight gain and significantly higher shear force measurements on fillets; adding a cryoprotectant prior to freezing whole trout filets minimized negative effects of frozen storage.

State Aquaculture forums held in 2000 and 2001 attracted 70 and 100 participants; overall evaluation of the program was 4.34 on a 5-point scale; approximately 300 requests for information have been received during the last two years.

Feeding trout a high energy (18% fat vs. standard 11%), high protein (48% vs. standard 38%) resulted in a 50% increase in weight gain.

Several genomic libraries for rainbow trout have been developed and have been used to isolate and sequence rainbow trout microsatellites (highly variable DNA regions). Expressed Sequence Tags and other DNA sequences involved with growth regulation have been identified.

- c) Funding – Hatch, State, Special Research Grant
- d) Scope of Impact – Integrated research and extension

**Program 2(Goals 2 & 3):** Ensure a healthy, well-nourished population with access to a safe and secure food system.

**Overview**

Program 2 combines both national goals 2 and 3 due to the strong relationship between the goals and relatively small size of this program in West Virginia. The focus of research for this goal is on food quality and safety for the products emphasized under Program (Goal) 1; on concerns with potential accumulation of toxic substances in soils and subsequent entry into the human food chain; and on nutrition of the rural, low income families, especially pregnant women.

Easy access to large urban markets and available land in a rural setting provide West Virginia with a competitive advantage in the production of broilers and turkeys. Likewise, abundant cool water resources with nearly constant year-round temperature, provide state producers with a potentially significant advantage in the production of cool water food fish such as trout.

Capitalizing on these advantages in the production of poultry, turkey and fish requires end products that are of consistent high quality and safe for consumption. Research at the West Virginia Station has shown considerable variation in several measures of quality for trout produced in Virginia and West Virginia, some of which has been related to water characteristics and management practices. Related research has documented significant advantages from use of a cryoprotectant prior to freezing trout fillets.

Campylobacter and Salmonella represent human health concerns for producers of poultry products. Information concerning the ecology of these species, while relatively extensive in chickens, is limited for turkeys. Several multi-week trials recently completed have monitored the frequency of Campylobacter in feces and water, and Salmonella in feeders, waterers, air and litter at turkey production facilities in West Virginia. Results of these projects have characterized risk probabilities for Campylobacter and have determined the most effective control point for Salmonella.

Contamination of soils with lead and/or arsenic from the use of lead arsenate on fruit trees or from chromated copper arsenate (CCA) in treated wood used in constructing raised vegetable beds, has drawn criticism from environmental groups and become a public concern. Research to assess the extent of these problems has compared alternative models with titration data to predict the movement/binding of lead in soils, and has documented plant accumulations of soil arsenic.

Much of rural West Virginia is characterized by relatively high levels of unemployment and low median income. Under these circumstances, the Supplemental Nutrition Program for Women, Infants and Children (WIC) is especially important as one component of a broad program to mitigate the cycle of rural poverty. Station research has identified factors associated with variations in the use of WIC programs, as well as variations in infant birth weight and in the use of prenatal care.

Goals two and three currently represent a very limited research area in West Virginia. We expect additional effort relevant to these goals with the addition of new research faculty over the next year. We are quite satisfied with accomplishments contributing to this program area, given the low level of resources currently allotted, and further believe we have focused our resources to areas of greatest potential benefit to citizens of West Virginia.

### **Expenditures and SY for Program 2 (Goal 2 & 3)**

<b>Source</b>	<b>\$ or SY</b>
Formula	90,364
State Funding	169,626
SY's	1.2

**Key Theme – Food Safety and Quality**

- a) Description – Research to ensure food quality and safety, focused on products produced in West Virginia.
- b) Impacts – Variations in measures of trout fillet quality (dressing percentage, pH, moisture, fat, expressible moisture and smoked fillet hardness) were considerable across producers, indicating a lack of product consistency; adding a cryoprotectant prior to freezing whole trout fillets minimized negative effects of frozen storage.

Campylobacter was isolated from nearly 60% of growing turkeys examined during a twenty-week trial period, indicating a need to implement pre-harvest control measures; turkeys placed on used litter had a lower incidence of Campylobacter colonization than turkeys placed on new litter; the critical control point for Salmonella in turkey production is the waterer.

Modeling of lead adsorption on attapulgite, Illite, Kaolinite, and montmorillonite using Double, Triple, or Constant Capacitance models explained experimental data equally well; arsenic levels in soils from beds constructed of CCA treated wood were three to four times the levels found on beds constructed of cement blocks; however, arsenic concentrations in cabbage, green peppers, onions and tomatoes grown in CCA wood treated beds were not different from those grown in cement block constructed beds.

Availability of transportation, family problems and unhappiness with a pregnancy were most important reasons for women in the WIC program failing to initiate prenatal care; low infant birth weight was associated with the first two of these, and also with low intake of several vitamins and minerals.

- c) Funding – Hatch, State
- d) Scope of Impact – state specific

**Program 3 (Goal 4):** Greater harmony between agricultural and forestry practices and the environment.

### Overview

Much of West Virginia represents a continuous interface between a natural environment and the practices of farming and forestry. Although farmers and foresters are among those most concerned with the adoption and use of sustainable practices having minimal negative impact on our natural environment, they also are justifiably concerned with maintaining their livelihoods. Promoting a symbiotic coexistence between our farms, forests, and natural environments, where policy decisions are based on reliable, scientific information, represents a major focus of research conducted in the West Virginia Agricultural and Forestry Experiment Station.

Station projects center on evaluation and remediation where needed, of farming, forestry and mining practices on wildlife populations and on soil and water quality. During the

past year, impacts of stream sediment (from bank disturbance) on feeding behavior and growth of brook trout, smallmouth bass, and aquatic invertebrates was documented. Other work evaluated upland, central Appalachian forests of three types (white, black, and northern oak; black cherry and maple; red spruce, yellow birch predominating) for number, suitability and proportional use of tree cavities by mammals and cavity dwelling birds. Additionally, a GIS database of the Cheat river and Decker's Creek watershed in northern West Virginia was constructed which summarizes current land use, water and wildlife habitat quality, and fish diversity profiles to assess the interactive effects of forestry, agriculture and acid mine drainage on fish communities in the lower Cheat river basin.

Studies of soil quality included an evaluation of species diversity and physiological differences between ectomycorrhizal fungi from serpentine and non-serpentine soils and the potential use of the former in programs to remediate high metal soils. An assessment of soil quality on reclaimed mountain top removal sites, compared to contiguous native soils, documented soil quality of the former after three to 30 years of recovery. Additionally a study was initiated in northeastern West Virginia (an area of significant growth in poultry production) to determine phosphorus retention capacities of various soil types in the area and thereby allow determination of environmentally safe loading rates for poultry wastes or other materials high in phosphorus. Finally composting reactors were developed and tested to assess their ability to remove soil pesticide residues, and a related study documented plant removal of soil lead and cadmium.

Acid mine drainage is a serious threat to water quality in many areas of West Virginia. A study was conducted to determine the efficacy of trenches filled with slag and limestone to treat acid mine drainage from point and non-point sources. A second study examined the effect on water quality of fly ash application to surface mines. Improper operation of home septic systems represent an additional threat to water quality. Where standard leach field systems are inappropriate (limited land area, shallow water tables, slowly permeable soils, etc.), home aeration units have been used. Water quality of effluent from these systems, and the significance of pathogenic *Arcobacter* spp. found in these effluents, was examined.

Progress in achieving the objectives of Program 3 (relevant to national goal 4) as they apply to West Virginia conditions is extremely encouraging. Objective information regarding impacts of human activities on natural populations will be invaluable input to informed public policy and private decision making. Studies to identify the extent of, and develop remediation for, insults to soil and water quality are contributing to economic well being and quality of life for West Virginia citizens.



### Expenditures and SY for Program 3 (Goal 4)

Source	\$ or SY
Formula	812,698
State Funding	1,298,873
SY's	10.0

#### Key Theme – Wildlife Science and Management

- a) Description – Research to evaluate and remediate as necessary negative impacts of agriculture and forestry on natural populations.
- b) Impacts – Brook trout are able to overcome the reduction in ability to site prey from turbidity (sediment) by increased mobility but growth is reduced due to the higher energy expended in locating food. Smallmouth bass were less affected. Reduction in abundance and diversity of aquatic invertebrates also resulted from increased sediment.

Availability of cavities for mammals and cavity nesting birds was significantly greater in mixed oak forests as compared to black cherry – maple and red spruce – yellow birch forests. Additionally greater proportional use of cavities occurred on back water sides, compared to navigational sides, of 10 islands located in the Ohio river.

As expected, there is a consistent relationship between stream order and fish species diversity in the Cheat river watershed. Where the watershed is subject to acid mine drainage, however, species diversity is zero regardless of stream order. Considerable unexplained variation in species diversity was noted which may be explained by interactions of agriculture, forestry and acid mine drainage in the watershed.

- a) Funding – McIntire Stennis and State
- b) Scope of impact – State specific

#### Key Theme – Soil Quality

- a) Description – Research to assess and develop remediation programs for soil contaminants.
- b) Impacts – Communities of ectomycorrhizal fungi differ in serpentine and non-serpentine soils with considerably less diversity in the former. Isolates from serpentine soils were genetically distinct from those inhabiting non-serpentine soils and characterized by an ability to secrete greater amounts of malate ( a metal chelator) and acid phosphatase. These adapted species may be useful in soil reclamation programs.

The quality of soils developing on reclaimed mountaintop removal mines improves substantially with time, at least to 30 years. Physical, chemical and microbiological properties of the older sites examined were at least as good as contiguous native sites.

Composting reactors using poultry litter as an energy source degraded up to 68% of methyl parathion soil contaminate. Successive compost cycles should remove other pesticides based on their half-life residuals. Removal of heavy metals from soils by selected plants can be an effective, low cost method of soil contaminant remediation.

- a) Funding – Hatch and State
- b) Scope of impact – State specific

### **Key Theme – Water Quality**

- a) Description – Research to assess and develop remediation programs for water contaminants.
- b) Impacts – Water flow over slag and limestone filled trenches was found to be an effective method of remediation for water contaminated by acid mine drainage. Similar results showed considerable improvement in water pH and metal concentrations from the application of fly ash.

More than 90% of currently installed home aeration unit septic treatment systems failed to meet state effluent standards for at least one pollutant. Improper maintenance of the systems was determined to be the most likely cause. *Arcobacter butzleri*, a recently recognized pathogen associated with human and domestic animal wastes, was found to be relatively resistant to the nutrient-depleted environment of groundwater at 15C (14 day population half-life).

- a) Funding – Hatch and State
- b) Scope of Impact – Multi-state Research  
CA-B, CA-D, CO, CT, GA, IA, MD, ME, MI, MN, MT, NH, NM, NV, NY-I, OH, OR, TN, VT

**Program 4 (Goal 5):** Enhance economic opportunity and quality of life for citizens and communities.

### **Overview**

West Virginia traditionally has lagged behind the national average in measures of human capital development. High poverty rates, declining per capita income, and persistent out-migration are chronic state problems. Research involving technologies and programs to enhance economic development consequently represents a high priority in the West Virginia Agricultural and Forestry Experiment Station.

The extensive rural areas of West Virginia have dictated that Station research will focus on economic development in rural communities having agricultural or forest based economies and on suitable replacements for a coal mining industry with reduced and declining employment opportunities. Research conducted during the preceding year included a project to characterize forest based economies in 55 West Virginia counties with respect to economic opportunities existing in timber, wood products, recreation, and tourist sectors. Community infrastructure and socio-economic characteristics also were evaluated along with community based and state agency programs and the efficacies of strategies available and employed for economic development.

Studies to assess economic opportunities to develop state-wide and/or community based tourism industries, including an evaluation of expanding interpreter's knowledge of visitor's expectation, were continued and detailed economic analyses of food fish enterprises in West Virginia were conducted (reported under Program 1 – Aquaculture). Additionally, studies were initiated to evaluate economic opportunities to establish a fee fishing industry and for eco-labeling of wood products, including application of forest practice certifications, in improving public image and enhancing markets for Appalachian hardwood products.

A broader based study examined the long-term competitiveness of U.S. poultry and tree fruit industries, both of which are substantially represented in West Virginia. Barriers to expanded international trade, requirements to remain competitive, and impact of the NAFTA also were examined.

Results contributing to the objectives of Program 4 (national Goal 5) were limited by the level of resources allocated to this program. Additionally several new programs were initiated during 1999 and are expected to generate concrete results in the coming year. Additionally, significant results contributing to community economic development were reported under Program 1, Aquaculture.

#### **Expenditures and SY for Program 4 (Goal 5)**

<b>Source</b>	<b>\$ or SY</b>
Formula	238,578
State Funding	131,976
SY's	1.5

#### **Key Theme – Community Development**

- a) Description – Research to identify and assist communities in developing profitable and sustainable industries.
- b) Impacts – Results suggest value added enterprises, improved workforce skills, tax incentives and improved worker compensation are among variables most important to forest-based economic development and reduction of citizen out-migration. Decreases in the percentage of state citizens below the poverty level has been

accompanied by an increase in income inequity within the state. Public policy should address accomplishing the former while avoiding the latter.

The U.S. poultry industry continues to be highly competitive in the world market with lower cost production than most European competitors who compete largely due to government export subsidies. Barriers to trade typically involve real or asserted health issues. Brazil, however, has lower cost of production and will be a strong competitor in the future. Continued productivity will require continued technological development.

Brazil represents an extremely strong U.S. competitor for orange juice but the U.S. remains strongly competitive for domestic apples and other fresh fruits. Annual levels of U.S. international trade have increased since the passage of NAFTA but were up-trending prior to its passage, making impact assessment difficult.

- a) Source of funding – Hatch and State
- b) Scope of Impact – Multi-state Research  
AL, AR, FL, GA, KY, LA, MS, OR, TX, NC(A&T), ND

## **B. Stakeholder Input Process**

The Dean/Director, along with selected administrative staff and faculty, held six, public listening sessions throughout the state. All sessions were publicly announced through regional newspapers, appropriate newsletters and local county extension offices. The College also continues to use semiannual meetings of the College Visiting Committee as a source of input. The Visiting Committee is intentionally balanced to represent the diversity of agricultural and forestry enterprises in West Virginia, as well as consumers of products and services from those industries. Additionally, the Experiment Station has established a broadly based Advisory Board charged with on-going evaluation of the Station's research portfolio. This Board will hold its initial meeting this April. Counsel from these various sources has been extremely valuable in guiding our research programs.

## **C. Program Review Process**

There have been no changes in the merit review process from that indicated in the Plan of Work.

## **D. Evaluation of the Success of Multi and Joint Activities**

Personnel from the West Virginia Station participated in six Northeastern, two Southern and one Western regional projects. Multi-state cooperation allows researchers to address numerous questions which could not be addressed by any state alone. Additionally, opportunities to share ideas, resources and expertise is especially beneficial to the West Virginia Station where resources are limited.

Northeast regional project, NE-185, represents a defining project for the West Virginia Station research effort due to its focus on economic development of local food systems. The rural and oftentimes isolated nature of many communities in the state, as well as their dependence on farm and forest economies, has made stakeholders in West Virginia extremely concerned with community economic development. Many of these stakeholders, additionally are from rural, low income families, typically underserved by governmental programs.

Results of research conducted by the participants in NE-185 have developed and refined protocols to study food systems of individual counties or regions within the participating states. Most importantly, results are demonstrating how the structures and viabilities of local food systems are heavily affected by public policy. Several states, including West Virginia, have used results to educate state agencies and local government officials and to assist them in making informed policy decisions.

Multi-state projects relevant to specific, economically important plant commodities in West Virginia include projects to evaluate new apple cultivars, to genetically enhance cold tolerance in horticultural plants, and to develop biologically based IPM systems for the management of plant parasitic nematodes and Chestnut pathogens. Production of horticultural crops, including tree fruits and especially apples, represent areas of potential economic growth for West Virginia stakeholders. Evaluation of yield and quality for apple cultivars relevant to specific geographic areas and conditions; and the selection of those best suited for specific micro-environments, has enabled regional and national producers to remain globally competitive, keeping prices low for consumers without sacrifice of quality.

Plant parasitic nematodes and Chestnut blight represent chronic and acute problems, respectively, having extreme economic consequences. Compounding these problems are growing stakeholder concerns with the use of synthetic pesticides to control plant pests and diseases. Alternative control options, such as breeding of resistant plant strains, improved cultural practices and the identification/introduction of pest predators, are ensuring more sustainable and environmental friendly crop production systems and reducing pesticide exposure risks.

Multi-state research projects involving pasture-based production systems for beef, sheep and dairy; as well as projects related to animal waste management and developing methods for more efficient reproduction in pasture maintained livestock, are of key importance in enabling West Virginia producers to capitalize on the abundant state grasslands. Again many of the stakeholders in these projects represent low income, rural and often underserved citizens seeking to supplement family income with a relatively low-intensity agricultural operation. The low cost production and improved marketing systems being evaluated in these projects, as well as the reproductive and animal waste management programs which have been developed, have the potential to contribute markedly to the economic growth of our rural communities.

Joint, integrated research and extension activities have been a central focus at West Virginia University during the past year. Our administrative structure which separates extension from the College of Agriculture, Forestry and Consumer Sciences has been allowed to restrict joint programs to an unacceptable level. A first step toward correcting this situation has been to appoint the Associate Director of the Experiment Station as an Associate Director in extension and correspondingly appoint the Director of Animal and Natural Resource programs in Extension as Associate Dean in the College. We additionally expect to increase our number of faculty with joint Extension-College appointments.

Programmatic interactions between the College and Extension are increasing dramatically. The need for Research-Extension cooperation – programs of technology development and delivery – was the most frequent topic of concern at stakeholder meetings conducted during the past year and we are committed to addressing this concern. Integrated projects now span all divisions of the College (Animal and Veterinary Sciences, Family and Consumer Sciences, Forestry, Plant Sciences and Resource Management) with the most mature and extensive example being the aquaculture project discussed in Program 1. This is a multidisciplinary, multi-college, multi-institutional (with West Virginia State), integrated project to develop food fish and recreational fishing industries in the state. Its direction of focus is from the ultimate user to the technology delivery to the technology development, with the first defining the latter two. Additional examples include joint programs to foster increased use of abundant, low cost grasslands for the pasture production of beef, sheep and dairy; research and extension programs to support developing food fish and expanding poultry industries; and coordinated efforts with farmers, foresters and the general public to improve state water quality.

## **F. Integrated Research and Extension Activities**

Program expenditures listed in Appendix C are described briefly as follows:

1. Involves research and technology transfer related to developing superior strains of grass; eliminating the toxic effect of the endophyte fungus; devising more profitable livestock management systems for beef, sheep and dairy; improving animal marketing systems; and producing economic data, budgets and forecasts which enable profitable enterprises.
1. Research and technology transfer to enhance poultry growth rate and efficiency, improve product quality and safety, anticipate market trends and changes, and responsibly dispose of animal waste.
1. A comprehensive, integrated effort to develop a sustainable, profitable food fish industry with focus on production, processing, marketing, value-added products, and use of abandoned mine water sources.

1. A state-wide, integrated effort to improve water quality actually or potentially compromised by acid mine drainage, improper animal waste management and poorly maintained septic systems.





**Appendix C**  
**U.S. Department of Agriculture**  
Cooperative State Research, Education, and Extension Service  
Supplement to the Annual Report of Accomplishments and Results  
Multistate Extension Activities and Integrated Activities  
(Attach Brief Summaries)

Institution West Virginia University  
State West Virginia

Check one:      Multistate Extension Activities

  X   Integrated Activities (Hatch Act Funds)

     Integrated Activities (Smith-Lever Act Funds)

**Actual Expenditures**

Line of Planned Program/Activity	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
<u>Pasture Production of Livestock</u>	<u>280,135</u>	_____	_____	_____	_____
<u>Competitive Poultry Industry</u>	<u>279,656</u>	_____	_____	_____	_____
<u>Develop/Support Aquaculture</u>	<u>160,762</u>	_____	_____	_____	_____
<u>Improved Water Quality</u>	<u>169,940</u>	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
<b>Total</b>	<u>890,493</u>	_____	_____	_____	_____

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Director

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2/26/00  
Date