In this issue:
2 Water Resources Research
5 The Cost of Trucking Meat
6 Crop Residues Have Forage Potential
8 Supplementation: Livestock on Residues Need It
10 Home Economics' New Home
12 Meet Your Earthwatching Task Force
15 A Look at Nebraska's Export Picture
16 How To Protect Sheep From Flies
18 Can the Industry Really Afford Eggshell Waste?
20 25 Years of Foundation Seed
22 Why Farm Families Moonlight
23 Simulation and the Swine Producer
24 Areas of Excellence

On the cover:
Conservation and Survey staff inventory the state's natural resources, including mineral resources such as the limestone being mined and processed near Weeping Water by Hopper Bros. Quarries (foreground) and Kerford Limestone Co. (background). See story page 12. Photo by Jay Fussell.

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Water is one of Nebraska's most valuable natural resources. Because of its importance, water has been the subject of scores of research projects at the University of Nebraska-Lincoln over the years. Scientists have explored ways of managing and measuring its supply, conservation and quality and have helped define its role in the planning and development of land.

Agronomists, geologists, engineers and political scientists are involved in water research at the University as well as community planners and economists. Duplication of effort and lack of direction is largely eliminated because a single agency coordinates most of the water research done in Nebraska. It is handled by one unit of UN-L’s Institute of Agriculture and Natural Resources called the Nebraska Water Resources Research Institute (NWRRI).

The NWRRI acts as a liaison between persons interested in initiating water research and the scientists who can do it. Director Warren Viessman, Jr., and Administrative Assistant Karen Stork call on personnel from Experiment Station, Extension Service, UN-L colleges and staff members of other universities and colleges in the state to carry out actual projects.

An executive committee and an advisory committee made up of leaders in state government, private business and the University system assist the NWRRI by identifying research needs, maintaining communication with state and federal agencies, and guiding program development.

NWRRI’s role as research coordinator and clearinghouse for projects and funds is unique and somewhat complex. But its record of achievement is clear and impressive.

Since the Institute’s establishment by the Federal Water Resources Research Act of 1964, some 42 projects have been supported to explore water related problems.

Recent projects have produced the following:

—Information to help irrigators choose herbicides with the least environmental hazard.

—Computer models to study the content and flow of storm water runoff in urban areas.

—Information on how plants respond to different water levels from drought to flood. A drought selection technique developed from this project is helping plant breeders in Arizona, Texas, Illinois, India, Australia and Israel as well as Nebraska.

—A small, prototype waste management system which shows promise in reducing the organic strength of feedlot runoff.

These and other projects have been initiated to meet the NWRRI’s primary objectives: (1) to develop and conduct a program of basic and problem-oriented research; (2) to identify the water research needs of Nebraska; (3) to establish effective communications between the Institute and state and federal agencies, industries, educational centers and other organizations concerned with the water resources of Nebraska; (4) to provide advice and assistance on water-related problems; and (5) to (continued on next page)
Water Resources...

disseminate information to University departments, state and federal agencies and other organizations and the public.

The NWRRI receives an allocation each year from the Office of Water Research and Technology in the U.S. Department of Interior. These funds are reallocated to researchers on the basis of competitive project proposals.

The NWRRI can help state agencies find competent researchers for specific problems and can also develop project proposals upon request.

In addition, the Institute publishes reports, technical and popular articles, press releases, and a monthly newsletter. NWRRI sponsors seminars and continuing education programs, and researchers speak to scientific and lay groups interested in water resources research.

In addition to the funds provided by the U.S. Department of Interior, the Institute also receives income from contract research. Currently three contracts are in progress.

The Bureau of Reclamation is providing funds for a financing feasibility study on water resources projects which might emerge from the Platte River Basin Level B Study. The contract calls for identifying all possible sources of funding for water resources projects in the state.

The Old West Regional Commission is funding two projects, “Energy Reduction Through Improved Irrigation Practices” and “Water Quality Study of Runoff from Agricultural Lands.” Results of these projects should be useful to farmers in improving irrigation efficiency and controlling runoff pollution.

In its state-funded watershed modeling program, the NWRRI has developed generalized watershed models for planning, design and management. It also has trained state agencies and other personnel in the use of these techniques, translated findings into operational manuals, and acquainted the public with results.

A working model of the basic hydrologic system of a portion of the Upper Big Blue River Basin has been developed cooperatively with the Conservation and Survey Division (see “Power of the Water Model” in the Fall 1974 issue of the Quarterly). Declines in groundwater levels and pressure for an expanded irrigation agriculture economy have prompted state legislators and others to turn to this project for assistance.

State and federal agencies are becoming increasingly aware of the research support the NWRRI can provide. For example, the Institute is assisting the Planning Board of the Platte River Basin Level B Study by assessing alternatives for various objectives of development. This research has encouraged several of the state’s Natural Resources Districts to explore the feasibility of conducting similar studies in their respective areas.

The Nebraska Water Resources Research Institute is a focus for coordination, identification, implementation and dissemination of water-related research. In the future, the Institute will play an expanded role in the development, planning and management of the state’s water resources.
The Cost of Trucking MEAT

Truck transportation is a crucial link in the chain of activities that brings meat and meat products from Nebraska to consumers all over the United States. Nearly all livestock and approximately three-fourths of the meat transported from Nebraska are moved by truck. Nebraska's competitive position in the livestock industry depends in part on the cost of these trucking activities.

Higher transportation costs tend to put producing areas most distant from consumer markets at the greatest disadvantage. Rising energy costs, slower highway speeds and avoidable regulatory costs merit careful scrutiny by the livestock industry.

Meat produced in Nebraska is shipped to virtually every state in the nation and to many foreign countries, more than half of it to major consumer centers on the east and west coasts.

Trucks took more than 76 percent of the estimated 52 million pounds of meat shipped from Nebraska during a “typical” week, while 18 percent went by truck trailers aboard rail flatcars. The remaining 6 percent went by railroad refrigerator cars. Forty-two percent of the truck shipments went 1,000 miles or more.

Packers usually contract with meat trucking firms for their transportation needs. The interstate operations of these firms are regulated by the U. S. Interstate Commerce Commission (ICC). The number of interstate trucking firms is limited, depending on the number of permits which the ICC has seen fit to issue.

In return for insulating the firms against potential new competition, the ICC must approve rates charged and services rendered by these firms. Permits are limited in number, but they are transferable and frequently have a substantial cash value. Trucking firms frequently lease their operating rights from a permit holder, paying a fee based on gross trucking revenue.

Costs of trucking meat from Nebraska to east-coast destinations in mid-1973 ranged from $2.52 to $4.29 per cwt. The cost variation resulted primarily from differences in the number of payloads trucks were able to haul each year. The cost estimates are exclusive of permit-leasing fees, and are based on the assumption that all round-trip expenses, except a small allowance for out-of-the-way travel in picking up backhauls, are assigned to meat. Cost estimates may be liberal if backhaul revenues are substantial.

(continued on next page)
Crop Residues Have Forage Potential

L. J. Perry, John Ward, and Kenneth Von Bargen

Crop residues offer Nebraska’s beef industry an economical alternate roughage source. Crop residue is that plant material (forage) remaining in the field following grain harvest. Since it is a low quality fibrous type forage, it is used by ruminant animals as an energy source. Protein levels tend to be lower than animal requirements depending on the type of forage, time of utilization, age and stage of production of the animal being fed.

Crop residues normally are used to complement an existing forage-livestock program. With proper supplementation they may be used as the forage base throughout a livestock program. Grazing of crop residues is usually limited to the time between grain harvest and seedbed preparation and is dependent upon favorable weather conditions. Thus, they serve as an inflexible forage resource unless collected for livestock use at another time.

Crop residues are used a number of ways. Beef cows and yearlings graze them. Sometimes residues are collected and harvested for emergency roughage for grazing animals during inclement weather and as supplemental feed, possibly replacing hay. Residues are also used as roughage for partial or total drylot programs for beef cows.

Corn is the most abundant crop residue followed by wheat and grain sorghum. Corn and grain sorghum residues are primarily grazed by animals rather than machine collected. Oats, millet, and wheat straw are often machine collected and used as supplementary roughage. Little use is made of soybean residue at present, although it may be used in the future. Sugar beet tops in Western Nebraska are used to a greater extent than other crop residues in the state.

Corn residue carrying capacities normally average between 1½ and 2½ acres per cow during the fall and early winter grazing season, which is usually 80 to 100 days. Carrying capacity on grain sorghum is usually between 2 and 3 acres per cow.

As a result, Nebraska corn and grain sorghum acreage is capable of carrying between 3½—4 million cows during the residue grazing season. This residue is not being fully used as beef cow numbers are lowest in those areas of the state where corn and grain sorghum acreages are greatest (Table 1). Currently, available corn and grain sorghum residues are being used to the greatest degree in the Northwest, North, Southwest, and Central Districts as indicated by relatively high cow and/or yearling numbers relative to crop residue acreage (Figure 1).

Crop residue forage supply will likely increase in the future because of the demand for feed grains and expected increase in irrigated feed grains. This additional acreage will likely occur in those districts with high cow and/or yearling numbers. The available crop producing land is

Trucking...

Large firms were only slightly more efficient than smaller ones. A 10-truck firm operating at 100-per cent capacity (42 long-haul trips per year) experienced costs only 31 cents per cwt higher than a 300-truck firm operating at full capacity. Reduction of truck utilization to 40 percent of capacity increased costs for the 10-truck firm by $1.56, from $2.73 to $4.29 per cwt; costs for the 300-truck firm increased from $2.52 to $3.75.

An increase in diesel fuel prices of 20 cents per gallon since the study was begun has raised trucking costs by 38 cents per cwt (each additional 5 cents per gallon adds about 9.5 cents per cwt to delivered meat costs).

The reduced speed limit cuts truck utilization rates by reducing the number of loads which can be delivered per year. The reduced speed rate adds another 27 to 34 cents per cwt, to costs depending on fleet size, due to higher average fixed costs. If drivers’ wages are increased in compensation for reduced annual mileage (drivers are normally paid a mileage rate) trucking costs increase another 31 cents per cwt. The resulting total cost of energy-related factors—higher fuel costs and reduced speed limit—is approximately $1.00 per cwt of delivered meat.

Another significant cost of meat trucking is found in the leasing of permit rights. Holders of ICC contract-shipping permits commonly receive 25 percent of gross carrier revenues in payment for use of their permit privileges. Since the regulated rate (in effect prior to the energy crisis) for shipments to the east coast was approximately $3.20, the cost of the permit amounts to about 80 cents per cwt of delivered meat.

The permit cost is incurred as a direct result of government regulation and might be avoided in the absence of such regulation. The rather modest economies of size—31 cents per cwt savings for a 300-truck firm over costs of a 10-truck firm—suggest that competition might be enhanced by deregulation and shipping rates reduced.

While these costs are not large relative to the total cost of producing and marketing meat, the effect on Nebraska’s competitive position may be significant.
Table 1. Beef cow numbers, 1963 and 1973, and corn and grain sorghum acres for 1973 in Nebraska by crop reporting districts.

<table>
<thead>
<tr>
<th>District</th>
<th>1963 Cow Numbers</th>
<th>1973 Cow Numbers</th>
<th>1973 Corn</th>
<th>1973 Grain Sorghum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thou.</td>
<td>Thou.</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Northwest</td>
<td>261</td>
<td>286</td>
<td>112</td>
<td>5</td>
</tr>
<tr>
<td>North</td>
<td>509</td>
<td>523</td>
<td>242</td>
<td>20</td>
</tr>
<tr>
<td>Northeast</td>
<td>127</td>
<td>232</td>
<td>1,456</td>
<td>52</td>
</tr>
<tr>
<td>Central</td>
<td>206</td>
<td>288</td>
<td>765</td>
<td>60</td>
</tr>
<tr>
<td>East</td>
<td>119</td>
<td>207</td>
<td>1,628</td>
<td>644</td>
</tr>
<tr>
<td>Southwest</td>
<td>189</td>
<td>231</td>
<td>374</td>
<td>83</td>
</tr>
<tr>
<td>South</td>
<td>96</td>
<td>143</td>
<td>531</td>
<td>329</td>
</tr>
<tr>
<td>Southeast</td>
<td>116</td>
<td>185</td>
<td>742</td>
<td>867</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,623</strong></td>
<td><strong>2,095</strong></td>
<td><strong>5,850</strong></td>
<td><strong>2,060</strong></td>
</tr>
</tbody>
</table>

Cow numbers have been increasing most rapidly in the presently high feed grain cropping districts. If this trend continues, utilization of crop residues will certainly increase in those districts.

Warm season grass grazing is the dominant summer program in the western two-thirds of Nebraska. Increased production has occurred during the past few years through management practices, primarily through intensive production of grass under center pivot irrigation. Increasing cow numbers in the grazing area of the state with irrigated forages has great potential. However, it appears that better use of crop residues in the farming areas of the state may provide greater potential for increasing cow numbers than will be available in the traditional grazing areas.

As the demand for roughage increases, livestock operators will likely make more and better use of crop residues. Collection of crop residues may increase in the future although this method appears dependent on a variety of factors. The major ones are energy costs and availability, equipment, feasibility of drylotting or partial drylotting of beef cows, crop residues being used as a roughage source in feedlots, alternate forage costs and availability, and demand for beef.

Collecting crop residues results in removal of half or more of the above ground material, depending on the type of machine used. Roots and remaining crop material are available for return to the soil. Grazing of crop residues uses only 20 to 35 percent of the above ground material depending on stocking rates. Thus, much more material remains for soil incorporation following grazing than when residues are harvested mechanically.

Fig. 1 Ratio of corn and grain sorghum acreages to beef cow numbers by crop reporting districts.
Supplementation:
Livestock on Residues Need It

John K. Ward

Energy, protein, vitamin A, phosphorus and possibly other minerals may be deficient when animals are restricted to rations based on crop residues.

Due to characteristics of crop residues such as bulk, lower palatability, lower digestibility and limited content of available energy and protein, it is necessary to provide certain kinds of supplementation based on performance expected of animals grazing or being fed these materials.

The energy needs of a 1,000-pound gestating cow are approximately 7.6 lb of total digestible nutrients (TDN), or 12.4 Mcal, but increase to 12.5 and 20.4 respectively, for a lactating cow giving approximately 12 lb of milk. The in vitro digestibility of corn stalklage will range from 45-60 percent. This level of available energy is not adequate for young cows or for the support of lactation in the beef cow. Therefore, crop residues that are not supplemented with additional energy are best suited for mature cow maintenance rations.

Cows grazing crop residues in early fall pick up enough grain or by selected grazing obtain the more highly digestible fraction of the plant. Therefore, they may take in energy above maintenance levels.

If a cow is supplemented with protein, vitamin A and minerals she may gain as much as 1 pound a day when first turned into corn or grain sorghum stalks. In open winters with adequate stalk grazing, cows may gain weight without any additional energy supplementation. Composition of selected crop residues is shown in Table 1.

Lactating cows either grazing or being fed crop residues will need an additional energy source to show early estrus and reproduce efficiently. The nutritionally critical period for the cow post-calving begins shortly after calving and lasts through the breeding season. Results of an experiment at the University Field Laboratory at Mead indicate that Angus-Herford crossbred cows needed approximately 4 pounds of corn daily to maintain body weight during early lactation. If cow weight gain is expected during lactation, a slightly higher level of corn with adequate protein supplementation would be necessary.

Protein levels (4.5 to 5.0 percent) found in corn or grain sorghum residue would probably be adequate for the mature gestating cow early in the grazing season when grain and the more highly digestible portion of the plant are available. Since the protein needs of the lactating cow are about 9.2 percent, feeding lactating cows nothing but crop residues would result in a protein deficiency.

It appears that approximately 0.5 pounds of supplemental crude protein equivalent (CPE) is needed daily by gestating cows on crop residues during most winters. This quantity of CPE can be supplied either through high protein forages or protein supplements. Natural protein produced slightly greater winter gains than when non-protein nitrogen (NPN) was used.

JOHN K. WARD is Associate Professor of Animal Science.
These cattle, wintering on crop residues, are being fed a cubed supplement.

Nebraska cattlemen should not overlook the possibilities of using legume or high quality grass hay as protein sources. Good quality alfalfa hay may be worth approximately $75 per ton as a protein source when 32-percent commercial supplement costs $178 per ton. In addition to its value as a protein source, alfalfa also is a good source of energy, minerals and may contain significant quantities of carotene as a source of vitamin A.

Liquid supplements are being used to supply NPN to cattle grazing corn or milo stalks. Efficiency of NPN utilization seems to be somewhat lower than from natural protein; however, further research is needed in this area.

The relatively low digestibility of crop residue raises questions about the availability of minerals in the forage. Grain, which is highly digestible, is the only part of the corn or grain sorghum plant furnishing a significant quantity of phosphorus. Cows grazing these crop residues should be fed a supplement supplying at least half of the necessary phosphorus with calcium a possible deficiency particularly for immature cattle.

The trace mineral content of crop residues may be adequate, but until research demonstrates levels and availability of these minerals, they should be supplied in the mineral mixture or the protein supplement being fed.

Both gestating and lactating cows should be supplied with their full vitamin A requirements while grazing or being fed crop residues which have little vitamin A activity. This can be done through the protein or mineral supplement or by intra-muscular injection. When used with a protein supplement approximately 30,000 IU of vitamin A per pound should be fed. With salt about 1 million IU of vitamin A per pound would be adequate. As an injection 2 million to 3 million IU 40-60 days pre-calving or at 90-day intervals should be adequate.

Table 1. Composition of crop residues (dry matter basis).\(^1\)

<table>
<thead>
<tr>
<th>Material</th>
<th>Grade protein</th>
<th>Total digestible nutrients</th>
<th>IVDP(^2)</th>
<th>Calcium</th>
<th>Phosphorus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percent</td>
<td>Percent</td>
<td>Percent</td>
<td>Percent</td>
<td>Percent</td>
</tr>
<tr>
<td>Corn stalks</td>
<td>3.7(^3)</td>
<td>—</td>
<td>51(^3)</td>
<td>.28(^3)</td>
<td>.11(^3)</td>
</tr>
<tr>
<td>Corn shucklage</td>
<td>3.7(^3)</td>
<td>—</td>
<td>65(^3)</td>
<td>.16(^3)</td>
<td>.08(^3)</td>
</tr>
<tr>
<td>Corn stover</td>
<td>4.2(^3)</td>
<td>59(^3)</td>
<td>56(^3)</td>
<td>.37(^3)</td>
<td>.12(^3)</td>
</tr>
<tr>
<td>Corn cobs</td>
<td>2.8(^3)</td>
<td>47(^3)</td>
<td>60(^3)</td>
<td>.04(^3)</td>
<td>.06(^3)</td>
</tr>
<tr>
<td>Grain sorghum stalks</td>
<td>3.6(^3)</td>
<td>—</td>
<td>57(^3)</td>
<td>.29(^3)</td>
<td>.08(^3)</td>
</tr>
<tr>
<td>Grain sorghum stover</td>
<td>4.7(^3)</td>
<td>57(^3)</td>
<td>54(^3)</td>
<td>.37(^3)</td>
<td>.12(^3)</td>
</tr>
<tr>
<td>Soybean stalks</td>
<td>4.0(^3)</td>
<td>—</td>
<td>35(^3)</td>
<td>.73(^3)</td>
<td>.09(^3)</td>
</tr>
<tr>
<td>Soybean stover</td>
<td>4.0(^3)</td>
<td>38</td>
<td>35(^3)</td>
<td>.96(^3)</td>
<td>.10(^3)</td>
</tr>
<tr>
<td>Wheat straw</td>
<td>3.6</td>
<td>48</td>
<td>—</td>
<td>.17</td>
<td>.08</td>
</tr>
<tr>
<td>Oat Straw</td>
<td>4.4</td>
<td>52</td>
<td>—</td>
<td>.33</td>
<td>.10</td>
</tr>
<tr>
<td>Beet tops</td>
<td>16.0</td>
<td>64</td>
<td>—</td>
<td>1.02</td>
<td>.24</td>
</tr>
</tbody>
</table>

\(^2\)In Vitro Dry Matter Digestibility.
Above, above right, and below, state Extension specialists (standing) use workrooms to train Extension home economists.

Below, toilet facilities for a handicapped person are provided in the rehabilitation laboratory.

Home Economics’ New Home
Extension and research gain space
By Marcia Pearson

The College of Home Economics has a new home—a modern, three-level building on the University of Nebraska–Lincoln’s East Campus. A total of $1.7 million from the Nebraska Legislature, plus a $70,000 grant from the Department of Health, Education and Welfare, provided the College with classrooms, laboratories and offices in a building that has many unique features.

Probably the greatest single boost the new facility has given to home economics research and Extension programs is elbow room. Extension specialists now have sunny, spacious rooms in which to develop materials and train county and area Extension home economists. Researchers have quiet study areas, storage room, and places to use specialized equipment.

Two home economics departments not housed in the new building will benefit from extension renovation of the adjacent Food and Nutrition Building. Both departments will gain Extension workrooms. Food and Nutrition will have newer labs with better plumbing, a dormitory for 10 subjects for live-in human studies, offices, and a Community Nutrition Laboratory. Human Development and the Family will gain observational research facilities, work rooms, and office space.

MARCIA PEARSON is Assistant Extension Editor.

Below left, specially designed kitchen for rehabilitation research and teaching; Below right, a quiet place for Dept. of Education and Family Resources research.
Left, Dr. Joan Laughlin tests fabric flammability with new equipment—a flame cabinet and fume hood; Above, new equipment to test a fabric’s tendency to pill; Right, a graduate student tests carpet flammability in another fume hood.

Above, room for testing fabrics in controlled temperature and humidity; Above right, equipment to show the effect of different lights on fabric; Below left, private area for interviews for clothing research; Below right, a clothing researcher in the video taping area.
Meet Your EARTHWATCH

By Jay Fussell

Someone once commented that in making any decision, it never hurts to have the facts.

And digging up the facts about Nebraska's natural resources is what makes the Conservation and Survey Division your earthwatching task force, a task force whose gauges, meters, recording equipment, and staff are monitoring various parts of Nebraska's natural resources on a round-the-clock basis.

Your team of earthwatchers has been at its task of collecting natural resources information for more than half a century. The results of its many surveys, investigations, and research projects are shared with all Nebraskans.

Such investigations provide basic information about Nebraska's natural resources to political leaders, scholars, businessmen, and interested citizens—all toward the end of furnishing accurate, up-to-date information useful in development, management, and conservation of the state's natural resources.

In a season of perennial shortages, when new values are placed on energy and food, it takes less than a clairvoyant to see the growing importance of Nebraska's agriculture on the world scene and to realize that the state's agriculture is in turn built on a base of natural resources.

The truly remarkable thing is not that this vision has been granted to modern citizens but
rather that farsighted statesmen in Nebraska looked ahead to this day back in 1921. For it was then, in a state barely 54 years old, that the Nebraska State Legislature saw the need for keeping a running inventory of the state’s natural resources.

The Conservation and Survey Division was established and lodged administratively in the University of Nebraska:

- to investigate and record information about the geologically related natural resources of the state;
- to inventory, analyze, and evaluate the groundwater supplies of the state;
- to investigate and analyze the mineral and rock deposits of the state;
- to assist public, private, and government agencies working to conserve our natural resources;
- to study the geologic history of the state as an aid to growth and economic development;

(continued on next page)
Earthwatching . . .

- to publish maps and reports about these activities.

The Conservation and Survey Division has developed a data base for a variety of natural resources in Nebraska. It provides, on the basis of geologic and natural resources surveys, information on water availability, water quality, soils and their uses, weather, mineral resources including oil and gas, and other geologic data.

In addition, the Conservation and Survey Division is a repository for samples and cores, geophysical logs, and other geologic information from approximately 12,000 deep wells drilled for oil and gas by private industry. These geologic records constitute an important part of the resource base of the Division. They are used by staff geologists in basic research projects and are frequently consulted by drillers, land owners, geologists, and others representing the private sector.

Groundwater Studies

In 1981 this agency in cooperation with the U.S. Geological Survey began a program to study the groundwater resources of the state. This led to a program of drilling test holes throughout the state in order to gather information about groundwater supplies, mineral deposits, water levels, soil composition, rock structure, irrigation possibilities, and many other geologic matters of practical importance. Approximately 3,500 test holes have been drilled in the state since that time, putting Nebraska among the national leaders in this undertaking.

While some staffers are gathering geologic information from depths as great as 10,000 feet, others are collecting data from the first Earth Resources Technology Satellite (ERTS-1) orbiting around 565 miles above our heads. From the new Remote Sensing Center comes information that enables staff members to inventory such things as the state's center pivots, wetlands, land use activities, and fault lines important in the siting of dams, nuclear power plants, and other large structures.

In a cooperative water program with the U.S. Geological Survey, staffers help to collect 10,000 water-level readings throughout Nebraska annually.

Soil surveys undertaken cooperatively within the Soil Conservation Service of the U.S. Department of Agriculture have been prepared in modern format for approximately half the state, with plans for completing the job for all 93 counties as soon as possible, hopefully within a decade.

Nearly a century of daily weather records kept by climatologists.

In the climatology office, where records go back to 1878, weather data are collected 24 hours each day to furnish today's scientists, farmers, and businessmen with weather information needed for estimating building periods in new construction, in projecting planting and harvesting times for crops, in wildlife management, in tree-planting programs, and in many other practical endeavors.

Groundwater development and management, county soil surveys, and land use inventory are examples of current programs in which the newly created Natural Resources Districts have an active interest and work cooperatively with the Conservation and Survey Division.

Computer modeling of groundwater supplies and the inventorying of natural resources through the use of satellite imagery in the Remote Sensing Center are current program uses for new data-handling tools.

"People from our Division have set foot on just about every piece of property in the state," says Vincent H. Dreeszen, Director and State Geologist.

Because the welfare of Nebraska rests largely on an agricultural economy which in turn is built on a base of natural resources, the state legislature voted in 1973 to make the Conservation and Survey Division one of the units of the newly created Institute of Agriculture and Natural Resources. It is thus strengthened administratively within the University context and, in terms of services rendered, throughout the state.

"We try to satisfy all inquiries," says Director Dreeszen. His constant admonition to his staff is: Be honest with the data. At times this leads staff members to an overkill in assembling information. But, comments Dreeszen, this is preferable to making a mistake that could be costly to the citizens of the state.

"The biggest measure of our success," he says, "is that we seldom hear about the results of our recommendations." And as State Geologist, he knows that if he or his staff should make a mistake, they would certainly hear about it. So the absence of feedback is possibly one of the greatest compliments paid these earthwatchers.

The information bureau of the Conservation and Survey Division publishes resource reports, survey papers, reports of investigations, open-file reports, bulletins, maps, atlases, educational circulars, guidebooks, flyers, audio-visual aids, articles, and news releases.

Answers to Questions

These complement the personal counseling services and educational program consultations that research the needs and queries originating from individuals and groups. All Nebraskans who have natural resources questions are invited to visit, call, or write the Conservation and Survey Division at 113 Nebraska Hall on the campus of the University of Nebraska–Lincoln or at the University of Nebraska's Panhandle Station, 4502 Avenue J, in Scottsbluff.

"Your questions don't have to be earth-shaking," points out Dr. Marvin P. Carlson, assistant director, adding, "although we do have data on earthquakes too."
A Look at NEBRASKA'S EXPORT PICTURE

P. W. Lytle and Dennis L. Nun

Exports from Nebraska farms have increased dramatically in recent years. However, cancelled and renegotiated sales and other uncertainties about the export market could seriously affect the future incomes of Nebraska farmers.

Total exports of feed grains, wheat and flour, soybean and protein meal products, and meat products from the state in fiscal 1974 (year ending June 30, 1974) have been estimated by the Economic Research Service, USDA, at $938 million. This represents a 354-percent increase since fiscal 1968 and an 85-percent increase over the previous year.

The $938 million of exports accounts for just over 25 percent of the $3,709 million value of the 1973 production of these commodities in Nebraska. These exports represent almost 17 percent of the exports from the Great Plains and over 6 percent of the value of exports from the United States of these products.

Feed grain exports from Nebraska in fiscal 1974 have been estimated at $497 million, a 459-percent increase over fiscal 1968 and nearly a 105-percent increase over fiscal 1973. The value of exports of feed grains is almost 33 percent of the $1,530 million value of 1973 production in the state. Nebraska provided nearly 35 percent of the value of feed grains exports from the Great Plains and almost 11 percent of those from the United States.

Exports of wheat and flour products from Nebraska in fiscal 1974 ranked second to those of feed grains at $261 million. This was a 259-percent increase over fiscal 1968 exports and an 85-percent increase over those for fiscal 1973. The importance of foreign markets for wheat is underscored by the fact that over 76 percent of the value of 1973 production in Nebraska was exported. These exports accounted for nearly 8 percent of the value of wheat exports from the Great Plains and almost 6 percent of this value from the United States.

Soybean and protein meal products exports from the state in fiscal 1974 increased 693 percent since fiscal 1968 and 78 percent since fiscal 1973 to $107 million. Exports from the state accounted for nearly 56 percent of the value of Nebraska's 1973 soybean crop. Nebraska provided almost 37 percent of the value of soybean and protein meal exports from the Great Plains but only just over 2 percent of the exports from the United States.

The estimated value of exports of meat products from Nebraska in fiscal 1974 is $73 million. This market has grown 131 percent since fiscal 1968 and nearly 20 percent since fiscal 1973, even though it accounted for only slightly more than 4 percent of the production value in the state for 1973. Nebraska supplied 14 percent of the meat products exported from the Great Plains and nearly 6 percent of meat exports from the United States last fiscal year.

The dollar values shown here have not been discounted for changes in agricultural prices since 1968. Increased dollar activity in exporting is evident, determining purchasing power changes would require deflating the export values.

Corn and sorghum production declined radically, soybean production decreased, and wheat production increased in Nebraska this year compared to 1973. There appears to be an increased tendency for farmers to store grain instead of selling it for cash at harvest.

On the grain demand side, estimates in early fall 1974 indicated lower farrowing intentions and reduced numbers of cattle on feed in Nebraska as compared with a year ago. There was, however, an increase in the value of agricultural exports from the United States for July-August 1974, due mostly to price increases. The export value of soybeans and soybean products increased, but the export volume of wheat and feed grains decreased during these months compared to the same period in 1973.

Several factors create uncertainties about the future of the export market for agricultural commodities. For example, developing countries may not be able to pay for historically high-priced grains. The future policies of the United States about long-term loans and aid programs also will affect exports to these countries.

Developed countries may not choose to pay higher prices for agricultural exports from the United States. Also, future agricultural production levels of these countries and their commitment toward improved diets will affect the export market.

P. W. Lytle is Associate Professor and Dennis L. Nun is a graduate student in Agricultural Economics.
with either Cooper Screwworm Wound Dressing or Korlan Ear Tick Spray to mark the fly feeding sites and to speed up the healing.

The procedure was varied slightly in the 1974 trials. Shearing with a nine-tooth comb was started July 15, and the lambs were weighed after shearing prior to insecticide application. Korlan was replaced with Delnav (dioxathion) at a rate of 1/5 gal. 0.5 percent per lamb. The lambs were divided into 8 groups of 44 lambs. The groups consisted of 22 Hampshire and 22 Corriedale or Corriedale-Hampshire crossbreds. One half of each breed within each group was washed as described for the 1973 trials.

The treatments were Ciovap spray 1/5 gal. 0.5 percent per lamb, Delnav as mentioned above, forced use of Ciodrin 3-percent dust and no treatment. Each treatment was replicated. Fly feeding counts were made on the lambs at 3 days and again at 5 days post-treatment.

Ciovap, Korlan and Delnav all provided fly feeding control of at least 90 percent (Table 1). The treatment with forced use of dust was the most variable of the insecticide treatments and averaged about 75 percent fly feeding control.

The effect of washing the lambs prior to treating was negligible.

The 264 lambs in the second trial which had one of the insecticide treatments had an increase average daily gain (ADG) of .27 lb. over the 88 untreated lambs for the 9-day trial period. The increase performance ranged between 7.5 percent and 44.8 percent greater than the untreated lots, with those treated with the dust being the highest and the Ciovap group the least. It was observed that there was more irritation and coughing with the Ciovap treatment.

Because of our success with relatively simple methods of fly control, we recommend that producers try them if they will be shearing lambs in the summer. Insecticides and dust bags used in our research are readily available through farm supply stores.
Can the industry really afford 

EGGSHELL WASTE?

T. W. Sullivan, G. W. Froning

Nebraska's egg processing industry, a national leader in volume of production, uses about 2.5 million eggs daily. Processing this quantity of eggs leaves 30,000 to 35,000 pounds of eggshells for disposal. Shells are first centrifuged to remove all possible albumen, then are transferred with an auger-conveyor to a dump truck and hauled to sanitary landfills or farm land.

Little value is realized from eggshells following these procedures except the possible "liming effect" on farm land. Furthermore, transportation of eggshell waste from processing plants is an added expense for the processor.

Could eggshell waste be used in the production or manufacture of useful products? Probably so. Dried eggshell meal contains 6.41 percent protein, 33.0 percent calcium and .09 percent phosphorous. Protein with its component amino acids and calcium are nutrients needed in all poultry and livestock rations.

Producing meal

Eggshell meal or flour can be produced easily. Shells are dried at temperatures as high as 800°F, which would stop any microbial growth. After dehydration, the shell is ground in a hammer mill. The resulting product is an excellent source of calcium for poultry rations as demonstrated in feeding trials conducted at the University of Missouri and at Southern Illinois University.

The protein content of eggshell meal, which is derived from the shell membranes, should not be overlooked, especially in meals processed at lower temperatures. During the past 2 years, soybean meal has been selling for $200 to $300 per ton, depending on weather reports, export sales, speculators and other economic factors. When the current prices of ground limestone ($20/ton) and soybean meal ($160 to $180/ton) are considered, eggshell meal is

T. W. SULLIVAN and G. W. FRONING are Professors of Poultry and Wildlife Sciences; they acknowledge the help of graduate students H. J. KUHL and F. J. STRUWE.
worth at least $40 per ton as a poultry feed ingredient.

Another more valuable feed ingredient, which could be produced from eggshell waste, is phosphated eggshell, (5 percent protein, 19 percent phosphorus and 25 percent calcium.) Phosphated eggshell has been produced in the laboratory on a small scale by reacting equal parts of eggshell meal and concentrated phosphoric acid. The resulting material was oven dried at 200°F, ground, screened and evaluated as a phosphorus and calcium source in turkey starter rations. Two experiments of four weeks duration were conducted.

**Excellent Source**

Results from one feeding trial with phosphated eggshell are presented in Table 1. These data clearly show that phosphated eggshell is an excellent source of phosphorus and calcium for body weight gain, bone development and feed efficiency in young turkeys. This product compared favorably with mono-sodium phosphate, a standard reference compound which has a high feed value. Phosphated eggshell would be quite suitable as a replacement for feed grade dicalcium and defluorinated phosphates, which are now selling for $175 to $195 per ton. When current prices of feed grade phosphates and soybean meal ($160 to $180/ton) are considered, phosphated eggshell should be worth at least $200 per ton as a feed ingredient.

It should be mentioned that specially adapted equipment would be needed to make phosphated eggshell from concentrated phosphoric acid and dried eggshell meal, specifically, a small, rotary-type kiln similar to that used to make fertilizer and feed phosphate.

The big question is whether the poultry and feed industries can afford to bury an estimated 30,000 to 35,000 pounds of eggshells daily in Nebraska. The high cost of protein and phosphates plus increasing transportation costs would argue against the current eggshell disposal procedures.

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**Table 1. Comparative evaluation of phosphated eggshell and monosodium phosphate in a four-week feeding trial with starting turkeys.**

<table>
<thead>
<tr>
<th>Item</th>
<th>Avg. body wt. at 4 weeks</th>
<th>Percent of Bone ash at 4 weeks</th>
<th>Feed/gain 0-4 weeks</th>
<th>Relative value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phos. eggshell</td>
<td>590g (1.3 lb.)</td>
<td>42.8</td>
<td>1.67</td>
<td>99.5</td>
</tr>
<tr>
<td>MSP</td>
<td>591g (1.3 lb.)</td>
<td>43.0</td>
<td>1.62</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*MSP, mono-sodium phosphate, was the reference standard in this feeding trial.*
Good seed is basic to good crops, the premise upon which the University of Nebraska's Foundation Seed Division has built a quarter century of service. Since 1949 the Division has helped improve and distribute superior crop varieties and hybrids developed by the Agricultural Experiment Station and the Agricultural Research Service to seed producers and farmers.

Last fall the Division marked its silver anniversary by dedicating its newly developed seed processing and warehousing facilities at the NU Field Laboratory near Mead. The plant incorporates all of the newest and innovative processing and bagging equipment necessary to distribute foundation seed.

The Foundation Seed Division fulfills two important purposes: to increase small lots of breeder seed of new varieties to amounts that will allow rapid and equitable distribution to seed producers and ultimately to Nebraska farmers; and to maintain supplies of pure foundation seedstocks of established crop varieties and hybrids.

When the organization began it was known as the Nebraska Certified Hybrid Seed Corn Producers Association, and its job was to develop foundation seed supplies of corn.

During the early years hybrid corn seedstock and wheat varieties were the backbone of the program. The advent of hybrid sorghum in 1956 created a surge in the program. Parent seed of sorghum was distributed to Texas, Kansas, Colorado, Indiana and India.

In the late 1950's, Sioux and Warrior, two excellent new wheat varieties, were adapted to western Nebraska. A limited amount of breeder’s seed was produced on select, clean fields of certified seed growers in the Panhandle, a successful enterprise that afforded a rapid increase of seed supplies for western Nebraska and Colorado seed producers.

The Division’s main field opera-


tion was established at the Field Laboratory at Mead in 1962. Within 10 years a first-class, small grain processing plant and a corn seed processing plant were installed and wheat seed varieties were being developed and distributed.

Probably the Division’s most notable achievement has been its work with the variety of wheat called “Centurk.”

Centurk wheat was selected by wheat breeding scientists at the Nebraska Agricultural Experiment Station from a cross made in 1959. Additional testing of the variety followed, and in 1969, 3½ bushels of breeder seed of Centurk were turned over to the Foundation Seed Division to increase as rapidly as possible for the benefits of Nebraska Agriculture.

These 3½ bushels of breeder seed were planted in 40-inch rows with a seeding rate of as low as 9 pounds per acre. Normal rainfall, supplemented with irrigation, high fertility rates, cultivation for weed control and improved harvesting and processing methods all contributed to a final yield of 1,061 bushels of foundation seed in 1970.

In the fall of 1970, the 1,061 bushels of foundation Centurk were distributed by the Nebraska Agricultural Experiment Station and the Nebraska Foundation Seed Division to certified seed producers in Nebraska and to Foundation Seed Organizations in nine other states. In 1974, Centurk wheat seed was planted on 31 percent of the wheat acreage in Nebraska indicating a rapid seed increase and variety acceptance by Nebraska farmers.

The future for the Foundation Seed Division includes the increase of new varieties of all crops developed by the Experiment Station to sufficiently large amounts that will allow rapid and equitable distribution to certified seed producers and ultimately to Nebraska farmers. In 1974, 16 new crop varieties will be increased as prospective varieties for Nebraska agriculture.

Foundation seed crops are produced at several locations in Nebraska to minimize risk of crop failure due to climatic conditions and to provide adequate isolation necessary to insure genetic purity.

The increase of foundation seed is largely at two locations. The major production area is at the University of Nebraska Field Laboratory at Mead, where all foundation seed is processed and warehoused for distribution. A second production area is the Foundation Farm at Genoa.

Other seed production areas include the Panhandle District Station at Scottsbluff, the High Plains Agricultural Laboratory at Sidney, and the North Platte Station at North Platte. Foundation seed specialty crops such as alfalfa and dry bean seed are increased in Idaho, California and Washington.

WARREN SAHS is Assistant Director of the Agricultural Experiment Station.
Left, pianos now occupy the Foundation Seed Division's home in the 1940's, this building on No. 35th St. in Lincoln. Below, another early office, warehouse and drying facility for the Certified Seed Producers, forerunner of Foundation Seed Division. This one still stands at 1745 No. 33rd St. Lincoln.

Left, foreman Don Wilke bags seed at the new seed processing facilities, Loadline 3, at the University's Field Laboratory near Mead. The Foundation's building is pictured below.
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Why Farm Families Moonlight

R. J. Hanson

Dual employment may be becoming a common “way of life” among farm families and may provide the “staying power” for many farmers to remain in farming. Of those families who are unable to earn a satisfactory farm income, an increasing number are searching out off-farm employment if available to supplement farm incomes.

Within Nebraska, for example, 39 percent of all farmers were reported working off the farm in 1969 as compared to 32 percent in 1964. Moreover, 51 percent of these Nebraska farmers reporting off-farm employment in 1969 worked 100 days or more off the farm in contrast to 43 percent in 1964. However, most of these farmers would be found in eastern and possibly central Nebraska where off-farm employment opportunities are more readily available.

Nonfarm income represents an increasingly larger share of the total income earned by farm families. USDA estimates for 1973 revealed that nonfarm income made up over 45 percent of the average total income for a farm family in the United States. This was the case even though net farm income experienced an unprecedented increase that year due to improved farm product prices.

Dual employment is a feasible alternative for many farmers. Labor-saving technology has made it possible for farmers to do their work in less time, allowing more time for off-farm employment.

A 1971 state-wide sample of 4,000 Illinois farmers examined the flow of off-farm income to farm families and its importance to their total family income. This is one of a few studies of its kind.1

1Analysis of this sample was conducted with Professor R. G. F. Spitzle while the author was at the University of Illinois and Southern Illinois University.

Yet research findings in this study are indicative of trends not only in Illinois but also for farmers in other areas of the United States. Dual employment patterns reported from this Illinois study would be similar to those expected in only certain portions of Nebraska. Illinois has several large metropolitan areas located across the entire state. They offer a wide variety of employment opportunities within reasonable access to most farm families. However, only eastern and selected areas of central Nebraska would offer similar off-farm job opportunities.

Over half the average total income ($10,960) to Illinois farm families studied was received from off-farm sources, earning $5,675 while net farm income averaged $5,285. Wage and salary income from off-farm employment ($3,830) was clearly the major source of off-farm income to farm families, accounting for 67 percent of their off-farm income and 35 percent of their total family income. Although 20 percent of all farm families studied earned a total family income of less than $5,000, 49 percent reported a total family income exceeding $10,000.

Forty-five percent of all farmers studied reported working off the farm, whereas 29 percent of all farm wives held off-farm jobs. Thirty-four percent of those farmers working off the farm reported trade occupations, averaging $7,020 from these jobs. Factory employment (17 percent) and public service employment (21 percent) were also often reported. These farmers averaged $8,065 and $6,015 respectively from their jobs.

Office employment was reported most often (27 percent) by farm wives working off the farm. They averaged $3,410 at their work. Many wives also found employment as teachers (17 percent) and in medical occupations (15 percent), each group averaging $6,530 and $3,420 respectively. Most wives worked at part-time jobs while farmers generally worked at full-time jobs off the farm.

Why are farm family members working off the farm? The most frequent reason (30 percent) was the need to earn additional income to invest in the farming operation or to reduce farm debts. This suggests a desire by these families to remain in farming by expanding their farming operation and by improving their farm equity positions. Other frequent reasons cited were family home and living expenses (29 percent), retirement income (14 percent) and college educations for farm children (14 percent).

Several factors associated with farm size affected the level of off-farm earnings by farmers. Farm acreage, net income, gross sales and the number of livestock varied inversely with off-farm earnings.

Personal factors were found important. Off-farm earnings decreased with age and poor health, but increased substantially with education, family size, and vocational training. Farmers with college educations, for instance, averaged off-farm earnings of $8,050 while those with grade school educations earned $2,970.

Wage and salary earnings rose steadily as job experience and distance traveled to off-farm jobs increased. For example, farmers with 2 years or less experience at their off-farm jobs earned $4,990, while those with 12 or more years averaged $8,830.

An increasing number of farm families have combined farming with off-farm employment. In fact, many now earn a higher income from off-farm sources than from farming.

Dual employment provides a productive outlet for underemployed farm labor; but, more importantly, supplements farm income, raising total family income to more satisfactory levels. It is feasible for those wishing to continue farming when off-farm employment opportunities are there. □
Can I save on heat in a farrowing unit? Do I need to heat a growing-finishing building? What are the feed and fuel trade-offs? Is cooling really economical during the summer?

If these are some of the questions you have been asking this year, a computer model simulating how efficiently swine will perform at various air temperatures will be of help. A simulation model developed at the University of Nebraska—and used extensively in UN-L classrooms—has been shown to be compatible with actual swine growth study results.

To help you answer some of the above questions, the two graphs shown at left were developed using the simulation model. Figure 1 relates feed efficiency and Figure 2 has rate of gain as influenced by air temperature and body weight.

The figures show the optimum environmental temperature for different pig weights and the result of less-than-best conditions. The graphs indicate that you should not skimp on heat in a farrowing unit. Figure 1 shows the optimum temperature for a 5 lb. pig is 87°F, with a range of 81°F to 102°F between the curves representing 0.5 lbs. of extra feed required per pound of gain.

Thus, for raising baby pigs, it is better to be safe and be a little higher than optimum temperature. As a pig increases in weight, the optimum environmental temperature decreases until the pig reaches approximately 125 lbs. where the optimum temperature is 50°F. The temperature range between the curves representing the extra 0.5 lb. of feed per pound of gain widens as animal weight increases to 125 pounds. At 125 lbs., the range is 57°F to 93°F, and at 200 lbs., is 37°F to 87°F.

What about the feed and fuel trade-offs? With Figure 1, the extra feed cost caused by allowing environmental temperature to decrease or increase from optimum can be calculated by multiplying the cost of feed by the extra feed required. This value can then be compared to the cost difference between controlling the environment at optimum and permitting temperature variance.

(continued on next page)
Simulation...

For example, if the feed cost is 7¢ per pound of feed and the temperature outside is 30°F, then it will take 1.5 lb. (from Figure 1) of extra feed for a 50 lb. pig, or 10¢ more per pound of gain per day.

To increase the temperature to 68°—optimum temperature—would require a structure with a purchasing cost of about 3¢ per day based on 5 years of use. In this case, the pig produces enough heat to maintain the 68°F assuming the building has proper insulation and ventilation. Again it is important to note that growing-finishing hogs have a wide temperature range for effective production. Thus, exact environmental control is not as important.

The effect of air temperature and body weight upon the best gain, Figure 2, is essentially the same as the best feed efficiency curve. However, the high temperatures depress feed intake and thus depress gain more than feed efficiency. At the high temperatures, even though feed efficiency might be acceptable, the rate of gain would not. The -10-percent curve is similar below optimum temperatures to the 0.5 lb. of extra feed curve of Figure 1. However, comparing the -10-percent gain and the 0.5 lbs. of extra feed per pound of gain above optimum temperature shows a 9 to 14°F lower temperature for the gain curve.

The economic trade-offs between feed, fuel and building design are currently being investigated with actual weather data. Also, the benefits of evaporative cooling during the summer and solar heating during the winter are being evaluated.

This simulation model as well as models developed for broilers, turkeys and feeder cattle is being used in agricultural engineering course work to give student engineers experience in environmental management for growing livestock.

Areas of Excellence

The Animal Science Department and crop physiology are two "Areas of Excellence" designated by the University of Nebraska–Lincoln and appropriated additional funds by the Nebraska Legislature to meet specific, internally defined goals.

The Areas of Excellence program in animal science will result in an increase in the intensity and scope of the Department's swine and pork research projects, and will add new dimensions in teaching and Extension. The objectives will be accomplished by bringing in visiting faculty members and postdoctoral associates to share their knowledge and ideas.

The Legislature provided $20,800 for teaching and research support in crop physiology, including funds for acquiring a necessary electronics technician and graduate assistant. The role of crop physiologists is to determine why different crops and crop varieties differ in their ability to withstand stress—such as the 1974 drought—or to perform in different environments.

Growth in each of these Areas of Excellence will strengthen the University's support of Nebraska's agriculture.