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Farmers' Motivations for Adoption of Switchgrass

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Switchgrass (*Panicum virgatum* L., Poaceae) is a perennial warm-season grass native to Iowa, grown for decades on marginal lands not well suited for conventional row crops. It is now being recognized as a potential energy source and alternative cash crop for Iowans. The Chariton Valley Resource Conservation and Development (RC&D) is coordinating Iowa's first major switchgrass demonstration project, promoting the crop's potential for large-scale production through its Chariton Valley Biomass Project. The project goal is to successfully use switchgrass as an energy source by co-firing it with coal at the Alliant Power generating station in Chillicothe, Iowa. If co-firing proves successful, project organizers estimate that 20,250 ha (50,000 acres) or 181,440 tonnes (t) (200,000 tons) of switchgrass will be required to produce 35 MW of electrical power at a 5% co-fire rate.

Prairie Lands Bio-Products, Inc. is a not-for-profit member organization affiliated with the Chariton Valley Biomass Project. In addition to producing switchgrass for biomass, Prairie Lands Bio-Products, Inc. is developing other markets for switchgrass, including forages, mulch for landscaping, fiberboard and paper, use as filler in plastic products, stove and fireplace pellets and logs for residential heating, and animal bedding. If these ventures also succeed, Chariton Valley promoters will be challenged to recruit as many as 500 switchgrass producers to meet demands.

Insights on current adoption of alternative crops, farming practices, and land use are needed to develop recruitment guidelines and strategies that will foster future switchgrass adoption and long-term commitment to production. Social research on the adoption process of switchgrass and other farming alternatives was designed to provide these insights.

Iowa imports 98% of the fuels needed to generate energy in the state. Future success of a domestic energy industry in Iowa is dependent on the development of alternative energy sources, including biomass. The support and participation of biomass producers will be critical to this future. Currently, more than 80 farmers in southern Iowa planted nearly 2,800 ha (7,000 acres) of land in switchgrass for the Chariton Valley Biomass Project. The majority of these producers have invested significant time and financial resources to assist with biomass project planning during the past three years despite the fact that no market currently exists for switchgrass as an energy crop.

Farmers must analyze financial and social costs and benefits of new crops, farming practices, and economic activities. Better understanding the factors southern Iowa farmers consider when evaluating alternative land uses, economic activities on the farm, and resource allocation will help the Chariton Valley Biomass Project develop and implement guidelines to recruit switchgrass growers and promote long-term producer participation.

Specifically, project members need to understand: (1) What motivates or discourages the adoption of energy crops, other alternative crops, new agricultural practices, and varied land uses? (2) What are the incentives and disincentives to adoption of alternative farming activities, including profit, risk, uncertainty, reputation, inputs and equipment availability, financial status, financial guarantees, program subsidies, support networks, learning curves, community attitudes, and family attitudes? (3) What crop and product attributes, infrastructure and markets, and financial and community support programs facilitate or impede adoption?

COMPLEMENTARY RESEARCH

Extensive economic and agronomic research is currently underway at Iowa State University to assess the viability of switchgrass as biomass. Research efforts focus on: (1) the economic potential of switchgrass as an agronomic crop for bioenergy, documenting on-farm costs and resource commitments for switchgrass production, assessing regional economic impacts of large-scale switchgrass production, quantification of energy consumption for switchgrass production; (2) switchgrass production in relation to soil variability and environmental quality, identifying landscape and nitrogen effects on switchgrass production potential, quantification of soil properties and their relation to switchgrass yield and quality, assessing erosion potential in switchgrass fields;

and (3) evaluation and development of switchgrass (and reed canarygrass) germplasm for bioenergy production and adaptation to Iowa (Brummer et al. 1998).

METHODOLOGY

To complement this agronomic and economic research on the viability of switchgrass production for biomass, we designed social research on the motivations behind, obstacles to, and consequences of adoption of alternative farming practices, especially switchgrass, in southern Iowa's Chariton Valley. Fifty-two members of the agricultural community in southern Iowa participated in extensive interviews. Among the participants were switchgrass producers; conventional farmers; genetically-modified organism (GMO) producers; organic farmers, livestock, small animal, and exotic species producers; individuals involved in agro-forestry and seed production; extension specialists; and agro-industry representatives. In addition to interviewing these individuals, we reviewed archival documents, took facility and farm tours, had casual conversations with other members of the rural community, and spent time in many fields, orchards, pastures, barns, and farm homes to better understand the context in which southern Iowa farmers make their decisions about adoption of alternative crops.

The Chariton Valley Biomass Project encompasses the four south central Iowa counties of Lucas, Wayne, Monroe, and Appanoose (Fig. 1). Ethnographic fieldwork was conducted in these counties, as well as in contiguous Wapello and Davis counties. Several of the individuals interviewed, although they participate in alternative farming practices in the six identified counties, reside elsewhere, so Jefferson, Van Buren, and Mahaska counties, among others, are represented also.

Ethnographic fieldwork was conducted between March and August of 2000, with the majority of interviews conducted between mid-May to late July. Qualitative analysis began immediately and continued through the report writing phase, October through December of 2000.

A convenience sample of 52 members of the agricultural community in the six counties targeted in this study was identified using a snowball sampling technique. Care was taken to gain broad representation of the farming community by sex, age, county of residence, and type of farming operation. During the fieldwork it became apparent that religion was a salient factor in adoption of alternatives. Researchers then sought participation from various faith groups in these six counties, including mainstream Protestant and Catholic denominations, as well as Amish, Mennonite, Apostolic Christians, and members of the Maharishi Vedic community. The sample included 47 men and 5 women. Although we did not ask the age of participants, we estimate they ranged in age from 35 to over 80, with the majority in their mid-40s to mid-50s. Although several of those interviewed have migrated to these counties within the past 10 years, most are native to their county, or have been in business in their county for more than 30 years.

Table 1 describes the sample. Nineteen of the farmers in the sample currently grow switchgrass and 15 of these participate in the biomass project. Five sample farmers have expressed interest in switchgrass pro-

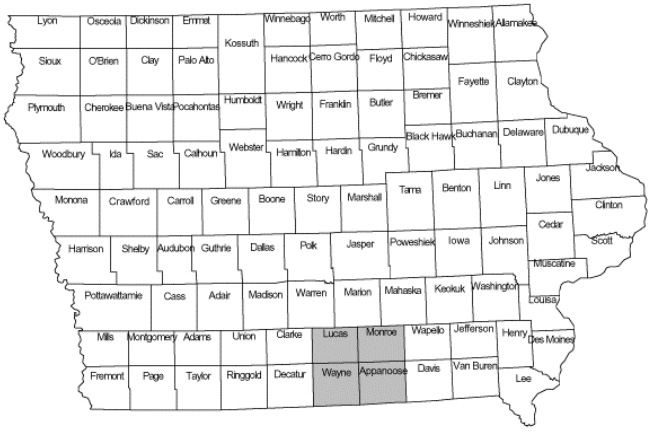

Fig. 1. Map of Iowa designating the four counties served by the Chariton Valley Biomass Project.

Table 1. Description of the sample.

Sample description	No.
Switchgrass producer	19
Switchgrass curious producer	5
Conventional producer (row crops w/ chemicals)	12
GMO producer	4
Organics producer	4
Livestock producer	15
Small animals and exotics producer	5
Agro-forestry producer	7
Farm organization & industry representatives	9

duction and attended informational meetings, but for a variety of reasons have chosen not to pursue switchgrass production at this time. Twelve of the sample might be characterized as conventional farmers, although switchgrass producers are likely to consider their operations "conventional" as well. (For our purposes, conventional refers to farmers who currently grow row crops using chemicals but do not produce switchgrass.) At least four participants plant GMO soybeans or corn, while four raise organic crops. At least 15 are livestock producers, and five raise small animals and/or exotic species. Seven of the sample are engaged in some aspect of agro-forestry (fruits or nuts or timber.) Nine of the sample hold volunteer or paid positions with the Extension Service, Farm Bureau, rural development agency, or agribusiness. Because a number of participants have dual or triple roles in the agricultural community, the total of these categories exceeds 52.

THE GUIDING THEORY BEHIND SWITCHGRASS ADOPTION RESEARCH

Adoption-diffusion theory, as elaborated by Rogers (1995), guides this research. Rogers explains diffusion as "the process by which an innovation is communicated through certain channels over time among members of a social system." An innovation, according to Rogers, is "an idea, practice, or object that is perceived as new by an individual or other unit of adoption." For the purpose of this research, alternative farming practices and land uses such as switchgrass production for biomass are innovations.

"Change agents" frequently encourage adoption of a new idea, practice, or object, communicating the value of innovations through interpersonal as well as mass media channels of either local or "cosmopolite" origin. Rogers identifies five distinct though overlapping stages in the innovation adoption process: knowledge; persuasion; decision; implementation; and confirmation.

Classical adoption-diffusion theory has been criticized for pro-innovation bias, individual-blame bias, recall problems in diffusion research, and issues of equality. In the beginning, adoption-diffusion researchers identified characteristics of adopters, such as socio-economic status, personality, communication behavior, and risk tolerance (described as the innovativeness/needs paradox) that determine the likelihood of adoption. More recently, the focus of adoption-diffusion research has been on attributes of innovations and rates of adoption. Such attributes include relative advantage (economic factors, status aspects, effects of incentives); compatibility (with needs, values and beliefs, previously introduced ideas, and technology clusters); complexity; trialability; observability; diffusion affect; and, overadoption.

Rogers cautions that adoption-diffusion research must remain attuned to the desirable and undesirable, direct and indirect, anticipated and unanticipated consequences of innovations. Likewise, change agents of innovation, adoption, and diffusion need to be aware of the "KAP gap," inconsistencies between knowledge, attitude, and practice, as well as issues of equality—communication effects gaps, gap-widening consequences, and social structure inequities—to devise strategies for narrowing such gaps.

SWITCHGRASS PROPONENTS AND ADOPTERS

Prairie Lands Bio-Products, Inc.

Prairie Lands Bio-Products, Inc. (Prairie Lands) is a not-for-profit organization comprised of 60 switchgrass producers in southern Iowa. Their purpose, according to information available on their Internet Web site, is to "identify and develop switchgrass products and markets; produce switchgrass to satisfy demand for products; evaluate environmental benefits of producing and using switchgrass; and inform and educate the public about the potential of switchgrass." Their members receive "technical assistance with the establishment and management of switchgrass, current information on product development, opportunities to participate in new markets, regular updates on the biomass project, and opportunities to participate in demonstrations and research activities." They are, according to one of their members, "strange bedfellows" in that each member brings a unique set of motivations, needs, and desires to switchgrass production and Prairie Lands participation. Ten members oriented us to the culture of southern Iowa farming and shared their stories about switchgrass adoption.

One of the earliest adopters to reintroduce switchgrass in southern Iowa was cattle producer, Jay Merchant[1]. He has grown switchgrass intensively in Wayne County since 1980 as backup forage to feed cows

[1] All names are pseudonyms.

during the hot summer months. Merchant also uses switchgrass as wildlife cover. The benefits of switchgrass as a feed source were immediately apparent to him, but regrettably, he explained, because palatability of switchgrass decreased at maturity, word spread that "cows won't eat it." This misinformation discouraged many cow/calf operators from following his lead. Undeterred, Merchant maintains 16 ha (40 acres) of switchgrass in the biomass project as well as mixed-grass stands for wildlife.

Kenneth Tides runs a cow/calf operation in Appanoose County and has been extremely successful using switchgrass as summer pasture and for bedding and calving in late winter and early spring. He too started growing switchgrass more than 20 years ago, but he noted that he had to seed four times before getting a respectable stand. He has 73 ha (180 acres) now. "It's as good a grass hay as you can get," he explained, citing protein content upwards of 12%. With stands 2 m (6 ft) tall, Tides is able to calve cows in his switchgrass; he turns the herd loose allowing about 1 ha (2 acres) per cow.

To begin his original 2.8 ha (7-acre) stand, Harold Chambers got switchgrass seed from Pheasants Forever. Later he bought seed from Kenneth Tides for land he had bid into the Conservation Reserve Program (CRP). His main motivation beyond soil conservation through erosion control on marginal lands was the advantage switchgrass has for wildlife habitat. His stands were taken out of the CRP last year, but he bid the land back into the program this year. At the time of initial planting, only switchgrass was required in his CRP tract, but he explains that newer CRP requirements prohibit more than 15% switchgrass in a mix of other prairie grasses, legumes, and forbs. Unfortunately, switchgrass is so tenacious that it chokes out most other plants, and the cost of some seed mixes can exceed $618/ha ($250/acre), making generous seeding prohibitively expensive. "One of the shortcomings of switchgrass," he cited is that unlike conventional row crops, "there is no loan deficiency payment (LDP) (or government price guarantee) for your switchgrass crop."

Casey Patterson joked that he "got talked into switchgrass" by some "silver-tongued" Prairie Lands member. He planted switchgrass two years ago in Mahaska County, but he didn't incur the exorbitant expense that Chambers had mentioned. Patterson reported that he was allowed to plant 100% switchgrass when he bid 6.1 ha (15 acres) in the CRP recently. But, he added, when the mistake was discovered, his land was reclassified as wildlife habitat "to keep everyone out of trouble."

Other producers influence adoption decisions of newer producers. Dennis Brader "blames" everything on Jay Merchant. As a result of his influence, Brader seeded 48.6 ha (120 acres) of switchgrass. He subsequently sold that farm and bought another, seeding the new farm with 18.1 ha (45 acres) of switchgrass. Brader's main motivation was wildlife habitat, although he admits that with his stands in the CRP "that's all we can use it for now." Brader has worked on several switchgrass harvest crews. He said switchgrass is obviously a great economic development opportunity for southern Iowa if the test burn works (referring to the planned co-firing of switchgrass with coal at the Alliant Power generating station), but it also has benefits to wildlife. Brader originally seeded 'Blackwell', but has since shifted to seeding with 'Cave-in-rock', the current recommended cultivar.

Jerrold Messerli has been active in switchgrass harvesting because he owns the square baler that has been used on the switchgrass stands of many Prairie Lands members. Messerli baled switchgrass for Jay Merchant, but the crop was lost because the bales could not survive outdoor storage. In response, Prairie Lands invested in what is affectionately known as "the switchgrass palace," a large Morton-style building for indoor storage of switchgrass bales destined for the test burn at the Alliant Power generating station. Despite the availability of a secure storage facility, Messerli has not contributed his own yield. He reported that he has not been very successful in seeding his own 8.1 ha (20-acre) stands that are not in the CRP. "The spring was just too wet," he explained.

Wildlife habitat is a prime motivator for many switchgrass adopters. G.W. Benesch has 405 ha (1,000 acres) in the CRP, 122 (300) of which are planted in switchgrass. Benesch loves to hunt and switchgrass habitat provides a great venue for fee-hunting. (He leases land to the Celebrity Corporation for the annual governor's hunt.) Benesch gives switchgrass high marks for its aesthetic value. He claims that more than sixty wild turkeys live in his switchgrass stands, providing lovely "music" with their frosty morning calls. In recent years, southern Iowa has been attracting hunters from great distances, and many area farmers have invested in fee-hunting retreats as a revenue source, as well as for their own recreation. "Poor hunting property is more lucrative than good farmland," according to Benesch.

Richard Hites was growing switchgrass for summer pasture when he heard about the biomass project. Encouraged by Kenneth Tides, a farmer Hites holds in high esteem, he decided to volunteer switchgrass acres for research and biomass harvest. Originally Hites had a cow/calf operation, but poor health forced him to give up the cattle and move more intensively into switchgrass. Hites has reseeded three times to improve his stand. He maintains it for attracting wildlife—deer, quail, and pheasants. Hites remarked that weeds are necessary as food for wildlife, but government regulations discourage weeds.

Jay Merchant explained that USDA rules also prohibit grazing or harvesting on CRP land, but thanks to a bill introduced by Iowa Senator Tom Harkin, a temporary waiver has been granted for biomass research. As a result, switchgrass farmers with CRP contracts are permitted to volunteer their stands for research and limited harvest without a reduction in CRP receipts, provided they reap no financial gains from the switchgrass. If they are paid for their switchgrass, they will be required to repay the difference to the CRP.

CRP rules have changed several times, especially with regard to switchgrass management, according to William Sargent, another southern Iowa switchgrass producer. Initially, there were no restrictions, he reported. The goal was to merely get a switchgrass stand established. Later the expectation was for 80%–90% of the CRP to be planted in switchgrass. Subsequent rulings have required varying levels of legumes, grasses, and forbs to be added to the seeding mix. Such federal rule changes, compounded by differing interpretations at the district administration level, threaten the viability of switchgrass production. With seed costs ranging from $6.6/kg ($3/lb.) up to $220/kg ($100/lb.) (some forbs list for more than $881/kg [$25 an ounce]), affordability and profitability become problematic. “No one likes the way the Conservation Reserve Program is managed,” Sargent concluded.

Harold Chambers cited another example of government rules hostile to switchgrass production. “Research suggests harvesting switchgrass once every three to four years would benefit the stands,” but rules prohibit the harvesting of grasses on CRP land. “These regulations will ruin the soil,” G.W. Benesch added. Some members, bewildered with CRP proscriptions, ask “If the purpose of the CRP is to protect the soil from erosion and to conserve land for future generations, why would CRP regulations prohibit management practices that would improve soil quality? And why would CRP payments to farmers be in jeopardy for activities that assure land conservation?” (At the same time, they acknowledge that many of their farming peers view CRP payments as an unwarranted subsidy that unfairly rewards farmers who incur other benefits from land held in the CRP.) “The government is really working against us here,” Harold Chambers protested. “Regulations get in the way. We are now required to enhance switchgrass stands with legumes, but we can’t mow for cold-season grass, so grasses get choked out. If we could mow and manage one-third of the crop yearly, we could optimize the crop for wildlife management.”

Also an advocate for wildlife, G.W. Benesch objects to U.S. Department of Agriculture and Department of Natural Resources rules that purport to protect wildlife while actually posing a greater threat to them. For example, he cites the prohibition against mowing during the nesting season, explaining that he watched a cooper red hawk (a protected species) destroy other wildlife during harvest of row crops. “The hawk killed three pheasants and two rabbits within twenty minutes, but did not eat them. These were thrill kills,” Benesch explained. In the area of which he speaks, the quail are gone and the turkeys are in trouble, yet he is not allowed to kill or harass the hawks that are preying on other wildlife.

Economic and agronomic research at Iowa State University will be critical to switchgrass profitability. For example, Prairie Lands members noted that the 2.3 to 2.7 kg (5 to 6 lb.) of pure live seed (PLS) once suggested for establishment of switchgrass are insufficient. The suggested amount is currently up to 4.5 kg (10 lb.) PLS, and they predict it will eventually reach 6.8 kg (15 lb.) PLS. (Research done in Kansas advises planting 11.4 kg (25 lb.) PLS to establish optimal switchgrass stands.) Determining seeding rates and costs will be vital in determining profitability and viability of switchgrass as biomass. In addition to researching the economic potential of switchgrass as a biomass source, Iowa State University (ISU) scientists are studying management practices, transportation and storage, and erosion control, as well as the quality of switchgrass used as wildlife habitat and the effects of harvesting on wildlife populations.

Prairie Lands members are testing and demonstrating a variety of switchgrass management strategies. “Switchgrass can’t tolerate depth,” Kenneth Tides explained. “The best method for planting switchgrass is

'frosting' or 'frost-seeding'," that is, broadcasting the seed after the first freeze and rolling it to achieve a very shallow depth. Tides agreed that Prairie Lands has demonstrated the viability of switchgrass on CRP land, but he argues, "You can make switchgrass pay without CRP." He pastures cows on 30.4 ha (75 acres) until the end of May. He later sells the summer hay, reaping 108.8 t (120 tons) from the 30.4 ha (75 acres) at $49.6/t ($45 a ton).

Harold Chambers likewise has been able to realize a profit on switchgrass without CRP. He harvests the switchgrass for seed and sells the remaining straw to be used as mulch for highway construction. According to a Prairie Lands news release, Chambers harvested 168–224 kg/ha (150 to 200 lb./acre) of pure live seed that sold for $8.8–11/kg ($4 to $5/lb.). The straw residue was baled and sold to the Department of Transportation or local construction companies for $40.8–54.4/t ($45 to $60/ton). Chambers' harvest came from land that earlier had been in the CRP, otherwise he would have been prohibited from managing and harvesting and generating revenue from his CRP "crop."

The Prairie Lands discussion always seemed to return to concerns about CRP regulations. The CRP is an important source of income in southern Iowa. According to newspaper reports, the CRP enrolls nearly 56,700 ha (140,000 acres) of highly erosive land (HEL) in Wayne, Monroe, Lucas, and Appanoose counties, one-tenth of the 567,000 ha (1.4 million acres) in the four counties. At $160–$196/ha ($65 to $80/acre), CRP payments provide more than $10 million of revenue for southern Iowa. But the "aggravation factor" of CRP regulations discourages many potential producers from growing switchgrass. Prairie Lands members argue the need for legislation to allow management of CRP crops and foraging on CRP lands, claiming that alternative land uses could increase active use of the CRP without placing erosion control and soil conservation at risk. Indeed, proponents argue that prudent management could increase soil fertility. They disagree, however, on whether a payment reduction is warranted for such use. "Why reduce the CRP payment if there is no loss of CRP benefit?" some ask. Others recognize that non-CRP farmers are most critical of alternative uses of CRP and resent additional revenues being gleaned by CRP farmers who are already receiving a subsidy for the same land.

Like many of their contemporaries, these southern Iowa farmers remain skeptical of government programs aimed at reviving the farm economy. Most believe that government programs benefit large producers at the expense of the "little guy." Former Secretary of Agriculture Earl Butz's 1970s advocacy of farming "fence row to fence row" was disastrous for the marginal lands in southern Iowa. It aggravated erosion problems, further depleted soil nutrients, and reduced water quality as the result of chemical runoff and siltation, according to these farmers.

Decades earlier, the federal government introduced multiflora rose to southern Iowa as a "living fence" that subsequently became a scourge to farmers; it has "fish-hook-like barbs" and is so thick you can't walk through it, and regrettably, it can't be killed. It proliferated throughout ditches and invaded farm fields and yards, causing injury and consternation to humans and animals in southern Iowa. (Thankfully, area farmers have reported a disease is now killing off much of the multiflora rose.) Prairie Lands members, along with most southern Iowa farmers, will quickly name a dozen federal policies-gone-wrong. In contrast to their cynicism toward federal programs, many area farmers express greater comfort and trust in locally generated ideas and projects. Thus, the Chariton Valley Biomass Project and Prairie Lands Bio-Products, Inc. have an advantage.

Prairie Lands members warned that those least likely to adopt switchgrass, for biomass or any other purpose, are farmers currently growing 100% of their row crops on a rotational basis. "They're looking for profit, and although corn and beans are not profitable … at least they provide cash." According to G.W. Benesch, the wildlife benefits of switchgrass are unlikely to appeal to them. "Row crop folks don't appreciate wildlife; they begrudge even one-quarter of an acre for habitat and they don't want animals in their corn or beans." Prairie Lands members believe that many farmers can't or won't "think outside the box." Rather, they follow "tradition," preferring to farm "like their fathers and grandfathers." They argue that most farm transactions remain "off-the-cuff," what Prairie Lands members characterized as the "Whatareyapayin'today? syndrome," rather than taking the proactive position of "This is my crop and this is what I expect to be paid for it." But members also acknowledged that most farmers know little about switchgrass, and that's why the

mission of Prairie Lands is so important. Admittedly, however, the biomass project has lost participation of "good members" due to its protracted start-up period. Cooperators already have committed three years and have yet to see profitable results.

While the profitability of switchgrass biomass remains uncertain, many switchgrass producers see the potential of carbon trading credits. Because switchgrass transfers its carbon to the soil and preliminary results suggest that little carbon is emitted into the air when switchgrass is burned, there is speculation that farmers will be able to earn revenue by trading credits they receive as the result of switchgrass carbon sequestration. Estimates range wildly, from $52–3704/ha [$21 to $1500 (!) per acre]. Prairie Lands members already report contacts from "carbon brokers" who are seeking to handle future carbon credit trading transactions. The reality of carbon credits seems plausible, but the future value is unclear.

Harlan Payne

Harlan Payne worked for the Agricultural Stabilization and Conservation Service (ASCS) office in Corydon when switchgrass was re-introduced in southern Iowa. "I'm the sort of guy who'll try anything new," explained Payne. Although an employee of ASCS and Natural Resource Conservation Service for more than twenty years, Payne was also active in farming and cattle production. Now retired, Payne still owns two farms; he rents pastureland to a neighbor for cattle grazing, maintains a food plot and pond for wildlife, and keeps the remainder of his land in the CRP. He has two stands of switchgrass committed to the biomass project, a 8.1 ha (20-acre) stand planted three years ago and 6.5 ha (16 acres) planted this year.

Payne planted his switchgrass for the CRP, learning about switchgrass management from magazines and newspaper articles. Although the first year yielded a poor stand, it got thicker each succeeding year with the addition of fertilizer, despite the fact that he never burned it or reseeded. For Payne, there was no investment in equipment. Initially, he hired a custom driller for planting. He inter-seeded, or "frost-seeded" his newest stand with the currently recommended cultivar, 'Cave-in-rock'. He claims to have no weed problem and a "near-perfect" stand. Payne keeps a watchful eye on the switchgrass, out of curiosity mostly, as the Chariton Valley Biomass Project now manages his switchgrass. They check his stands, take soil samples, add fertilizer, study various management practices, mow, bale, and transport the biomass crop. Payne reported that his switchgrass was first harvested in February and again in October, explaining that the CRP prohibits harvesting the entire stand at once. Therefore, his stands are mowed in strips, alternating rows with each harvest. He gets annual updates on the progress of his stands and local biomass efforts from a biomass project folder.

Prior to retirement, Payne spent much of his career mapping ponds and terraces within the Chariton Valley drainage area. He has mobility problems today—weakening ligaments and muscles due to nerve damage he suspects is the result of custom spraying. Because of his concern about clean water, he has focused on wetland restoration, and his motivation for participating in the CRP was to eliminate chemical use that could harm the water in the South Chariton River and Lake Rathbun.

Payne also appreciates the wildlife benefits of switchgrass. He has three ponds on his land near which he grows two plots of food for wildlife, including 2.8–3.2 ha (7 to 8 acres) of corn and beans and milo (sorghum) for the birds. Even if the test-burn of switchgrass at the Alliant Power generating station fails, Payne will continue with switchgrass production for conservation, erosion control, and wildlife habitat. He has seen pheasant and quail populations increase as the result of switchgrass, and has seen a proliferation of songbirds, including finches, thrushes, bob-o-links, and red-winged blackbirds, as well as yard birds such as sparrows, bluebirds, jenny wrens, and hummingbirds. Payne noted that deer and turkey use his switchgrass for winter bedding.

Switchgrass has not been Payne's only experience with farming alternatives. He experimented with the trefoil legume as a non-chemical source of nitrogen for his pasture, and he has been planting trees as windbreaks and buffers. Payne has never grown organic or GMO crops because they were introduced after he retired from crop farming.

Stephen and Julia Harms

Stephen and Julia Harms contend that early adopters will be key to the diffusion of switchgrass for biomass among southern Iowa farmers. They believe the cutting edge of alternative practices will be an interest-

ing marriage between conventional agriculture and niche or specialty farming. They expect that "modern-day hippies who are into alternative lifestyles" will be in the forefront. They don't consider Wayne County to be ripe with the innovative spirit required for the transformation. Instead they feel they are "out there by themselves" in their exploration of alternative agriculture, and are pleased to be involved with the biomass project. The Harms also are members of Practical Farmers of Iowa, a group they say is leading the charge in community supported agriculture and other farming alternatives.

Like most Wayne County farmers, Stephen and Julia have jobs off the farm as well. He is a minister and she is a teacher, but they identify themselves as a farm family. Much of their land is in the CRP, and although they participate in the biomass project, Stephen and Julia still manage their own switchgrass, along with other prairie grass stands. They planted warm-season grasses on their CRP land, including switchgrass, 1.6 ha (4 acres) of Indian grass, and 0.4 ha (1 acre) of big bluestem that they seeded by hand. They also planted little bluestem and sideoats grama, but these failed because CRP regulations required a mix with switchgrass that choked out everything else. The Harms' also maintain stands of reed canarygrass and planted 4 ha (10 acres) of trees in a forest plot of hardwoods, red oaks, white oaks, walnuts, and food for wildlife.

A coincidence led to the Harms' participation in the biomass project. Stephen explained that they were interested in enrolling more land in the CRP at about the same time he began reading about biomass in the paper. A chance meeting with Jay Merchant outside the Soil Conservation Service (SCS) office resulted in their enlistment in switchgrass and biomass research.

Some of the Harms' switchgrass stands were more than 12-years-old and had never been harvested. "They were slow getting started," Stephen recalls, "due to weeds and problems with anthills. They required a lot of management." Huge anthills continue to hamper equipment use in the Harms' stands. "We need to disk in late spring to rid the stands of anthills," Stephen explained. The Harms' have had several intentional burns and one accidental burn in their switchgrass. Julia, who volunteers as a guide at a nearby prairie reserve, explained that switchgrass needs burns to flourish. "Prairie grasses need heat to germinate, but after a fire they rejuvenate immediately and they're beautiful when they're coming back," she said.

Stephen and Julia have bid their poorest land patch-by-patch into the CRP. They explained that there were no strings attached 12 to 15 years ago. The goal was just to get a stand. Although it is a sod, switchgrass comes up in clumps and its main purpose in the CRP is to anchor the soil. But the CRP recently has required inclusion of legumes in switchgrass stands to add nutrients to the soil, although farmers argue that the requirement wastes money because most legumes are choked out by the switchgrass. Stephen notes that legumes are probably counterproductive for biomass production due to reduced switchgrass yields.

The Harms claim that the culture of southern Iowa is shaped, in large part, by the rugged individualism that characterized its early Scotch-Irish settlers. That's why there are fewer cooperatives in southern Iowa then in central and northern Iowa, which was settled by other ethnic groups, according to Stephen. (Stephen believes that Amish entrepreneurs in southern Iowa are an anomaly in this regard.) Conventional farmers in southern Iowa are suspicious of alternatives, according to Stephen. "But conventional farmers have been sucked into something that's crushing them," he added, citing vertical integration of agriculture and Freedom to Farm as possible culprits. Although Wayne County was the first to fill its CRP quota, this was a very "rational" move on the part of area farmers, according to Stephen, not one based on a cooperative or communitarian ethic. He contends that convincing southern Iowa farmers to change will require a strategy attuned to rugged individualism. "These farmers are willing to change, but they change in ways different from other Iowa farmers," Stephen concluded.

Tom Stoner

Tom Stoner grows switchgrass, along with GMO beans and corn, on a farm close to the Missouri border in Wayne County. "Cropping is difficult in southern Iowa," Stoner explained, admitting that he's probably "farming land I shouldn't be." Stoner grows *Bt* corn because his land is vulnerable to corn borers, and he grows Roundup Ready® soybeans because they reduce worry and are more compatible with off-farm work. (In addition to farming, Stoner sells real estate.) Stoner raised hogs in confinement until the trend toward leaner hogs and declining hog prices convinced him it was time to get out. He added that he "should" be in cow/calf production, but it requires management and money to invest.

Stoner planted switchgrass 18 years ago in "set-aside" acres. (Set-aside acres were a feature of previous farm bills.) He learned about switchgrass through an alternative crop class offered by Iowa State University. He explained that the ground wasn't very good for crops so he planted switchgrass mostly "to do something different." His goal was seed production. Stoner converted his set-aside to CRP, but eventually pulled his switchgrass out of the CRP because payments were getting "chintzy". "It wasn't worth it," Stoner explained. He harvested the seed but admits he wasn't very efficient. Although the seed sold for $22.0–$026.4/kg ($10 to $12/lb.) then, all the profits evaporated when he had to repair the combine he had borrowed for the harvest. "But I had fun," he chuckled. Seed production has been Stoner's long-time dream, but he explained that his stands are not the variety recommended now. A Missouri seed man traded seed with him; he can't add nitrogen to his variety.

Less of Stoner's switchgrass is used for biomass research now that it is returned to the CRP, but ISU is conducting wildlife research there, enumerating pheasant populations per hectare with or without switchgrass cutting. The Biomass Project also manages some (but not the newest) of Stoner's stands. Current plans are to harvest half of his crop for biomass and allow wildlife research on the other half.

Stoner observed that most farmers in his area are taking a "wait-and-see" attitude toward switchgrass. In the beginning, most producers were growing switchgrass because it was eligible for the CRP. Potential new producers are waiting for an indication on price and profitability before making a decision. "Farmers change fast if there is an economic incentive," Stoner said. Personally, Stoner is eager for the day he can grow all switchgrass instead of row crops. He is concerned about erosive soils, admitting that soybeans are highly erosive, especially when it rains. But he is concerned that switchgrass currently is not profitable, even with its combined benefits as feedstock for cattle. And unlike row crops, there is no LDP on switchgrass, "but include carbon credits and it might become viable," Stoner adds. "We need alternatives to corn and soybeans," Stoner urged, "but how do we establish the markets? It'll take something like the switchgrass project; individual farmers can't do it alone."

Daniel and Lori Irish

The Daniel Irish family owns land in Appanoose County just north of the Chariton Valley RC&D office outside Centerville, Iowa. Employed off-farm, Irish has no intention of row-cropping on his land. "There's no need for me to add to the oversupply of corn and beans," he explained. Although Irish eventually plans to bid land into the CRP, he initially planted 1.6 ha (4 acres) of switchgrass to eliminate the need for weekly summer mowing.

Dan and his wife Lori find many things about switchgrass appealing. The primary attraction, after erosion control, is wildlife habitat. Irish planted corn in with the switchgrass to attract turkey, deer, quail, and pheasant. He is planning to add fruit trees, raspberries, blackberries, and wild plum as additional food sources. "I would like to see more reversion to prairie in southern Iowa, just for the pleasure it brings. Quality of life is the main attraction for me," Irish said. To enlist the support of others who treasure southern Iowa's wildlife, Irish noted that it will be important for biomass promoters to demonstrate that switchgrass harvests will not jeopardize habitat.

Lori is the daughter of Kenneth Tides, a prominent producer of switchgrass in southern Iowa and a pioneer cooperator in the Chariton Valley Biomass Project. Tides provides Dan and Lori with easy access to the latest information on switchgrass management, its promise as a biomass source, its other varied uses, and its economic viability. Curiously, Lori's brother, who farms land between the Tides' and the Irish's, grows no switchgrass. He has committed all his land to row crops and feeding cattle.

Irish explained that farmers need long-range security, CRP security, and acreage control in order to make a commitment to switchgrass. Several area farmers, he notes, have bid their whole farm into the CRP and then used their CRP payments to buy another farm on which they practice conventional agriculture, specifically chemical-dependent row crops. "You've got to be able to bear the risk involved in switchgrass production," Irish warned.

Irish is a strong proponent of alternative energy. He believes a number of potential switchgrass growers share his views. But, he says, using scare tactics such as the threat of global warming is unlikely to convince area farmers of the need for biomass as an alternative energy crop. More convincing, Irish believes, is to tout

the potential of switchgrass to promote energy self-sufficiency in Iowa. "All our energy dollars leave the state, whether to Saudi Arabia, the Middle East, Wyoming, Colorado, Ohio, Pennsylvania, or West Virginia," he said. "Switchgrass promoters should report the amount of excise tax paid to Wyoming, for example. 'Is that why their taxes are so much lower than ours'?" Irish believes that touting switchgrass as an Iowa energy product, while demonstrating state savings in energy excise taxes, would be very convincing to potential biomass growers in southern Iowa.

And it is unlikely that other states would compete in the southern Iowa biomass market, Irish argues, because transportation costs from field to generating station would be prohibitive. But, he complains that, in this regard, farmers are their own worst enemies. "Rather than producing alternative crops or finding unique markets, they say 'Let's all do what the other guys are doing.' This leads to saturated markets and lower prices. Farmers undercut one another on price."

Conservation is a theme woven through much of Irish's discussion of switchgrass. A strong proponent of the CRP, for example, he sees it less as a farm subsidy program and more as a universal conservation program. "The CRP is the best government program, because it benefits all. It's an investment in our future. We all have a stake in soil conservation, reduced siltation in our waterways, reduced commodity market saturation." Similarly, Irish is impressed with the ability of switchgrass to sequester carbon in the soil and, as a result, is interested in the potential carbon credits that switchgrass production could generate. "I'm a greedy capitalist," he jokes, adding, "I'd also be interested in harvesting and selling switchgrass seed if it was worth it."

SWITCHGRASS SKEPTICS AND DETRACTORS

Wilson Spires

Wilson Spires has attended some of the informational meetings about switchgrass and researched its biomass potential in Farm Bureau and Farm Service Cooperative publications, but he decided not to participate. "It doesn't fit with my operation," he explained. His ground is "too good" to convert to switchgrass for the biomass project. He has the land in row crops and he needs the extra pasture for his cattle. Spires doesn't participate in the CRP either. He is opposed to the program, in part because too many "big people" are buying land and neglecting it. "They just want the government to pay for it," he said.

At 36, with children to support, Spires says he can't afford to take land out of production. He's reluctant even to put land in pasture. And he thinks other young farmers are unlikely to adopt switchgrass as a biomass crop for many of the same reasons. "Young farmers need revenue. They can't afford to be out for the two to three years it takes to establish a good stand of switchgrass," he said.

One of the big disincentives of switchgrass and other alternative crops, according to Spires, is that unlike corn and soybeans, you can't get crop insurance for them. "If you wait three years and still don't have a stand, you've lost income, interest, time, and expense, and you're still out. … I'm not afraid to try new things, to be a pioneer, but in my situation, I can't afford that risk—especially not on rented land." (He does grow food grade soybeans on 64.8 ha [160 acres].) Despite his reluctance, Spires sees promise in biomass for southern Iowa. "With a change in circumstances, I could see making an investment in switchgrass," he said.

Mark Steger

Mark Steger farms rented land in Wayne County. Last season he sold 6,000 units of soybeans and all but 50 were GMO cultivars. Although they were introduced to the area as recently as 1996, GMO crops (Roundup Ready® soybeans and *Bt* corn) are not considered "alternative" crops in southern Iowa. Local extension agents estimated that adoption of genetically-modified soybeans has reached 80% in many southern Iowa counties, while Bt corn represented as much as 25% of the year 2000 corn crop.

Profits are usually touted as the main impetus for adoption of new crops or farming methods, but most farmers who switched to GMOs in southern Iowa admit they are not making more money. They believe that GMOs are more economical in other ways. Steger said he's not making more money with GMOs, but they are much less hassle. "They're easier. And there's no financial incentive to grow non-GMO in southern Iowa," Steger explained. "GMOs are not value-added, but rather production-oriented," he added. "They make chemical

application easier, and because they require fewer passes through the field, they potentially reduce fuel costs." GMOs are particularly attractive to farmers whose off-farm jobs restrict the time available for crop management. Such farmers need the more flexible production schedule that Roundup Ready® beans allow, for example.

According to Steger, "Roundup Ready® beans make poor farmers into good farmers. Now weed control is a no-brainer. Previously, you had to identify each weed and its growth stage and determine the best chemical. If you missed the application window, it was a problem. … Roundup® provides a wider window of opportunity."

Steger also explains that the market for non-GMO beans, referred to as STS beans, is "in the wrong direction" for farmers in this area. In his county, markets are oriented toward the east. "Everything flows to the Mississippi. But STS goes west to Kansas City … that means increased transportation costs." In addition, producers of non-GMO crops are required to segregate their grains "with one-half to 1% bean tolerance, so one bean in 700 (sic) can disqualify you." In southern Iowa there has been little sign of the "GMO scare" experienced by Iowa farmers in the northwest, according to Steger. Elevators in southern Iowa continued to take GMO beans and corn without hesitation in 2000. In fact, growers of *Bt* corn received a premium for production in 1999. (Growers explained, however, that it will be "a wash" this year, because increased costs combined with reduced yields mean that even with a premium price, farmers won't net anything beyond their costs).

When contrasted with the increased ease of farming with GMOs, switchgrass produced as biomass introduces greater complexity, in Steger's opinion. He says that there are too many unknowns with switchgrass. "There's no historical record," he said, "so there's not enough guarantee of income. … We don't know what to expect for production or what they are going to pay. … Switchgrass may have many product options in the future, but you can't sell the program today because there's too much risk involved. Switchgrass is a long-term investment, so you must own land, lots of land; you can't be a tenant.

Phillip Runyon

Phillip Runyon is retired from farming, but his grandson raises cattle on land that Runyon once had in row crops. Several of Runyon's neighbors grow switchgrass and participate in the biomass project and he has attended a number of local informational meetings that promoted the crop. He also has read quite a bit about it in the local paper and said that word-of-mouth, especially testimonials from his neighbors, has been the most effective way to communicate the benefits of switchgrass. Still, Runyon wonders whether the project can be successful. "Where will they get enough?" he questions regarding Alliant Power's need for 181,440 t (200,000 tons) of baled switchgrass to sustain a 5% coal substitution at the Alliant Power generating station. "And what with transportation costs and all, how will they ever be able to compete with Wyoming coal?"

Asked what might convince enough farmers to grow switchgrass as biomass, Runyon says it will require good information on how much profit farmers can expect, whether and how it will be economical to raise, and whether it can rival the admittedly low return of corn or beans. He also said that adding value by identifying other uses or by-products of switchgrass would help motivate farmers to produce switchgrass as a biomass crop.

Charles and Johanna Taylor

Charles and Johanna Taylor are much more skeptical of switchgrass production for biomass, although they grow 16.2 ha (40 acres) of switchgrass in the CRP and cash rent an additional 2 ha (5 acres) of switchgrass to the biomass project for fertilizer testing. Their skepticism grows from past experience in "value-added" programs that never added any value to their operation. Among these programs were seed beans, seed oats, and high-oil corn that failed. Such ventures are personally stressful, especially when promised incentives evaporate by the second year, Taylor explained. "There are always too many hoops to jump through. You have to hit their windows, and if you don't there are penalties. Specialty crops typically offer price premiums, but with their lower yields, you rarely realize any real gains. And you have requirements such as changing crop rotations, crop segregation and grain isolation, and reduced capacity due to empty bins. … These kinds of requirements for alternative crops don't mesh well with corn and bean production. Management is possible, of course, but if the weather doesn't cooperate and you miss the production window, you

lose the premium."

An additional frustration is what Taylor characterized as the arbitrary and capricious nature of program rules. "If you have what they want, then anything will pass. Otherwise they can reject you out-of-hand. We had grain they rejected due to 'bad germination,' but several months later (when production quotas weren't met), they called back and asked if we still had the grain. We got paid our premium, but it created 'bad faith,'" Taylor said. The Taylors feel that large-scale producers have a much easier time with special programs because they have greater leverage in the market.

Taylor readily admits his cynicism regarding biomass. "Switchgrass is a boondoggle. There is no way we can get as much energy off an acre of switchgrass as it is taking us to harvest it, store it, and deliver it to the generating plant. When they rented a storage shed for the switchgrass, it cost a full 50% of the producers' gross receipts. This entire program is artificially-supported. … The oil company PACs will thwart any cost differential geared toward alternatives." Taylor added, "The cost per tonne must be $72.6 ($80—about 4 cents/lb.). How different is that from coal? And how much more energy will that produce?" "Even with carbon credits, we're subsidizing something that's not economical," he concluded.

The Taylors don't expect relaxed CRP regulations to make switchgrass production easier; "with Freedom to Farm netting $99/ha ($40/acre) and the CRP netting $148/ha ($60/acre), the farm subsidy on regular land is getting closer to that for CRP." Government policies are not helping rural development, according to Taylor. "Cargill and ADM are getting rich on agriculture. 'Big Pork' gets a lot of support even though research has shown that small producers are more efficient. If a corporation goes into default, the debts are written off, the management stays, and the investors lose, but if small farmers default, they lose the farm. … Rather than allow a decent market price, the government initiates programs to 'prop things up'."

Like many of their counterparts, the Taylors are feeling the squeeze. Both Charles and Johanna work off-the-farm. "Wayne County has one-third the population today than were here in 1890," Taylor explained, "but the county has tripled the number of employees in recent years. Mandated programs that require increased property tax revenue to fund, even though the population is declining, increase the burden on farmers and landowners." "We're doing more and more," Taylor said of southern Iowa farm families.

SUMMARY OF FINDINGS

There are 3 pertinent questions: (1) What motivates or discourages the adoption of energy crops, other alternative crops, new agricultural practices, and varied land uses? (2) What are the incentives and disincentives to adoption of alternative farming activities, including profit, risk, uncertainty, reputation, inputs and equipment availability, financial status, financial guarantees, program subsidies, support networks, learning curves, community attitudes, and family attitudes? (3) What crop and product attributes, infrastructure and markets, and financial and community support programs facilitate or impede adoption?

This survey provided insights to all of these questions and identified factors favorable and unfavorable to adoption of switchgrass as an energy crop, as well as information farmers will continue to seek regarding the viability of biomass production.

Favorable Factors

Profitability was usually the first identified as the motivation for adoption of any crop, farming practice, or alternative land use. However, it was apparent that intangibles not easily quantified or explained by economic theory are important determinants of adoption attitudes and behaviors as well. Participants in this study explained that they rarely were motivated by just one thing, but rather by a combination of factors. Most participants had difficulty identifying which motivations were primary, secondary, tertiary, and so forth. Instead they said a variety of considerations came into play at different times, and usually they weighed the relative advantages and disadvantages. During the adoption process, all adopters confronted a number of questions, either implicitly or explicitly. Affirmative answers to any of these questions reveal the kinds of considerations that motivated adoption of switchgrass or other alternative farming practices.

Profitability/Return on Investment. Can I make more with switchgrass than it costs me to produce it? Is it sustainable, that is, can I reasonably continue to support my family and myself on this, along with other economic activities?

Other Economic Considerations. Does switchgrass production fit with my current farming operation? Are management needs of switchgrass production compatible with other farming demands and/or my off-farm employment? Will it be easier or harder to farm? If it is harder to farm, are the rewards commensurate? What additional capital outlay is required for switchgrass production? Is switchgrass production compatible with my land tenure and acreage control? Can I tolerate the risk inherent in switchgrass production?

Compatibility with Values and Beliefs. Is this the right thing to do socially, ethically, or morally? Will this activity benefit my family and community? Does this fit with the lifestyle my family and I value? Is this activity or practice consistent with my mission in life? Is switchgrass production compatible with my concerns about health, safety, conservation, and/or the environment? Is switchgrass production good for the soil? The water? The air? Animal health? Human health? Is this activity sustainable?

Esthetic Considerations. Will switchgrass production provide me with an interesting and rewarding challenge? Will it improve the quality of life for me and my family? Will it improve the quality of life for the larger community? Will I gain greater pleasure as a result? Will I be better-educated, more excited, or intellectually stimulated by this activity or practice?

Success. Can I achieve my goals with switchgrass production? Will there be visible proof of economic gain? Increased yield? Better erosion control? Habitat diversity? Increased wildlife? Improved health for me and my family? Improved health for my livestock? Improved soil, air, and/or water quality? Is this activity sustainable?

Extended Benefits. Is there a need for what I produce through this activity or practice? For me and my family? For the community? Is switchgrass production good for the family farm? Is it good for the rural economy? Will switchgrass production induce greater energy self-sufficiency for my community and/or state?

While negative responses to any of these questions could discourage adoption of switchgrass, a few negatives introduced the kind of challenge that actually served to motivate the adoption of switchgrass, other biomass crops, and other alternative farming activities and practices. Such negatives became obstacles to overcome, adversities to manage, challenges to face. But very tangible benefits motivate farmers in southern Iowa to adopt switchgrass, including: need for summer forage; need for spring calving milieu; recommended grass for crop land; erosion control on marginal land; soil conservation; improved water quality through reduced use of chemicals; wildlife habitat to increase populations of deer, turkey, pheasants, quail, and songbirds, among others; appreciation of native forbs and grasses, along with prairie restoration; eliminated need for extensive lawn mowing; esthetic qualities, beauty, and quality of rural life; management requirements compatible with off-farm employment; best fit with capitalization and land tenure situation; environmental concerns, especially reduced dependence on pesticides and improved soil quality; farm safety, especially concerns about handling chemicals; income to supplement other economic activities; compatibility with land use priorities; desire to supply a demand; supplement income from off-farm employment; and potential benefit to community by reducing dependency on out-of-state energy sources.

Research participants identified other factors favorable to the adoption of alternatives such as switchgrass, although many of these considerations fit within the broader questions and categories discussed earlier. Few of these individual factors can make or break an adoption decision, but they are important considerations for farmers. They include: tax incentives—for value-added products or renewable fuels, for example; expanded use of crop lands to support production—with or without payment deductions; ease of application—for programs or practices; reduced expenditures—cost savings can be as important as increased revenues; cash receipts—promised future income is sometimes less important that cash-in-hand today; andsecure incentives—no evaporation in subsequent years

Unfavorable Factors

While either contentment or inertia could explain why farmers in southern Iowa would not readily adopt farming activities and practices better suited to area soil conditions and resources, there are many things that discourage them or thwart their attempts. Most farmers confront the same sorts of questions listed previously with regard to profitability and other economic considerations, compatibility with values and beliefs, aesthetic considerations, success, and so forth. Negative responses to any of these questions could discourage farmers from making changes in their farming operations. Listed below are a number of factors that discourage adop-

tion of switchgrass and/or other alternative farming activities and practices:

1. Southern Iowa farmers expressed a general and pervasive skepticism and/or distrust of government programs, policies, rules, and regulations they say discourage or thwart adoption of farming alternatives. Among these, paradoxically, is reduced federal support of agriculture. CRP restrictions against land management, grazing, or harvesting, whether beneficial or benign to marginal soils, were often cited, as were financial penalties (withholding of CRP payments or repayment requirements) for breach of CRP rules, when such breach did not reduce the conservation benefits of the program. More recent requirements to mix expensive (indeed, cost- prohibitive) forbs and legumes with switchgrass, despite evidence that they are eventually choked out, were an example of policies hostile to biomass production.
2. Small farm operators, in particular, reported that universally applied government rules and regulations penalize smaller producers because their costs of compliance are disproportionately higher. Small producers feel they are placed at a disadvantage by prevailing farm policies geared to big producers. The "aggravation factor" of federal, state, and local bureaucracy discourages adoption.
3. Many farmers prefer to "test the waters" before making a larger commitment ("commit no more than 10% and go slowly," several advised). Alternative activities, practices, or land uses that cannot be implemented gradually or incrementally were less likely to be adopted. (This is referred to as "trialability" in diffusion literature.)
4. A large number of southern Iowa farmers have jobs off-the-farm as well. Farming activities and practices that create scheduling conflicts between on-farm management and off-farm employment discourage adoption of alternatives. (This aspect of "compatibility" is discussed in diffusion literature.)
5. Increased complexity of alternative farming, coupled with the lack of adequate information, guidance, role models, and/or training, discourages adoption, as does the distance southern Iowa farmers must travel to access services such as internet marketing and web page design.
6. Additional capital outlay, particularly the need for specialized equipment, crop isolation, grain segregation, increased storage capacity, and transportation costs, discourages adoption of alternatives.
7. Lack of secure land tenure and/or acreage control discourages adoption, especially of a commodity with a lengthy establishment period such as switchgrass for biomass.
8. The lack of secure, reliable, alternative markets, whether distant or local, foreign or domestic, discourages adoption of new and/or untried crops.
9. The inability to obtain crop insurance or receive LDP on alternative crops discourages adoption, especially by risk-averse farmers, many of whom are younger or newer to farming.
10. General uncertainty about the viability and profitability of alternative farming activities, practices, and land uses discourages adoption.
11. Concern about the sustainability of alternative farming in terms of economics, farming "fads," soil quality, water quality, and so forth discourages adoption.
12. A general "lack of fit" between current and contemplated farm operations discourages adoption. (This is another aspect of compatibility discussed in the diffusion literature.)

Needs to Know

Many southern Iowa farmers are taking a "wait-and-see" attitude toward switchgrass as an energy crop. They are eager for encouraging results of the economic and agronomic research of Iowa State University, Chariton Valley RC&D, Prairie Lands Bio-Products, Inc., and Alliant Power. Here are some things research participants, especially reluctant adopters, said they need to know before making decisions about switchgrass or other farming alternatives. (This "wait-and-see" attitude is indicative of the "observability" requirements of innovations discussed in diffusion literature.)

Potential adopters need to know actual or anticipated: costs per acre; labor involved; equipment requirements; other capital requirements; fertilizer needs; land best suited for production; expected return on investment; market identification and stability; and cost-benefit comparison between switchgrass, conventional row crops, and other alternatives.

Southern Iowa farmers indicated a need for particular services to support their farm operations and facilitate adoption of alternatives such as switchgrass as biomass. These included: market development, marketing assistance, bookkeeping training and assistance, computer and internet training (web page development and management), and strategies for adapting to rapid change within the rural/agricultural economy.

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