Diversifying Helps Small Farms Thrive

SCOTT BAUER (K8599-6)

ARS chemist Joyce Foster (left) and animal scientist Ken Turner talk with producer Debbie Lehman about economical ways to meet the nutritional needs of goats while maintaining productive pastures.

The Appalachian hills offer challenges relished by its independent-minded residents. And the same rolling, diverse topography that can make traditional midwestern farming practices impossible here also supports an extraordinarily broad array of plant species.

It is with the idea of seeing an opportunity in each challenge offered by the rugged but rich topography that U.S. Department of Agriculture scientists are helping Appalachian farmers look for niche markets for products such as grass-fed beef, ramps, and chevon.

"Why send cattle to the Midwest to be fattened on corn, when New York City restaurants and other East Coast markets are buying grass-finished beef from Argentina?" wonders William M. Clapham. He has been head of the Appalachian Farming Systems Research Center in Beaver, West Virginia, for the past 2 years. USDA's Agricultural Research Service operates the center, which is about 3,000 feet above sea level.

"One of the many things our hills are tremendous at producing is lush grass," Clapham says. "So why not keep the cows here, save the transportation costs for shipping them out to midwestern feedlots, and build up a niche market here for a meat product that will command a premium price in the health food market? Cattle that graze grass have leaner meat."

Ramps? Better known as wild leek, this onion relative with a garlicky flavor may have anticancer properties. It certainly is a cultural icon in the Appalachian hills, with seasonal festivals built around it. For centuries, locals have celebrated the wild leek, touting its virtues in everything from salads to relishes, as well as just eaten plain—raw or steamed.

This spring, horticulturist Carol M. Schumann planted some ramp bulbs in woods around the ARS lab. "They seem ideal for an understory crop because they mature so early in the spring, before the tree leaves are out," Schumann says, "and they're dormant at the same time the forest is fully shaded."

"The search for niche products and new markets for small farms is key to the mission of our laboratory."

—William M. Clapham

Appalachian hills could be a food connoisseur's paradise!

SCOTT BAUER (K8595-9)

Preferring woody and weedy species, goats select the young growing points first as they browse downward from the upper parts of a plant.

The efforts of the lab's scientists to experiment with cultivating leeks in farm woods are typical of the lab's new emphasis on capitalizing on the region's remarkable geographic resource to create products for specialty markets.

"The search for niche products and new markets for small farms is key to the mission of our newly named lab," Clapham says. The facility was originally established in 1980 as the Appalachian Soil and Water Conservation Research Laboratory. The research center is in southern West Virginia and occupies 280 acres.

As suited as leeks are to forest understory, so, too, is agroforestry well suited to the Appalachian region, where hills are covered with either trees or pastures. Agroforestry is the growing of forest crops on farmland or farm crops in forests.

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>
> **—Charles M. Feldhake**

ARS soil scientist Charles M. Feldhake has planted 1,200 black locust trees in a steep hillside pasture. He planted the trees in rows about 30 feet apart in a 5-acre watershed where 25 sheep graze. Another 25 graze in an adjacent, treeless watershed. Feldhake wants to find out whether the deep-rooting trees can catch excess nutrients from livestock urine and manure before the waste reaches groundwater. The trees also provide shade for grass and other pasture plants, as well as for livestock, during hot summer days.

Feldhake and ARS agronomist David P. Belesky put small pasture plots in existing woodlands, thinning out some of the trees to increase growth of forage for livestock.

This spring, Feldhake planted walnut and pawpaw trees in a hayfield on an organic farm operated by West Virginia's Lightstone Foundation. "One challenge will be keeping the grass from outcompeting the tree seedlings without herbicides," says Feldhake.

SCOTT BAUER (K8591-12)

In an abandoned Appalachian pasture, animal scientist Ken Turner and chemist Joyce Foster label invasive shrubs for later assessment of the nutritive value of their plant tissues for browsing livestock.

Get Your Goat!

As for chevon, it's the industry term for goat meat. "Our hills are ideal for goats," Clapham says, "but they're usually there only as brush mowers, since the hills are too steep for tractors or mechanical mowers."

The thinking at the center is: Why not sell the goats for meat after they're

SCOTT BAUER (K8594-15)

Chemist Joyce Foster extracts chemicals from the leaves of shrubs to determine which plants are safe, palatable, and nutritious for livestock.

A wild white clover plant collected from a sheep-grazing pasture by geneticist Paul Voigt may be used to develop new white clover varieties adapted to the twin stresses of animal grazing and the Appalachian environment.

SCOTT BAUER (K8598-2)

done mowing? Many fields in the Appalachian hills are abandoned parts of farms that produce no income for farmers, except possibly fees from hunters. They are overrun with weeds like multiflora rose and honeysuckle. The center's scientists are experimenting with ways to return these fields to productivity.

One such field is near the Dan Hale Reservoir for the City of Princeton, West Virginia. It is a former cornfield overrun with shrubs, grass, and other weeds. Nothing has been done to the field in a decade, except to mow a few alleys through it for hunters.

Joyce G. Foster, an ARS chemist, and Kenneth E. Turner, an ARS animal scientist, have teamed up for the abandoned fields project. Their idea is to use goats to do the initial clearing. At the same time, they want to be sure the goats eat nutritiously so they can be sold for meat when their work is done.

Not that chevon production would stop once the land was cleared enough to become a pasture for cattle and sheep. The goats would continue to graze alongside the sheep and cattle. For the most part, they wouldn't be competing for forage, because their grazing tastes and behavior are so dissimilar.

Somewhat like deer, goats graze high and from the top down, preferring the growing tips and buds of tall grasses and woody shrubs. They avoid the white clover that is a mainstay of sheep and cattle.

Foster analyzes the chemical makeup of native and exotic pasture plants at various maturities to find those that are safe, nutritious, and palatable to various kinds of livestock.

"You have to watch plants closely. They're tricky. To defend against the eating habits of goats and deer, plants often produce noxious chemicals during their early growth stages to deter the animals," she says.

To account for the possible role of various soil types, Foster and Turner are also studying abandoned farmland restoration on different soils in the region. For example, they are studying unfarmed fields on karst topography, where underlying limestone strata lend themselves to cave formation. (See "Scientists Go Underground To Check Water Quality," August 1993, *Agricultural Research*, page 4.)

To help farmers fatten goats, sheep, and cattle for market, agronomist David P. Belesky is exploring ways to extend the grazing season—earlier in the spring and later in the fall. He also wants to fill in gaps in forage production during droughts and hot summer days. For the heat, he is looking at warm-season grasses like bermudagrass to supplement existing cool-season ones, such as tall fescue, that stop producing during hot days.

Belesky and colleagues are also building systems that match forage supply and quality with the nutritional needs of grazing livestock. Their approach builds on the hardy characteristics of adapted forage species and minimizes the need for purchased feed supplements for livestock.

SCOTT BAUER (K8593-1)

Soil scientist Charles Feldhake measures photosynthetically active radiation as part of a study on how seasonal microclimate modification by variable-density conifer stands affects the quality and yield of forage grown below.

Rolling in Clover

Plant geneticist Paul W. Voigt is breeding new white clover varieties to help farmers renovate their pastures with hardier ones that can stand up better to the pressures of sheep and cattle eating or stepping on the plants' stolons, or runners.

Most commercial varieties are not well-adapted to pasture use. Voigt wants to combine the high yields of larger leafed white clovers with the hardy stolons of the small-leafed forms.

He and colleagues from USDA's Natural Resources Conservation Service (NRCS) and the West Virginia and Virginia Extension Services recently finished collecting sample tips of stolons from more than 2,000 wild white clovers from the central Appalachian region. After the tips are well-rooted and producing good growth in a greenhouse at the Beaver center, he will take cuttings and start other plants. Those will be maintained at Beaver, and the original collection will be planted at the new USDA-NRCS Plant Materials Center near Alderson, West Virginia.

The Alderson plants will be evaluated to determine leaf size and stolon structure. Based on these data, promising plants in the greenhouse at Beaver will be grouped together. When those plants flower, they will be put into net cages with honey bees to cross-pollinate them to produce seed. Then, working with Turner, Voigt will test plants from that seed in pastures with livestock grazing.

If he's successful, farmers in the Appalachian region, as well as elsewhere in the country, will have more durable pastures.

"White clover is widely used and is a very important pasture crop," Voigt says. "It provides livestock with high-quality protein while also providing nitrogen fertilizer for itself and grasses growing with it."

John Vandevender, manager of the Alderson plant materials center in southern West Virginia—about 60 miles from Beaver and 1,500 feet lower in elevation—works with Voigt and his colleagues.

"We test their plants, and they test ours," Vandevender says. His center, recently relocated from Quick Sand, Kentucky, has released several cultivars of conservation and forage plants, including a clover and a lespedeza that Foster is considering as a possible forage. The center's releases include grasses, legumes, and trees.

Vandevender plans to spend some time promoting an earlier black locust cultivar release and to explore the possibility of encouraging farmers to use it and other cultivars to start tree nursery businesses in West Virginia.

"I'd like to see if we could help farmers go beyond the traditional enterprises of cattle and sheep," he says. "We'd need to discuss this with economists and others first, to see if it's feasible to develop a market—assess the need for a product and then produce enough to meet the need.

Tree nurseries could be one of the supporting industries for agroforestry. Vandevender has 3 acres set aside for Feldhake's and Schumann's agroforestry experiments. He is also helping Foster locate various lines of lespedeza and is discussing the possibility of testing dogwood trees for goat browsing.

Vandevender says his center has three new releases pending over the next few years, the first being an orchardgrass cultivar.

Water—Quality and Quantity

Lloyd Burns welcomes any help he can get with feeding his calves, which he raises on 258 rolling acres for Midwest feedlots. This year's early drought has him worried about producing enough grass to fatten his cattle up to their 800-pound sale weights. Like most farmers, he's always thinking about water.

"It's essential to my livelihood," he says, thinking not only of the drought but of the groundwater deep beneath his farm, which supplies his drinking water. It reassures him to know that ARS hydrologist Douglas G. Boyer goes 300 feet underground to study water quality below his pastures and barns.

Boyer walks and crawls through caves deep underneath pastures and dairy farms to sample cave streams and springs for contaminants such as nitrogen, phosphorus, and fecal bacteria. He will soon add *Cryptosporidium parvum* parasites to his list of contaminants to routinely check for.

C. parvum sickened more than 400,000 people in Milwaukee, Wisconsin, in 1993. The protozoan lays eggs, or oocysts, inside intestines of domestic and wild animals and humans. Shed in manure or human waste, disease-causing oocysts can enter lakes and streams by rain or snowmelt runoff and from inadequate septic systems.

Boyer's 9 years of caving and studying water quality have shown that animal waste is the main source of water pollution in the karst area. This is a labyrinth of limestone bedrock into which underground streams can easily scour out caves. Water sampling can't be done by the traditional method of drilling a narrow pipe well down to the water table because the bedrock is thick, and the water runs in such narrow, labyrinthine paths that striking it would be very difficult.

Boyer says water quality is definitely a small farms issue, because the farmers in this area don't have any treated water. It all comes from wells.

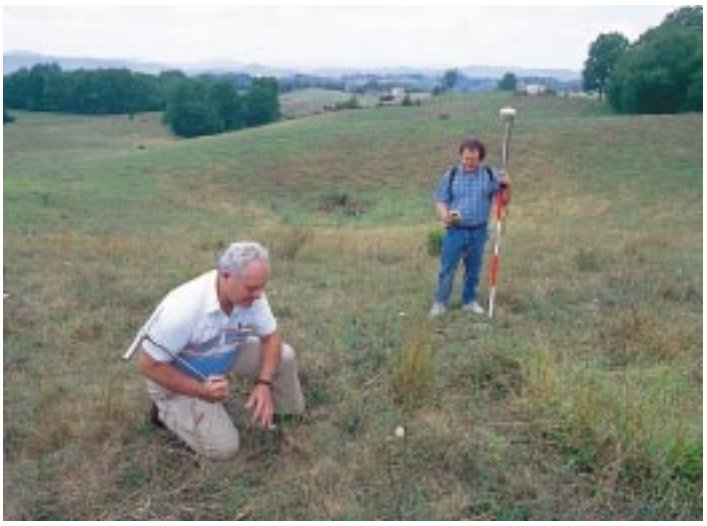
"There's been a growing public awareness of groundwater pollution over the past 15 years, especially among farmers," Burns agrees.

His son Lonnie farms with him and has been a caver since the 1990s, inspired by Boyer. Like his father and neighbors, he supplements his farm income with a full-time job in town. He says more people would be concerned about water quality if they had the information Boyer has shared with them. They feel fortunate to be able to talk to Boyer about the karst formation and groundwater flow below their farm.

"When you stand in a surface stream and then follow that stream down to 300 feet, walking and crawling for hours, and then see well casings reaching the stream, you get a whole different perspective," Lonnie Burns says.

"Farming in the Appalachian region is like farming anywhere—it's an uphill business," he says, referring not to the hills that present their own special challenge, but to the everyday struggles farmers face—like too much or too little rain—resulting in too little income.

SCOTT BAUER (K8596-6)



In studying animal waste distribution in a karst sinkhole, plant physiologist Ralph Clark (left) withdraws a soil sample while hydrologist Doug Boyer operates a global positioning system device.

SCOTT BAUER (K8600-5)

Plant physiologist Ralph Clark (left) and hydrologist Doug Boyer examine a water sample taken from a spring flowing out of this cave entrance.

"The karst land has its own set of challenges, though," Lonnie says. "Streams can fall down 300 feet real quickly, along with possible contaminants from animal manure." He says many people in the karst area are already trying to take measures to keep the streams and groundwater clean.

Because of Boyer's information, Lonnie and his father and a crew from the West Virginia Association for Cave Studies spent the third Saturday of each month, for about 6 months, removing a ton of metal and 29 tons of trash from a sinkhole on property they acquired across the road from their farm. This is the second sinkhole they've cleaned.

Sinkholes are ground-level depressions formed as surface water carves its way through fractures in the limestone. They are critical points in the landscape because water runoff often drains through them quickly down to cave streams.

Boyer believes that cattle may be congregating around sinkholes and threatening water quality with their manure. To check this theory, he plans to use global positioning system receivers placed on several beef steers to continuously track them by satellite.

The soil that doesn't have limestone bedrock underneath it is actually the problem soil, because it is usually too high in acids for many plants. It also often has very low levels of phosphorus, a critical plant nutrient, and high levels of toxic forms of soil aluminum. The Beaver center has many experts on marginal soils who are searching for ways to improve them and the plants that grow on them.

"Good soil is the starting point for all of our small farms projects," says Clapham. "Recognizing that, we have a soil scientist on each of our four research teams. The interaction between soil, plants, animals, and water is at the heart of each of our projects to help small farmers."—By **Don Comis,** ARS.

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