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minnesota science

UNIVERSITY OF MINNESOTA
AGRICULTURAL EXPERIMENT STATION

interview with the DIRECTOR

During the two and a half decades of its existence, the official publication of the Minnesota Agricultural Experiment Station has undergone considerable change. In September 1966, the magazine's original title, "Minnesota Farm and Home Science", was shortened to Minnesota Science. Since that date, change has been the rule rather than the exception. Three successive editors have molded and shaped Minnesota Science into a brighter looking and modern designed magazine.

More recent issues of Minnesota Science have featured two new sections---"Science Shorts" and "Interview with the Director." Both of these features were introduced to broaden the base of Minnesota Science's appeal since many new subscribers live in urban areas. Science Shorts are capsulized research reports that present the abbreviated details of a project in easily understood terms. Interview with the Director is a no-holds-barred dialogue between the editor and William F. Hueg, Jr., Director of the Minnesota Agricultural Experiment Station. The interview is intended to provide a fresher, more personal dialogue than the traditional, but formal approach taken in "Research in a Growing Minnesota," the Director's column in past years.

We asked Dr. Hueg why the Minnesota Station has placed heavy emphasis on Minnesota Science and other publications to publicize research activities.

EDITOR: Dr. Hueg, you have strongly supported the effort to modernize Minnesota Science. Why, as a director of research, does this effort deserve your attention?

HUEG: The obvious answer, of course, is that the Minnesota Station relies heavily upon the citizens of the state for a major portion of its financial support. Minnesota Science is, in effect, the window through which people view our research efforts.

EDITOR: But aren't some other state stations dropping their magazines altogether?

HUEG: Yes, that's true. And many states seem to have adopted the attitude of "benign neglect" toward their magazines. They look the same as they did 30 years ago. There's been no effort on their part to keep pace with the process of modernization so apparent in commercial publications.

EDITOR: Do you think station publications should compete with commercial magazines?

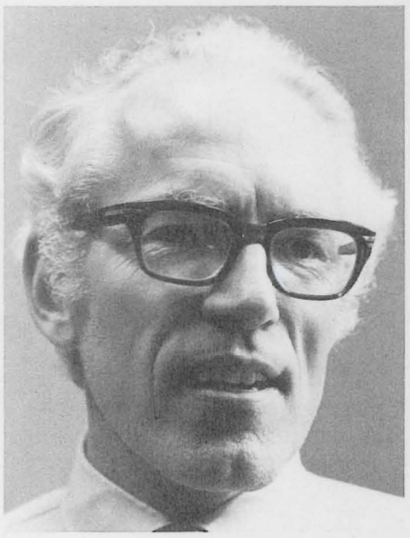
HUEG: Yes and No. Obviously, we can't begin to match the staff or resources available to commercial publishers. But nevertheless we do compete with them for the public's attention. In that sense, we are competitors---along with television radio, newspapers, and even direct mail.

EDITOR: Do station magazines even have a chance with this type of competition?

HUEG: There's no question in my mind that we do. Our audience looks to us as a very reliable source of information---a reputation that commercial magazines may deserve, but don't always enjoy.

EDITOR: At least one critic has suggested that Minnesota Science is putting too much emphasis on "people-related"

"We have opened the magazine's covers to several new and legitimate areas of investigation . . . and . . . at the same time maintained our link with the past."



"Many states seem to have adopted the attitude of "benign neglect" toward their magazines. They look the same as they did 30 years ago."

"Our audience looks to us as a very reliable source of information---a reputation that commercial magazines may deserve, but don't always enjoy."

or sociological research at the expense of crop production research. How do you react to that charge?

HUEG: Our research program is changing. We are calling greater attention to such research areas as community development, rural poverty, and problems of minorities. But the number of real dollars actually going to production agriculture, marketing, and overall management activities has increased markedly over the past 10 years. During that time, our research program has nearly doubled and the production agriculture enterprise has gained most from this expansion.

EDITOR: Someone has said production research is really "people-related" research. Do you agree?

HUEG: Yes, and that really removes the claws from that argument. Production research---whether its increasing the quantity or improving the quality of food, producing superior plant fibers for clothing, or boosting timber yields for home construction---is really related to human needs. However, we would be remiss in our responsibilities if our program of research did not reflect other problems confronting society. Some of these new programs---because they are new programs---may receive considerable attention in Minnesota Science. But---if I may belabor the point---this in no way diminishes the importance of research in areas traditionally associated with agriculture.

EDITOR: One more question, Dr. Hueg. What does the future hold for Minnesota Science?

HUEG: Well, I think I've indicated that we have opened the magazine's covers to several new and legitimate areas of investigation. At the same time we have maintained our link with the past through scientist-authors who reflect the continuity of an ongoing research enterprise. This will be melded with our determination to experiment with communications techniques---to remain responsive to change and alert to advances in technology that one day may make Minnesota Science an obsolete method of presenting information to our clientele. Until that day arrives, though, we will continue our efforts to provide our readers with an informative, attractive, and engaging report of the Minnesota Station's latest accomplishments.

minnesota science

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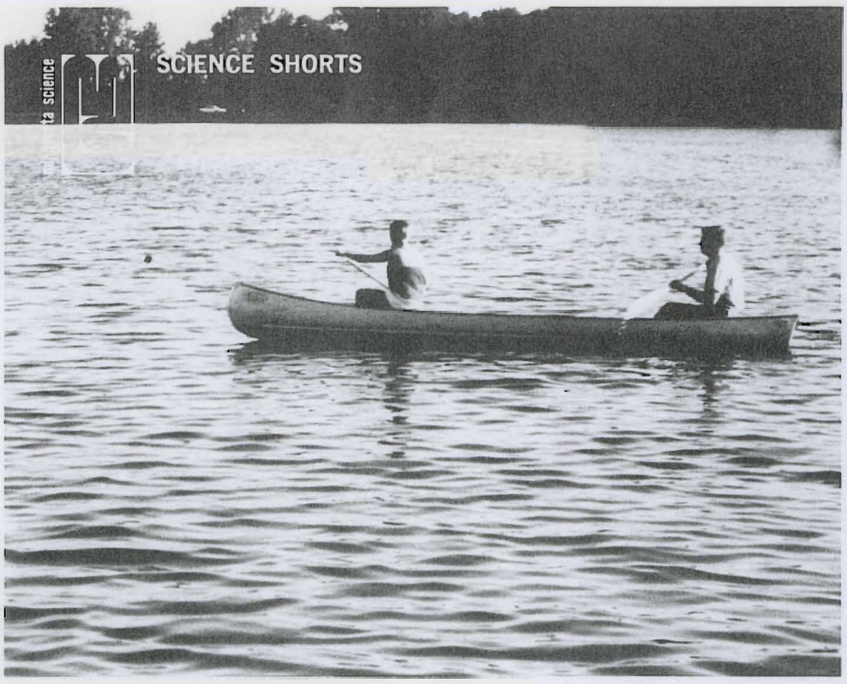


BWCA campers oppose public roads, underground shaft mining, resorts, and homes in area.

BWCA Development Opposed

Between 75 and 85 percent of the Boundary Waters Canoe Area (BWCA) campers interviewed oppose allowing public roads, underground shaft mining, resorts and homes in the area.

Opinions were divided, however, on issues of the level of government regulations, commercial logging, and motor restrictions in the BWCA, according to a former University research assistant, Stephen McCool, now at Wisconsin State University, and University forester Lawrence Merriam. Survey findings are based on interviews with BWCA outfitting firms and canoeists in 1968 and 1969.

The BWCA is one of the most heavily used wilderness areas in the United States and annually accounts for about one-fourth of all man-days use of the nation's wilderness areas. Between 60 and 70 percent of the groups visiting the area have been outfitted, McCool and Merriam said.

Motor restrictions in the BWCA was the management issue most likely to be talked about by outfitters and campers, researchers said. "Outfitters volunteered this information to newcomers and oldtimers asked for it. Outfitters are also most likely to volunteer or initiate interaction on this subject when they are a large operation and when the group is completely outfitted."

BWCA outfitters may be providing the major share of information on the wilderness area for 60 to 70 percent of the visiting groups, they said.

And on all issues, campers who interacted with the outfitter on management issues showed less resistance to Forest Service policies.

Other results of the study indicated:

- **Outfitted groups** tend to be older, slightly more educated, larger in size, less experienced, paddling canoeists, and less likely to come from Minnesota than non-outfitted groups.
- **Completely outfitted** groups talked more frequently about the subjects measured, such as travel route, campsite cleanup, camp equipment, fishing spots, management issues, and canoe country conduct than partly outfitted groups. Oldtimers talked more about management issues and less about camping skills than newcomers.
- **Large outfitters** are more free from local ideas and prejudices and have more preservationist attitudes than small outfitters.
- **Out-of-state** outfitted groups were less interested in and knowledgeable about the BWCA than in-state non-outfitted groups.

"The outfitter's role will become increasingly important in implementing BWCA regulations and management policy, and in communicating important information," McCool and Merriam said.

COST BENEFIT ANALYSIS NEEDED FOR METRO PRT

Personal rapid transit (PRT) may provide the best transit system for the Twin Cities metropolitan area considering the alternatives of automobile, bus, and rail-type systems, but more research is needed, according to University economists Terry Roe and Mathew Shane of the Department of Agricultural and Applied Economics.

The two economists presented a framework for a cost-benefit analysis of urban transportation systems at the second session of the National Conference on Personal Rapid Transit.

The economists suggested that the costs and benefits of alternative systems be studied to provide a more rational basis for deciding which system will best fit the Twin Cities' needs.

Construction and equipment estimates show that PRT will cost from one-third to one-fifth that of a comparable rapid rail system. But operating costs would not be significantly different since both would be computer-operated. So even based on a superficial analysis, rail-type systems are not a viable economic alternative to PRT systems, Roe and Shane said.

"The real issue for PRT systems is not whether they can compete with rail, which they obviously can, but with the automotive mode (of travel). Only a system that can generate sufficient usage and that is a reasonable investment of public funds will be a viable alternative to automobiles," the economists added.

Successful introduction of a new transit system will redistribute transportation usage from existing systems to the new system. This will benefit users of the new and existing systems —particularly automobile users. For instance, if a new PRT route to the central business district reduces the peak flow of auto traffic, then this would increase the efficiency of auto transit, they said.

The economists noted that it is often assumed that public transit must be subsidized. But this implies some fundamental problem with the existing transit systems—namely the systems cannot generate adequate demand. "Systems that require subsidization are not designed to provide competitive alternatives to private autos. Thus, one test of the economic viability of any new transit system must be its ability to attract ridership adequate to cover all expenses," Roe and Shane said.

If it is felt that certain groups should be encouraged to use the system, then this could be done through special fares rather than through a general subsidy of the system. Losses incurred by existing public transit systems are just another symptom that they are no longer viable transportation alternatives, they concluded.

INFRARED AERIAL PHOTOS CAPTURE DISEASE SPREAD

Dutch elm and other tree and crop diseases occurring over large areas of Minnesota may be monitored by aerial photography on a day-to-day basis in the near future. Present methods of monitoring plant diseases by ground survey parties involve much time and money and are not totally reliable because ground surveyors must sample relatively small portions of cropland or forests, according to University forester Merle Meyer and plant pathologist David French.

University researchers have been using infrared aerial photography to trace the spread of crop diseases such as sugar beet leaf spot, potato leaf blight, and tree diseases such as Dutch elm disease, oak wilt, and dwarf mistletoe in black spruce forests.

Infrared photography records only certain wavelengths of light rather than a clear color photograph. These wavelengths are invisible to the human eye —just as certain very low or high pitched sounds can't be heard. Plant diseases are detected because ailing plants give off different wavelengths of infrared light than healthy plants. These different wavelengths are captured on the special infrared film and are quite distinct to the eye once the film is developed.

Using infrared aerial photography, surveyors might scan the entire Minnesota and eastern North Dakota sugar beet growing area in a single day to assess sugar beet leaf spot conditions. "With rapid photo processing and interpretation, we envision growers throughout the region being notified of the latest disease situation in much less time than is now possible with current ground survey methods," the researchers say.

Aerial photography might also provide more reliable survey data because it would greatly increase the number of fields surveyed and would also permit observations over entire fields rather than small portions. In University experiments, infrared aerial photography has been successful in locating nearly 100 percent of the trees with Dutch elm disease and 60 to 80 percent of the oak with oak wilt.

The apparent advantage in aerial photography over ground survey is a savings in time and money. "In one 64-square-mile community, 1 month was required for a complete ground survey of the elms, and the cost was approximately $5,000. We expect that an aerial survey of this area could be completed in half this time and for less money," Meyer and French say.

NEW MILK FEVER DRUG APPEARS TO BE SAFER

A new drug looks promising as a possible preventative of milk fever in dairy cows. Initial results indicate that Holstein cows given 25-Hydroxycholecalciferol (25-HCC) orally shortly before calving had fewer cases of milk fever, according to University extension dairy nutritionist Michael Hutjens.

When Jersey cows in a dairy herd known to have a high incidence of milk fever were treated with the drug, incidence of milk fever was reduced by nearly one-half, Hutjens said. Six out of eight cows treated for milk fever with the drug recovered within 3 to 24 hours after injection. The problem of soft tissue calcification associated with massive doses of vitamin D for treatment of milk fever was not observed with the 25-HCC treatments.

Cost per treatment is projected to be competitive with the cost of calcium borogluconate treatments, he said. In addition, 25-HCC treatment appears to be safer for the cow than the calcium borogluconate. More research concerning timing, dosage number, and levels must be completed before 25-HCC can be made available for farm application. Hutjens estimated that it would be at least another 6 months before 25-HCC might be cleared by the Food and Drug Administration and made available to dairy farmers.

SHORT CYCLE HARVEST BOOSTS ASPEN YIELDS

Harvesting small aspen stems every 12 years could yield as much wood fiber on an average annual yield basis as harvesting only mature aspen on the same site, according to a University forestry study.

The short-cycle harvesting concept of aspen "opens new possibilities for reducing the cost as well as meeting present and predicted increased future demands for wood fiber," according to research assistant Ronald Person and Alvin Hallgren, associate professor at the University, and John Hubbard, a research forester for Boise Cascade Corporation.

Short-cycle harvesting might make possible the use of more of the state's aspen in the manufacture of paper, fiberboard, cardboard boxes, wallboard, and other products.

Harvesting aspen stems (called 'suckers') with agricultural-type equipment such as a corn chopper might be possible and could significantly reduce harvesting costs, the researchers say.

In areas sampled near International Falls, the total yield of aspen for 12-year rotations over a period of 40 years was figured to be about 39 cords per acre—about 4 cords greater than the yield from a single cut of 40-year old aspen.

The researchers warn, however, that much more needs to be learned about harvesting aspen suckers.

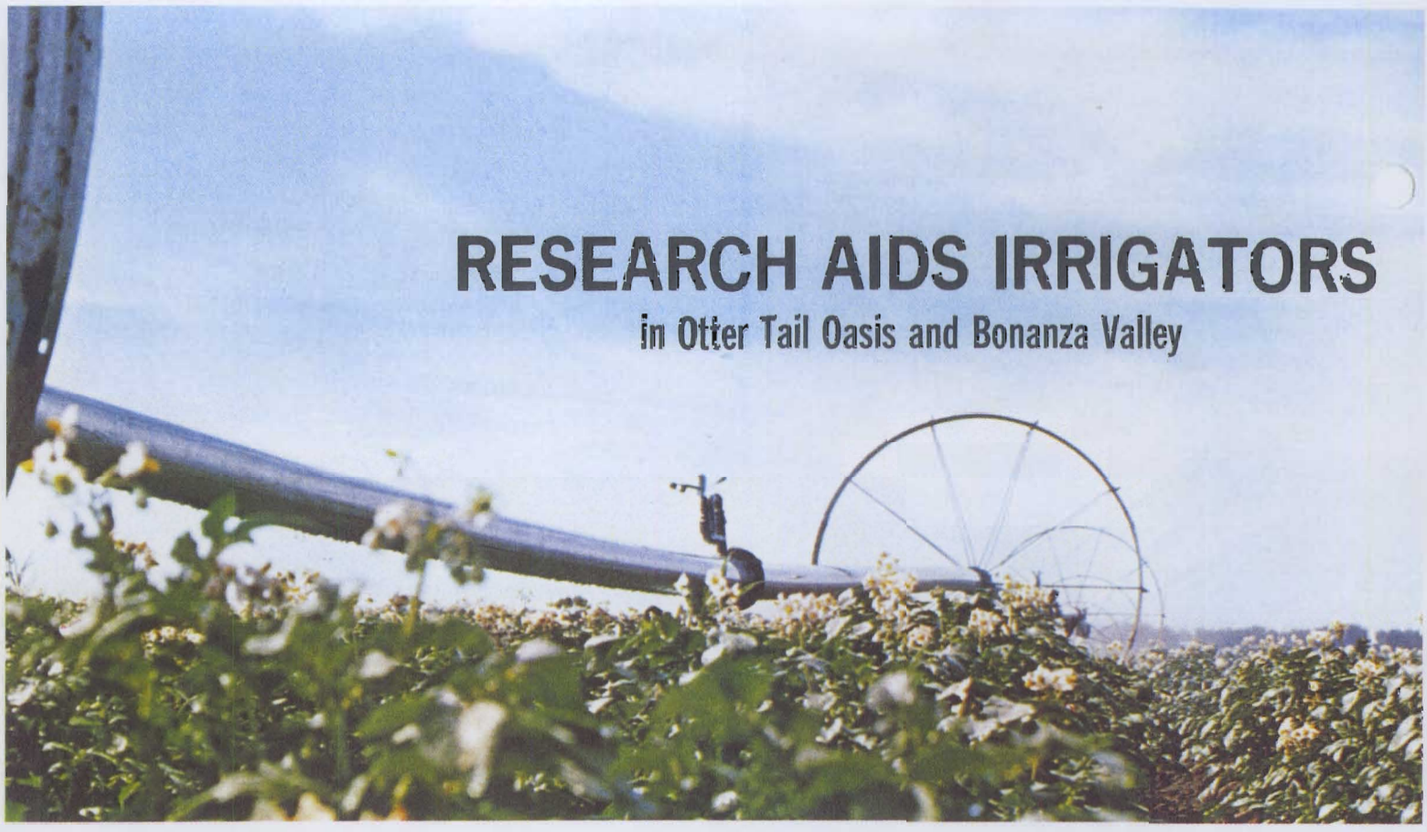
"It is not known if an area will continue to produce fiber yields from suckers with repeated cutting. Fertilization, irrigation, and other forms of site preparation may be necessary to achieve continued high yields. Also, high among the problems that have to be solved are the economic and technical aspects of harvesting and making wood pulp from small sucker stems."

The state's total aspen pulpwood harvest is about 500,000 cords a year, but aspen is growing faster than it is being cut. Aspen, sometimes called "popple," is undercut by more than 300,000 cords a year. When a forest is undercut, trees mature and die faster than they are harvested—consequently many trees are wasted.

Results of the research study can be obtained from the College of forestry, University of Minnesota, St. Paul 55101. Ask for Minnesota Forestry Research Notes, No. 224, "Yields From Short-Rotation Aspen Suckers."

RESEARCH AIDS IRRIGATORS

in Otter Tail Oasis and Bonanza Valley



Most irrigation development in the Otter Tail Oasis has come about during the past 3 years. Sandy soils in the area make it an unlikely spot for successful agricultural production, but irrigation enthusiasts say all that is being changed.

DAVID A. ZARKIN
extension information specialist
Department of Information and Agricultural Journalism

Sandy soils of Minnesota's Otter Tail County make Perham an unlikely spot for successful agricultural production, but irrigation proponents say all that is being changed. Perham, located in north central Otter Tail County has become Minnesota's hot spot for irrigation development in recent years.

B. Jay Iverson, Production Credit Association (PCA) representative at Perham, recalls when he came here in 1966 there were four irrigation systems in the county and all required a great deal of labor to operate. Now Otter Tail County has 45 systems financed with about $500,000 in loans, irrigating about 6,000 acres. An additional 75,000 to 100,000 acres could be irrigated, assuming land clearing would be minimal. Much of this new equipment operates with comparatively little assistance from the farmer.

Iverson estimates it will take at least 25 years for irrigation development of the area. Twelve new irrigation systems were financed in the area last year and he expects there may be as many as 20 new systems financed in 1972, but he cautions that after a good wet year interest in irrigation might lag.

Most irrigation development in the Otter Tail Oasis has come during the past 3 years. Irrigation, in terms of acreage, has developed more rapidly in the Otter Tail Oasis than any other area in central Minnesota, according to Fred Bergsrud, Staples, area extension agricultural engineer. It may be because farmers in the area enjoy some advantages over other areas, including more readily available capital, stronger individual economic bases, and land that lends itself to larger irrigation systems.

Denzil Cooper, Perham associate county extension agent, says the reason for increased irrigation development is that it is difficult to raise a crop here without it. Also, an active organization of interested farmers, the Central Minnesota Irrigators Association, cooperates to secure markets for specialty crops and tries to find low-cost sources of fertilizer and pesticides.

Interest is stimulated and information provided by the Central Minnesota Demonstration Research Irrigation Farm at the Staples Area Vocational-Technical School and the Minnesota Agricultural Experiment Station's Sand Plain Field at Elk River. The Agricultural Extension Service, mini-plots at Park Rapids, and the Extension-Tennessee Valley Association (TVA) test-demonstration plots are other resources in the area. They all contribute valuable information to farmers interested in irrigation.

About 12 years ago the Agricultural Extension Service started a series of meetings on irrigation. Now workshops are offered in Perham and Wadena to provide farmers up-to-date information on irrigation. Increased interest in irrigation has boosted the number of workshops from two to three a year. Only a dozen or so farmers attended these sessions at the start, but now about a 100 farmers turn out, Cooper says. Extension workers also meet locally with prospective irrigators and advise farmers on setting up irrigation equipment.

Irrigation in the Otter Tail Oasis is called "supplemental," but many feel that it is a necessity for successful agricultural production. Though the area normally gets about 24 inches of rainfall annually, during many years very little of it falls during July and August. "One week without rainfall will dry us out in the summer," Iverson says. The soil is so sandy that the little moisture that falls during summer rarely is sufficient for good crop production.

VISIT TO "GOLDEN SANDS"

Iverson says a trip to the Central Sands area of Wisconsin in 1965 convinced him and his party that successful agricultural production was possible with irrigation in the Otter Tail Oasis.

The Central (Golden) Sands of Wisconsin was encouraging to the Minnesotans, but they realized that Wisconsin farmers and researchers had a considerable head start. As early as 1910, Waushara County residents asked the University of Wisconsin for help because the central Wisconsin sands had not always been golden. During the first 50 years of the century, production was a continual struggle against droughts that lowered crop yields and quality. Residents made 95 acres of barren sand available for an experimental farm near Hancock. In 1947, irrigation facilities were installed on the Hancock Experimental Farm so scientists could explore the feasibility of irrigation on sandy soils and crop response to irrigation. Irrigation increased field corn yields from 40 to 105 bushels an acre and potatoes yields from 75 to 125 bushels an acre. The 80,000 acres under irrigation now in the Central Sands yield more than $30 million of produce annually. But University of Wisconsin scientists point out that the area's potential has not been fully tapped. Of the 2½ million acres that could be developed as cropland, only a half-million acres now are tilled.

PERHAM SURVEY

Filled with optimism from the trip to the Central Sands, Iverson returned to Minnesota to establish a PCA office at Perham. But before the irrigation push could begin a ground water survey was needed to (1) determine the quantity and quality of water available for irrigation; (2) establish guidelines for extensive use of water; (3) protect the investment of farmers who buy equipment; and (4) determine the effects of extensive water use on wildlife habitat.

A 2-year study was conducted starting July 1967 at a cost of $44,850. Federal funds paid half of the costs and the rest was provided by state, county, and local sources. Results of the survey indicated there was sufficient ground water for irrigation and that irrigation would have no appreciable effect on lake levels in the area.

Although Perham's economy has not been drastically altered with the upsurge in irrigation during the past 3 years, farmers there have been able to help themselves by irrigating. Their irrigation systems put on 10 to 12 inches of water during the growing season and the crop often requires this much or more.

IRRIGATION BENEFITS STUDIED

Benefits from irrigation more than covered the costs in years of limited rainfall, according to a study conducted last year in central Minnesota by University of Minnesota extension economists. Although the study is not completed, Paul Hasbargen, extension economist, says results to date suggest that large investments in irrigation equipment can only be economically justified if the system is well managed.

Irrigation equipment can pay for itself if there "are no other sins to cover," Iverson says. But irrigation won't cover up management problems—it probably will magnify them, he adds.

Iverson says most farmers who have applied for irrigation loans from his office "can handle them." He says he tries to fit the land, water, and capital with the right people in the right combinations.

SPECIALTY CROPS

Interest in specialty crop production has increased with development of irrigation in the Otter Tail Oasis, but markets for these crops could be improved. Although corn is the primary crop in the area some farmers irrigate potatoes, pinto and kidney beans, alfalfa, and a few farms near Wadena irrigate cucumbers, Cooper says.

Kidney and pinto beans are among the best alternative crops with yields of 1,500 pounds to over a ton an acre and gross incomes averaging $150 to $200 an acre. There is more money in beans than in corn, they fit in well with the corn rotation, and the new crop does not require any new equipment for the corn grower.

Potatoes also are a good alternative to corn, but there is no local ground swell for potato production at this time. Potato marketing and production technology and equipment are unfamiliar to most farmers here. One Red River Valley potato grower rents irrigated land here for potato production and other Valley growers have indicated they might do the same.

BONANZA VALLEY EXPERIENCE

Experience of 12 irrigators in other areas has shown that the switch to potatoes from another crop can be made successfully. Growers in the Bonanza Valley (located in Pope, Stearns, and Kandiyohi Counties) grew 400 acres of Norland, Norgold, and Anoka potatoes this past season. Only two of these growers had any previous experience with this crop. The irrigators wanted a high value specialty crop that could be produced efficiently. Bonanza Valley growers met with potato growers, processors, and brokers in other areas and located several brokers who said they could sell all the potatoes that they produced. After being assured a market, they asked extension agents for information on the production of high quality, high yield potatoes. (In the Otter Tail Oasis, "markets really aren't as good as we would like to see them," Cooper says.)

University of Minnesota extension specialists in horticulture, plant pathology, and soil science conducted educational meetings and made recommendations in the Bonanza Valley. Field meetings to discuss the crop's progress were held during the growing season and extension specialists and horticulturists from the West Central Branch Experiment Station at Morris made frequent trips to the valley to observe the crop.

Pope County extension agent John Morris reports that the novice Bonanza Valley potato growers had an excellent quality crop. Yield was 200 to 350 hundred-weight per acre. (In potato variety trials on sandy soils at the Experiment Station's Elk River Sand Plain Experimental Field, the highest yielding variety, Norchief, averaged 573 hundred-weight per acre. Five other varieties tested yielded in excess of 500 hundred-weight per acre.)

After this year's experience, Bonanza Valley growers are convinced they can succeed with potatoes and plan to grow another crop next year, Morris adds. And the Upper Great Lakes Regional Commission has funded a market feasibility study of selected irrigated specialty crops for central Minnesota. One objective of the study will be to investigate alternative types of marketing arrangements that might be practical now and in the future.

(Continued on page 10)

STATE INVADED BY ALFALFA PEST

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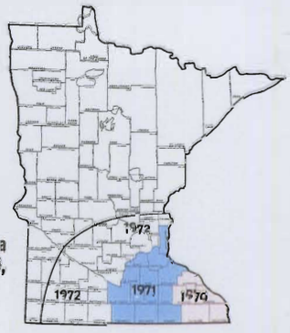

Known distribution of the alfalfa weevil in Minnesota in 1970, 1971, and projected for 1972.

Alfalfa weevil was first observed in Minnesota in 1970. Surveys that year revealed low numbers of weevils present in five southeastern counties—Houston, Fillmore, Winona, Wabasha, and Olmstead. In 1971, the weevil was found to have expanded its range west to Mankato and north as far as the Twin Cities, an apparent advance of 100 miles west and 50 miles north. Similar expansion of the weevil's range can be anticipated for 1972 (see map).

Alfalfa weevil now occurs in each of the contiguous 48 states. But it first appeared as two distinct and (until this year) geographically separated populations—eastern and western. The western strain was first detected near Salt

Lake City in 1904. It now occurs in 16 states, including the western halves of both Dakotas, Nebraska, and Kansas. The eastern strain was first detected near Baltimore in 1951. It has since spread explosively and now occurs in 35 states, including Minnesota, Iowa, and eastern portions of Nebraska, Kansas, Oklahoma. The eastern strain weevil is the major pest of alfalfa throughout its range. U.S. yield losses for 1966, alone, have been estimated at $56 million, with an additional $14 million spent on chemical control. In some eastern and southern states, large reductions in alfalfa acreages have been caused by establishment of the weevil.

A fairly typical pattern has emerged in eastern states experiencing weevil infestation. For 2 or 3 years following detection, the weevil does not reach high enough population densities to cause economic losses. But beyond these initial years the problem can become severe. Many growers have found it necessary to use multiple (2, 3, and even 4) applications of insecticide. With time, the problem appears to become less acute. In most states where the weevil has been established for a number of years, much acreage is not treated at all and little receives more than a single application.

It is not unusual to find that the newly introduced pest is especially devastating in its new environment. One reason for this is that natural enemies associated with the pest at its origin are absent in the new range. Several alfalfa weevil parasites have been introduced into the U.S. and at least six are now established. The most important is the parasitic wasp (*Bathyplectes curculionis*). By appropriately timing insecticide treatment (i.e., when adult wasps are not present), it is possible to combine biological and chemical control. Many cultural practices also minimize weevil injury. Vigorous varieties, good stands, and adequate soil fertility greatly reduce losses. Development of the weevil-resistant variety Team demonstrated the potential of using plant resistance.

Pest management practices should be based on the concept of economic thresholds. Costs of control measures, both immediate and long-range, have to be weighed against the benefits of increased yield or improved quality likely to result. For example, a long-term effect of insecticide use may be delay, or even failure, of natural enemies to become established. Accordingly, primary reliance should be placed on biological control and cultural practices—with insecticides used only when essential.

Determining when the economic threshold has been reached, however, is a problem. Alfalfa under proper cultural management has a remarkable tolerance to weevil injury. In the eastern U.S. it is generally thought that treatment is undesirable unless more than 50 percent of the stem terminals shows injury. USDA researchers in Maryland recently revised this criterion upward to 75 percent injury. In Indiana, larval populations of 1-3 per stem appear to represent the economic threshold.

A chief factor determining the severity of injury is how much growth alfalfa makes before the weevil eggs hatch in spring. Considerable fall egg laying is unlikely to occur in Minnesota. If this is the case (provided Minnesota does not experience unusually warm weather in early spring), alfalfa should be well established before the weevils hatch. This enables alfalfa to withstand relatively high weevil populations without incurring heavy losses.

Research on alfalfa weevil was begun last fall by the Minnesota Agricultural Experiment Station. The ultimate goal of entomologists studying this problem is development of an integrated management program—one that involves minimum costs for both the grower and the environment. To accomplish this, much biological information must be investigated. It is especially important that we study (1) the life cycle of the weevil under Minnesota conditions, which includes the time that each life stage occurs in relation to season, alfalfa growth, and farming practices; (2) adult weevil activities, such as feeding, egg laying, overwintering, and dispersion; (3) weevil tolerance to physical conditions at various stages of its life cycle. This is important in Minnesota because temperature conditions in winter and early spring are highly variable, and sometimes severe; (4) effectiveness of indigenous predators and introduced parasites; (5) genetic characteristics of Minnesota's weevil population compared to those in the east and the west; and (6) relationships between the type and intensity of crop damage and population densities of larval and adult weevils.

It has been said that the more an insect is controlled by insecticides, the less is known about its biology. We can extend this thinking to say that the more we wish to minimize the use of insecticides in managing an insect population, the more we need to know about its biology. Since the alfalfa weevil is a new insect pest in the state, we have a unique opportunity to develop a management program that emphasizes the total agro-ecosystem of the insect, rather than control by insecticides alone.

Experiment Station entomologists are studying the influence of Minnesota conditions on the alfalfa weevil's life cycle.

Photo at left shows the alfalfa weevil in its larval stage. Below is the adult beetle — also at extreme left — greatly enlarged.

FINANCING IRRIGATION (Continued from page 7)

Although irrigation has developed steadily in the Perham area, lack of long-term financing for irrigation equipment is a stumbling block to more rapid development. Too often, banks and other credit institutions will only extend short-term credit of 4 to 5 years for irrigation equipment but the system may last 15 years, according to farm management specialists at the University.

Financing a long-term investment such as an irrigation system with short-term credit can mean trouble for the farmer, according to Charles Cuykendall, University extension economist. A 1970 study of the costs and returns from irrigated corn showed that although irrigation equipment appeared profitable enough to cover a depreciation charge, it did not generate enough extra cash to cover a very rapid repayment schedule.

Irrigation equipment is a long-term investment like land, but most irrigation equipment in the Perham area is financed under short-term loans, most of them through PCA, which places a 7-year limit on its loans. Long-term credit is needed, but it is limited. Iverson points out why a 7-year loan for irrigation equipment is a limiting factor: "The land needs 3 to 5 tons of lime at $8 a ton and it also needs potash, sulfur, zinc, and possibly manganese and boron, aside from fertilizer needed to grow the crop. So over a 7-year period, for example, the farmer would be assuming an $8,000 loan for soil corrective measures plus an additional $25,000 loan for irrigation equipment. If both are financed with short-term loans and payable at the end of 7 years, the burden of debt payment will be larger than many farmers can handle. Taking note of this problem, economists Cuykendall and Hasbargen say farmers should seek long-term financing for irrigation.

Other sources of farm credit include banks, finance companies, the Farmers Home Administration (FHA), and insurance firms. Travelers Insurance Companies has made a few long-term loans (between 10 and 20 years) in the Otter Tail Oasis for farm land and irrigation equipment, according to John Simmons, Minneapolis manager of Travelers' farm mortgage department. This is Travelers' first experience with irrigation loans in this area. Simmons says his firm is doing business with people that are "quite well capitalized" and the Travelers farm mortgage representative in Redwood Falls is looking at additional prospects for irrigation loans.

Simmons says the Otter Tail Basin is of interest to his firm because the water is reasonably close to the surface and there are "pretty good" possibilities for potato production with irrigation.

Many insurance companies have been discouraged from making farm loans in recent years in Minnesota because of the 8 percent interest ceiling that the state usury law imposes. Insurance companies making farm loans in recent years have become "few and far between" because of the limit of interest they can charge individual lenders, Simmons said.

A year ago the Triple A bond interest rate was more than 9 percent. As a result, a large number of insurance companies dropped out of farm loans and went to bonds, Simmons adds.

University agricultural economist Mathew Shane says the state usury law should be modified or repealed since it has prevented individuals, including home and farm mortgage borrowers, from competing effectively with other borrowers, such as corporations and businesses, for funds.

Financing a long-term investment with short-term credit can spell trouble for farmers, say University economists. A 1970 study showed that although irrigation equipment appeared profitable enough to cover a depreciation charge, it did not generate enough extra cash to cover a very rapid repayment schedule.

WOOD PRODUCTS
An Uncertain Future?

JOHN G. HAYGREEN
professor and head
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In the next two or three decades wood-based materials will be faced with real and imaginary threats posed by manmade substitute products. Plastics, for example, might replace fine hardwoods in furniture. Steel or aluminum might be widely used in place of softwood dimension lumber for framing. And carpeting might be a commonly accepted substitute for hardwood flooring in new homes.

Three major factors could bring about a major switch from wood products to other materials. The first is the possibility of a shortage in the real supply of raw materials such as pulpwood, sawlogs, and veneer logs. Shortages cause prices to rise, which in turn may reduce consumption. Walnut lumber is a prime example of this. If it were readily available, the price would be lower, consumption higher, and the switch to competitive materials less pronounced.

A number of hard- and softwood species in certain log sizes and qualities are already becoming difficult to obtain at competitive prices. Yet in the U.S. presently, more wood is being grown than is cut or lost to natural causes. This situation is likely to prevail for another decade or two, but assuming continued population growth, affluence, and use of wood as a major building material, we will eventually reach a point where production and consumption of raw wood is either balanced or demand is greater than supply. If our nation hopes to prolong the day when requirements for wood exceed supply, it is imperative that the productivity of U.S. forest lands be increased. This will require public demand for land-use policies that recognize the importance of timber production. Failure to make timber production a legitimate national goal will improve the competitive position of non-wood materials.

The competitive clash between traditional wood furnishings and its chrome-and-vinyl counterparts is nowhere more apparent than in modern decor. By 1975, nearly 1 billion pounds of plastic will be used annually by the furniture industry.

WOOD VERSUS SUBSTITUTES

Technical developments in the properties of other materials might give them an advantage over wood in cost and serviceability. Plastics such as polystyrene, polyester, polyurethane, and ABS are being widely used in the furniture industry to simulate wood parts. By 1975, it is predicted that nearly 1 billion pounds of plastics will be used annually by the furniture industry.

As the table below shows, some strength properties of plastics are not greatly different from those of wood. The most important single physical property for many materials, bending stiffness, is quite similar. But plastics are generally 3 to 4 times as dense as wood, a factor that favors wood. Wood has a price advantage over plastics on a weight

Cost, density, and strength comparison of materials

Material	Cost/lb.*	Cost/cu. ft.*	Typical density lb./cu. ft.	Relative bending strength (MOR)†	Relative bending stiffness (MOE)†
Lumber	$ .07	$ 2.10	30	1	1
Wood fiber products	.10	6.00	60	0.4	0.25
Steel	.13	62.40	480	10	15
Aluminum	.45	74.20	165	2	4
Polystyrene	.16	11.40	70	2	1
Polyester	.20	21.00	105	6	1
ABS (Acrylonitrile-Butadiene-Styrene)	.35	33.20	95	1.5	0.5

* Typical costs, fall 1971.

† Relative strength. MOR is a measure of the load-carrying capacity of a beam. Here the MOR of each material is compared to wood. MOE is a measure of the resistance of a beam to bending (stiffness). Since beam stiffness is actually a function of both MOE and beam geometry, the comparison here would be valid only between solid beams of the same size.

basis and an even greater advantage on a volume basis. But the reason for using plastics is not because of physical properties nor cost of the materials: Molded and extruded plastics have a lower manufacturing cost than machined wood parts.

The steel, aluminum, and plastics industries are all spending vast sums of money to develop wood substitutes. In the case of plastic materials, these efforts seem to have paid off. But efforts to date to develop steel residential building systems have been met with frustration. Wood has a great advantage because of its low cost and high strength-to-density ratio (see data table). But new products that can successfully compete with wood might be developed in future years. A large home builder in Denver is presently using steel floor and wall systems. These homes are selling for less than other homes in the area constructed with conventional wood framing.

PRESERVATIONIST POLICIES

The third factor that could give non-wood products a competitive edge is the possible adoption of state and federal policies that downgrade the timber production objective of forest management. Several preservationist groups are applying such pressure now. Long rotation ages may be required even though shorter rotations would be adequate to grow sawlog-size material. Restrictions might also be placed on clear-cutting practices. The outcome could be a shortage of raw wood materials. If wood isn't used for the frame of a home, then steel, aluminum, or plastic will be. If wood is not used for furniture, then parts will probably be fabricated from plastics. The question that preservationists and conservationists must ask themselves is: "Would the nation's environment be better served if metals, coal, and petroleum are used as raw materials for homes rather than a renewable crop such as wood?"

Vinyl-covered steel cupboards — though more expensive — are making inroads into American kitchens. Aluminum foil wallpaper, vinyl floor tile and countertops are among other manmade materials replacing wood products.

STRENGTH-TO-WEIGHT RATIO

This brings us to the point where we can look at several factors that give wood an advantage over other materials. Let's consider the use of other materials for framing homes—one of the largest single uses of wood. Steel and aluminum are the two likely competitors. But as the table shows, despite aluminum's superior bending strength (twice that of wood) and stiffness (four times as great), it costs over 35 times as much as wood on a volume basis. Nevertheless, a large U.S. aluminum company is making a major effort to market an aluminum framing system for residential construction.

The situation is somewhat different with steel. It has a very high bending strength and is 15 times as stiff as wood. Much less steel on a volume basis can be used to carry the same loads supported by wood. Steel joists sometimes weigh only ⅓ as much as wood joists. To compete with wood from a cost standpoint, a steel structure must be made of steel studs, steel floors, and a steel roof truss system of very light weight. Because of the light weight, sound insulation presents serious technical problems. At present, the only place where steel may be as inexpensive to use is in non-load-bearing walls.

On the other hand, wood's high strength-to-weight ratio makes it possible to produce sheet materials such as plywood, fiberboard, and particleboard to cover the frame of a structure at relatively low cost. No other product on the horizon can match wood products for this application. Some competitive sheet materials do possess good sound and heat insulation properties, it should be noted, but they do not simultaneously offer the high bending and shear strength of wood products.

RENEWABLE RESOURCE

As the issue of renewable versus nonrenewable resources gains wider public awareness, forest products should assume an increasingly advantageous position. Concern for overpopulation and related environmental problems is in its infancy. It seems possible that we can solve the air and water pollution problems confronting our nation, but the more basic problem of overpopulation will be with us for some time to come. A continually increasing world population will mean an ever-increasing demand for shelter and written communication. Materials for both are largely forest products. Shelter could be made from metal and plastic. Would we accept adobe or concrete homes? Paper could be made from plastic. But these potential substitute materials are largely from nonrenewable sources. Aluminum ore is in limited supply. Various ores from which iron can be produced are plentiful, but not inexhaustible. Despite present predictions that there is enough iron ore to last hundreds of years, we may eventually run out.

Consider our supply of petroleum and coal—the source of raw material for plastics. No one knows for certain, but it has been estimated that over half of the oil reserves in North America have been located. Some authorities estimate that the U.S. has enough oil in developed fields to last only 8 more years and enough natural gas to last just 12 more years. Some Congressmen have advocated that we should import as much oil as possible to save our reserves. Viewed from this perspective, the use of nonrenewable resources for purposes that could be fulfilled by renewable resources seems a very question-

Wood's high strength-to-weight ratio, its relative low cost, and its sound and heat insulation properties make it a highly preferred building material. Nevertheless, a large U.S. aluminum company is making a major effort to market an aluminum framing system for residential construction. One Denver, Colorado, home builder is presently using steel floor and wall systems in new homes.

able policy.

Our supply of coal, which is the major raw material of plastics, is plentiful compared to petroleum. Quantities available in the world are said to be adequate for hundreds or even 1,000 years. Much of this coal, however, is low grade. Its high sulfur content presents serious air pollution problems. Research is underway to develop practical methods of converting coal to a gas or a liquid, which would allow its conversion to other forms of energy without creating undesirable pollutants. But a sound case could be made for the use of wood versus coal simply because coal is not a renewable resource. Also, environmental problems associated with strip mining of coal are extremely severe compared to those of timber harvesting.

ENERGY EXPENDITURES

Energy consumption is a major concern of many environmental groups today who are worried about the diminished supply of fossil fuels, and air and water pollution resulting from electrical power generation. Estimates have been made that it takes about 450 kilowatt hours to produce a ton of lumber, 2,500 to 10,000 kilowatt hours for a ton of steel, and 17,000 kilowatt hours for a ton of aluminum. Energy from almost 8 tons of coal is required to produce a ton of aluminum. Not enough information is available on energy requirements to draw firm conclusions regarding the environmental impact of a major shift from wood to other materials. However, it is obvious that more power is required to produce metals than wood products. Moreover, the amount of energy used in the production of materials eventually may become a much stronger determinant of the competitive edge a product holds. The day of "cheap" power in this country may be coming to an end. A recent article in *Forbes* magazine stated that in the last 3 years, coal has nearly doubled in price. Crude oil has gone up 30 percent in the last year. Natural gas prices are expected to double in the next decade. Electric rates went up for the first time in 40 years and are expected to increase 30 percent in the next 10 years. These burgeoning costs should put large power-consuming industries in a tough cost squeeze compared to those with lower energy requirements.

FUTURE OF FOREST PRODUCTS

Perhaps the most serious question facing the forest products industry is that of an adequate raw material base. The potential exists for a shortage of wood to develop in the coming decades. It could result from continued growth in world population—a simple case of consumption outstripping productive capacity. What would be more unfortunate—because it is avoidable—is a shortage resulting from public policy that dictates that forest lands should not be managed with timber production as one of the primary goals.

More likely than not, the environmental issue will eventually solidify public support for the use of wood materials over metal and plastic competitors. The fact that wood is a renewable resource, that relatively small amounts of energy are required to convert it to usable products, and that these products are recyclable or easily disposed of, rank high in the eyes of environmentalists. If these advantages gain widespread public awareness, then policy measures designed to safeguard the environment and simultaneously conserve our dwindling natural resources should insure a plentiful supply of wood materials for decades to come.

Marketing Northern Minnesota's Tourism Resources

UEL BLANK
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Department of Agricultural and Applied Economics

People away from home need nearly all the services they need when they're at home. Marinas, motels, tackle and bait shops, gas stations, and restaurants are easily identified with tourists. But tourists also purchase groceries, clothing, drugs, variety store items, and real estate. They frequent bowling alleys and movie theaters, and use local medical services and transportation systems.

Nearly every Minnesota community would like to increase its sales to tourists. Tourism, much like any other economic activity, can be systematically developed. With this in mind, our team of specialists analyzed selected aspects of the tourist industry in the Lake of the Woods-Rainy Lake area of northern Minnesota in 1969 and 1970.* Many of our findings have broad application to any area that wants to develop its tourist trade.

TOURISTS—WHO ARE THEY?

For the purposes of our study, we defined a tourist as anyone who travels into a given area for any short-time purpose. In the popular view, tourism is usually linked with vacation and recreational travel. But people travel for a wide variety of reasons and still use the same services—restaurants, overnight lodging, and service stations. Frequently, motives for travel are intermingled. Many business visitors also take time out to fish, play golf, and attend evening entertainment.

Nationwide, the reasons why people travel are just as varied. A 1967 national travel survey (see table 1) revealed that visits to friends and relatives account for over 40 percent of all travel in the U.S. Outdoor recreation and sightseeing accounted for nearly a quarter of all trips taken, and business travel made up 14 percent of all trips 100 miles or more from home or involving an overnight stay.

Tourist volume in the Lake of the Woods-Rainy Lake (LOWRL) area was found to be substantial. Counting each out-of-the-area person each time he entered the LOWRL area, we estimated the area hosts 706,000 annual visits. (See footnote* for explanation of person-day data.)

As table 2 shows, we classified the area's tourists into 10 groups according to primary travel purpose and lodging services used. About two-thirds of the annual visits (475,000) were primarily for recreation, vacationing, or leisure. Remaining visits (231,000) were primarily for business reasons. The first six categories rely on natural resources as an attraction, but every category depends upon provision of specific services and facilities.

*Author acknowledges assistance of James Kuska, assistant professor, Department of Horticultural Science; Dayton Lassen, area extension agent, Forestry and Recreation; John Loftus, research specialist, Department of Agricultural and Applied Economics; and Lawrence Simonson, extension specialist, Tourist Services.

Table 1. Travel purposes of U.S. individuals, 1967*

Purpose for travel	Person trips, millions†	Percentage
Business	50.4	14.0
Conventions	8.0	2.2
Visits to friends and relatives	152.3	42.2
Outdoor recreation	62.1	17.2
Entertainment	12.7	3.5
Sightseeing	26.2	7.2
Other pleasure travel	42.1	11.7
Personal and family affairs	6.9	1.9
No response	.5	.1
Total	361.2	100.0

* Source: National Travel Survey, 1967. Each trip constitutes one person traveling 100 or more miles from home or staying overnight.

† Counting each person each time a trip is taken; e.g., two people traveling together would be two person trips.

Table 2. Tourist visits to the Lake of the Woods-Rainy Lake area, 1970

Type of visitor	Person days*
Recreation or leisure (475,000 annual visits†)	
Resort guests	258,000
Campers	39,000
Sightseers staying overnight (hotels-motels)	11,000
Second home users	192,000
Fishermen, hunters, marina patrons, and sightseers not staying overnight or classified in other categories	‡
Winter sportsmen and spectators	‡
Travelers driving thru area, mostly into Canada, not staying overnight	‡
Visitors to friends and relatives	160,000
Business (231,000 annual visits)	
Travelers staying in hotels-motels	75,600
Travelers not staying overnight in commercial lodging	‡

* Person-day data were generated from use studies of accommodation facilities, with the exception of visitors to friends and relatives. A person-day analysis counts each person each day he is in the area: e.g., a family of four staying 5 days counts as 20 person days.

† Annual visit data were generated from an analysis of highway travel. An annual visit analysis counts each person each time he enters an area.

‡ Reliable data unavailable.

Resort guests are the largest category of tourists that could be accurately counted. They account for fewer than one-third of the total visitor days for which estimates are available. As table 3 indicates, resort guests spend an average of $7.01 per person per day in the LOWRL area.

Campers represent a relatively small proportion of the tourist market. Only 20 percent in 1968 and 22 percent in 1969 of all visitors traveling from the area had any kind of camping equipment. The average camper spends approximately half of what resort guests spend or $3.47 per day.

Sightseers as a general category include those interested in nature, history, and current communities. Sightseeing is

an important, growing component of travel motivation. While most tourists sightsee to an extent, only a small number travel to the LOWRL area primarily for this purpose. This small demand reflects the area's failure to promote itself as a sightseeing destination. Significantly, sightseers using motels are among the area's highest spending tourists.

Second home users are the second largest category of tourists. There are 640 second homes in Lake of the Woods, Koochiching, and Roseau Counties. Of these, 328 are owned by people residing in counties other than those in which their second home is located. Only 268, about 42 percent, are owned by individuals who reside outside the LOWRL area. According to a 1970 survey, second homes are used an average of 75 days annually by an average of four persons. Second home owners, the survey also revealed, spend $1,130 annually in the local county, and an estimated $720,000 is spent in the LOWRL area because of second homes. Only an estimated $300,000 is spent by second home owners from out of the area. While the latter figure applies to our study, the $720,000 amount is important because much of this money might not circulate in the local economy if the physical resources for second home sites were not available.

Fisherman, hunters, and marina users are difficult to enumerate because they are represented in most other categories, including those traveling for business purposes. Also, a large number of these travelers are day users—individuals who drive in for the day and return home instead of staying overnight.

Winter sportsmen travel to events such as snowmobiling races and hockey games, which generate major volumes of winter travel. The fact that participation in these sports largely takes place on weekends complements winter weekday business travel for auto, food service, and lodging facilities. Lodging operators report that winter weekend business sometimes surpasses mid-week volume. Individual snowmobile events have been estimated to result in over $30,000 of participant and spectator spending in a single community.

Individuals driving through the area, especially those enroute to Canada, are commonly regarded as a large group, although exact numbers are not known. These travelers represent potential tourists because they are vacationers who already prefer the north woods and waters. Upgrading services should increase sales to these individuals and transform their view of the area into that of a desirable destination.

Visitors to friends and relatives are often overlooked in the tourist picture. Visitors to the area were assumed to be in the same proportion to local population as for the entire U.S. population, and are estimated on that basis. When friends visit, it is common to eat out, go fishing, or picnic. So visitors may stimulate recreational expenditure and activities on the part of local citizens. For example, LOWRL restaurant guests who reported visits to friends and relatives as their primary reason for travel account for 10 percent of all summer restaurant sales.

Business travelers use the same food, lodging, and travel services as other tourists. Their reasons for travel may vary as much as the economic and social structure of the community. Apparently, many business tourists to the LOWRL area do not remain overnight in commercial lodging facilities, one of many questions left open for further study.

Table 4 shows data on the origins of tourists using services we selected for study in our survey. Note that

Table 3. Per person expenditures of tourists by type of lodging, Lake of the Woods-Rainy Lake area, 1970*

Expenditure items	Type of lodging		
	Hotels and motels	Resorts†	Camps
Lodging	$6.31	$3.24	$ .65
Food in restaurants and resorts	3.65	.61	.29
Groceries		1.21	.88
Auto expenses	2.42	.30	.67
Entertainment	.32	.08	.08
Fishing	.58	1.42	.80
Other		.15	.10
	$13.28	$7.01	$3.47
Average number per party	2.5	4.0	3.6

* Source: Survey conducted in summer 1970 in LOWRL area.
† Resort guests included those in both American plan and housekeeping resorts. The figure is an average for all resort guests.

Table 4. Origin of tourists, three selected market components, Lake of the Woods-Rainy Lake area, 1969

Origin	Out-of-area recreational traffic*	All motel registrations†		Out-of-area gas station customers‡	
		Summer	Entire year	Business	Recreational
				percent	
Minnesota	36	49	60	58	36
Illinois	13	8	5		
Canada	12	6	5		
Iowa	8	7	4	42	64
Wisconsin	7	4	5		
North Dakota	3	6	6		
All others	21	20	15		

* Analysis of highway traffic on main roads leading into LOWRL area, July-November 1969.
† Analysis of registrations, 1969.
‡ Survey data, July-September 1969.

Table 5. Dollar sales to tourists by service firms, Lake of the Woods-Rainy Lake area, 1970

Firm	Sales to tourists
Gasoline services	$3,100,000
Resorts	2,728,000
Restaurants and food services	2,025,000
Hotels and motels	701,000
Grocery stores	550,000
Other (taxes on second homes, expenditures for entertainment, sporting goods, medicine, fares, etc.)	1,330,000
Total	$10,434,000

much more business travel than recreational travel originates in Minnesota and that summer travelers came from a wider area than winter travelers.

SUPPLYING TOURIST SERVICES

For tourism to have economic impact in terms of profits, employment opportunities, and a tax base, services must be offered for sale to the traveler-tourist. Over 400 firms provide services directly related to travelers and tourists in the LOWRL area.

Most of these firms also serve the local population. Gasoline stations were found to make 37 percent of their total sales to out-of-the-area travelers. With tourist sales of $3,100,000, gasoline and related services accounted for the largest dollar volume of all firms. Over half of tourist sales were to those traveling for recreational purposes. An even larger proportion of tourist-related sales was made by restaurants: 54 percent of all sales was to customers from outside the LOWRL area. About 80 percent of tourist-related restaurant sales was to parties traveling into the area for recreational purposes. Grocery stores, which also serve local citizens and tourists, realized over an estimated $550,000 in sales to second home owners, campers, and housekeeping resort guests. The "other" category in table 5 includes an array of firms, agencies, and local economic components that profit directly from tourists.

Our study estimated that the $10,434,000 in tourist-related sales generated total local economic activity of $28.6 million, assuming that respending of every tourist sales dollar averaged $2.75 among local firms providing goods and services to businesses making direct sales to guests.

EXPANDING TOURISM

Identifying major features that make an area attractive as a travel destination is an important early step in expanding tourism. Principal steps in this process include development of major travel attractions. Markets and area resources must be analyzed and resources must be matched to the available market. The area must provide high quality services—restaurants, lodging, travel, rental equipment, etc.—and activities such as hiking, evening entertainment, hunting, fishing, sightseeing, tours, and the like. A set of sales programs must be established to sell the area and, finally, environmental quality management must be attended to—not only to appeal to travelers, but to improve the living quality for area residents.

FINANCIAL STATEMENT

MINNESOTA AGRICULTURAL EXPERIMENT STATION
RESEARCH FUND EXPENDITURES

Year Ended June 30, 1971

Expenditures by Source

	Percent	Amount
Federal Funds	14.9	$ 1,633,608
State Appropriations	63.0	6,916,468
Gifts and Grants	12.6	1,382,773
Fees, Sales, Miscellaneous	9.5	1,045,452
Total	100.0	$10,978,301

Expenditures by Object Classification

	Percent	Amount
Personal Services	68.7	$ 7,534,588
Travel	2.0	228,372
Equipment, Lands, Structures	5.7	625,272
Supplies and Expense	23.6	2,590,068
Total	100.0	$10,978,301

Expenditures by Location

	Percent	Amount
University Campus — St. Paul	84.0	$ 9,226,302
Branch Stations — within Minnesota	16.0	1,751,999
Total	100.0	$10,978,301

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