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IN THE NEXT ISSUE...

- GENETIC CHANGES DURING TWENTY YEARS OF BROILER BREEDING.
- RESIDUAL EFFECT OF NITROGEN FERTILIZER.
- DEVELOPMENT OF A COMMERCIAL FRUIT DRYER.
- HIGH DIETARY ENERGY CAN DECREASE REPRODUCTIVE PERFORMANCE OF YOUNG BEEF BULLS.

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Agriculture Canada

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COVER
The Canadian farmer stands in the forefront in meeting the world's growing demand for food. Story on page 3.

COUVERTURE
Le fermier canadien est en première ligne pour répondre à la demande mondiale toujours grandissante de nourriture. Voir l'article à la page 3.

FOOD, FUEL AND THE FUTURE

C.W. GIBBINGS

Un seul mot pourrait résumer ce qui s'est passé sur la scène internationale dans les années 1970: carburant. On pourrait peut-être ajouter le mot alimentation pour les années 80. De nos jours, les céréales et le pétrole constituent les ressources naturelles les plus essentielles à nos économies modernes. La demande mondiale sans cesse croissante dans le domaine de l'alimentation ne pourra être satisfaite à moins que les pays exportateurs de denrées alimentaires ne modifient leur système de transport et que les pays importateurs n'en fassent de même avec leur système de distribution. Pour réussir à assouvir la faim dans le monde, les pays concernés devront aussi prendre sérieusement en considération le coût des entrées et conséquemment le coût des céréales.

Fuel requirements for agricultural purposes continue to grow.

If you had to choose one word to sum up the international scene in the 70s, it would likely be "fuel". Perhaps two watchwords will prevail in the 80s: food and fuel.

The quadrupling of oil prices in 1973-74 was the greatest shock to hit the world economy in nearly 30 years. But the shock was more than economic. It was also intellectual. The idea that when resources become or can be made scarce their prices can be raised, was not a new one. But never had it been applied more effectively, or with such international impact.

Partly this was a result of timing. A world accustomed to devouring resources as quickly as they could be uncovered had just begun to comprehend not only that those resources were limited, but that one day they could simply dry up. This realization, coupled with the industrialized world's dependence on oil as a source of energy, provided the framework for the phenomenal success of the oil-exporting (OPEC) nations in raising prices.

The history and politics of grain and oil are very different. But a fundamental similarity exists: grain and oil are two of the natural resources most essential to modern economies. Grain has had a lesser impact on international relations in recent years. Yet grain is more crucial than oil to human life and health.

Events of the 80s may well force a major re-evaluation of food as a commodity, much like the re-evaluation that occurred with energy in the 70s. The adequacy of the world's food supply is, after all, a question of greater importance than the adequacy of energy supplies to run automobiles and factories. Why hasn't the world yet realized this? Partly because those who are hungry are also, by and large, powerless. And partly because the world energy situation has tended in recent years to distract attention from the even more frightening problem of food supplies.

In this context, the United States' decision earlier this year to limit grain exports to the Soviet Union is significant for the long term because it symbolizes the recognition of a major grain producer of the value of that basic commodity as a tool in international affairs.

Although it can be said that OPEC in effect held the industrialized world up for ransom, it has been beneficial in some ways. On an international scale, the higher oil prices forced on the world by OPEC have begun to stimulate the massive capital investment needed to develop new petroleum resources and alternate energy sources. This investment had to be made sooner or later; OPEC simply speeded up the process.

The same process could apply to food, and possibly to other basic and essential world commodities. More and more, the industrialized world is realizing there are limits to the growth it can expect to achieve in future years. Forced to choose between luxuries and basics, the weight of emphasis will have to shift toward basics like food.

These developments bode well for the agricultural producer. The farmer has always been important because of his ability to nurture from the soil the basic commodities of human survival. As the value of those commodities increases, so must the value of the farmer's labour. If the world is to be fed, it will have to assure its food producers of returns above the cost of production. Any other conclusion would be detrimental, in the long run, to both producers and consumers.

In the 70s, some gains were made in improving the economic health of the less-developed countries. It may be fair to say that rich country aid is now being increasingly concentrated on the poorest countries, and that less developed countries are more concerned about agricultural development. Some steps have been taken to protect the primary producing countries from fluctuations in their export earnings. And the "basic needs gap" between developed and less developed countries has narrowed.

But the cold fact is this: more people live in absolute poverty now than in 1970. According to a World Bank report published in the December 29, 1979 issue of The Economist, about 800 million people live in a condition of life "so characterised by malnutrition, illiteracy, disease, squalid surroundings, high infant mortality and low life expectancy as to be beneath any reasonable definition of human decency." This is the glaring failure of the 70s and, to be realistic, of all other decades before it.

With these facts at hand, one can readily predict that thousands will die in bouts of famine in several areas of the world during the 80s. The attention of the world, diverted in the past few years by the energy crisis, will focus once again on the problem of massive starvation. But it may well be that, during the 80s, the challenge of feeding the world's poor will pivot more and more on two central obstacles: financing and distributing food supplies.

The first of these obstacles reflects the relationship between food and fuel. The escalation in oil prices during the past six or seven years has eaten into the funds available to all oil-consuming nations. Governments that must also buy food, as many developing nations must, are thus faced with a bitter choice. If food costs rise in the 80s as fuel did in the 70s, starvation could well exceed all previous grim dimensions. And even massive aid programs by the rich nations to feed the poor could be thwarted by transportation limitations in exporting nations and distribution problems in recipient nations.

The "bottom line" for the grain industry the world over is the ability to move grain from points of production to points of use. Most major exporting nations now face and will continue to face internal transportation problems. The capacity of the United States, the world's foremost grain exporter, to move grain into both domestic and export channels is a relatively new issue in that country but one attracting more and more attention. Canadian transportation limitations have recently been identified and major steps are under way to overcome them. But it will be several years before the benefits of recent initiatives will be fully felt. Australia, Argentina and other major exporting nations have transportation constraints in various stages of resolution.

The world's growing demand for food will not be met in the 80s unless food exporting nations set their transportation houses in order. Improvements in the distribution systems of the recipient nations are also essential. The challenge of transporting grain to points of use and need will be at least as consuming in the 80s as the challenge of producing enough grain.

World trade in grain and oilseeds doubled during the 70s, and is expected to continue to grow dramatically. Even a simplistic analysis of supply-demand figures shows that world grain consumption is increasing at a rate that exceeds the gain in production in more years than not. Most of the growth is tied to population gains combined with improved standards of eating. In many emerging nations, additional disposable income is translated almost penny for penny into increased demand for food.

But several key issues must be resolved in the 80s if the demand for food is to be met. These questions are part of wider issues that will determine, not only the future of world food supplies, but the course of world economic development.

The first relates to the enormous task of moving grain to market. A continuing expansion in trade over the next decade, at anything like the rate experienced since 1970, will plainly call for enormous investment in the transportation and handling facilities of the main exporting countries. It will also require heavy expenditures on storage and ports in importing countries.

The second question relates to prices and costs. How will the increasing demand for food, particularly from low-income developing countries with balance-of-payment problems, be met by exporting countries whose producers face higher costs? The resolution of this equation may spell the difference between prosperity and famine.

A third issue is energy availability. If there is competition for scarce energy resources, will agriculture retain its share? This is a question both exporting and importing countries must face. Finally, there is the question of whether the world's producers can accelerate production to the levels required to meet the demand for food. A good portion of this challenge will fall on producers in the world's five major wheat exporting countries, including Canada.

The investments being made in Canada by both the public and private sector in rail transport, grain elevators and terminals, and other investments being made by farmers themselves on machinery and equipment, probably represent more than $6 billion in capital outlay. With these and other anticipated developments in the grain transportation and handling system, Canada should be able to export 30 million tonnes of grains and oilseeds by 1985 and about 36 million tonnes by 1990. These are the levels needed if Canada is to maintain its market share and do its part in meeting growing food needs in a world preoccupied by food and oil.

Mr. Gibbings, a former President of the Saskatchewan Wheat Pool, is currently a commissioner of the Canadian Wheat Board

THE THREAT TO OUR LIFE-SUPPORT SYSTEMS

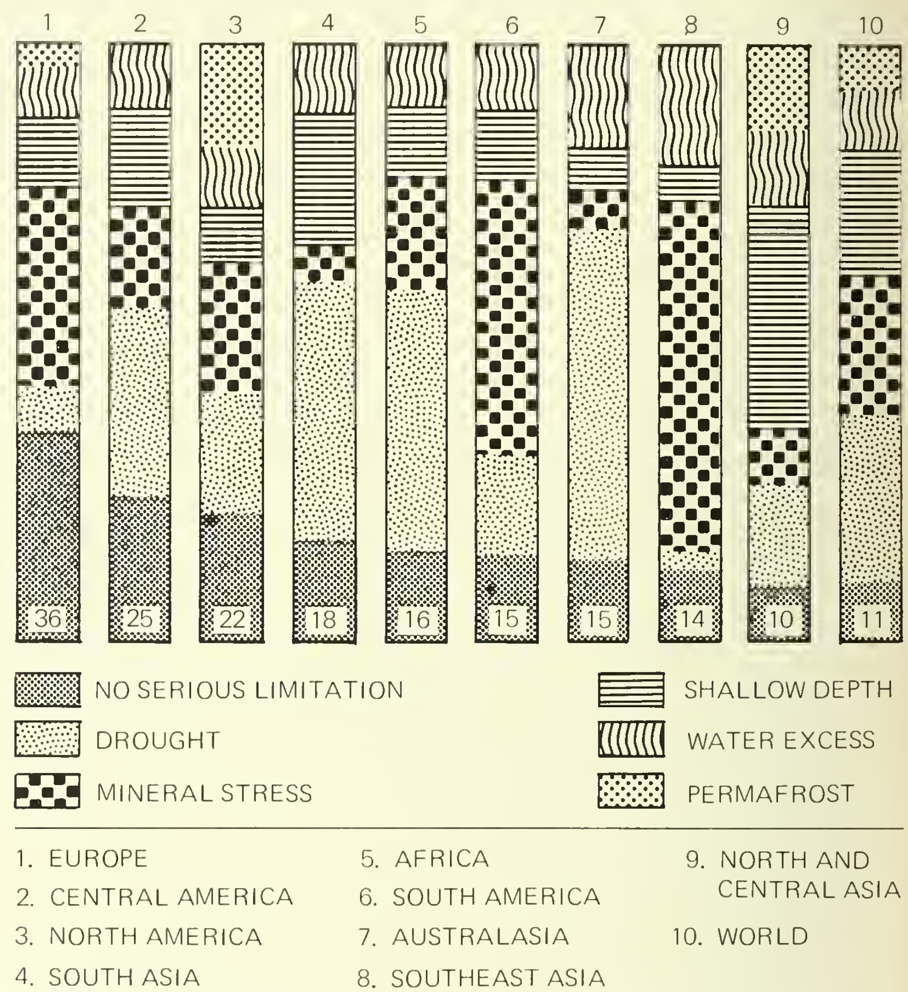
EDITED BY KEN CLARK

L'article qui suit nous remet en mémoire les dommages que nous causons à notre environnement en tentant de l'utiliser à nos propres fins. Il s'agit d'un texte inclu dans un long document intitulé "La stratégie de conservation du monde" publié en 1980 par l'Union internationale pour la conservation de la nature et des ressources naturelles, organisation financée en partie par les Nations unies. L'article traite de la menace qui pèse sur le système écologique du monde et des mesures que tentent de prendre certains organismes pour redresser une situation qui se dégrade et dont les effets pourraient compromettre notre survie.

The following article is a reminder of the damage we do to our environment in developing it for our own use. It is an edited version of an article which appeared in a larger document — World Conservation Strategy — issued in 1980 by the International Union for the Conservation of Nature and Natural Resources, a conservation organization financed partly by the United Nations. The article discusses the international threat to the world's ecosystem — the arrangement of inter-acting organisms and processes on which we depend for our survival — **Editor's note**

Life-support systems is shorthand for ecosystems, such as watershed forests or coastal wetlands, vital for all societies regardless of their stage of development. Today, the most important and most threatened life-support systems are those involving agriculture, forests, coastal areas and fresh water.

Agricultural systems — only about 11 per cent of the world's land area (excluding Antarctica) offers no serious limitation to agriculture; the rest suffers from drought, mineral stress (nutritional deficiencies or toxicities), shallow depth, excess water, or permafrost. The best land is not evenly distributed (see figure 1). The world's cropland currently occupies 14 million km^2, and although it may be possible to double this area, much of the best land is already being farmed.



REGIONAL DISTRIBUTION OF SOILS WITH OR WITHOUT LIMITATIONS FOR AGRICULTURE.

Figure 1.

Unfortunately large areas of prime quality land are being permanently taken out of agricultural use by being built on. In developed countries at least 3,000 km^2 of prime agricultural land are submerged every year under urban sprawl: between 1960 and 1970 Japan lost 7.3% of its agricultural land to buildings and roads and European countries lost from 1.5% (Norway) to 4.3% (Netherlands). In addition, close to one third of the world's arable land will be destroyed in the next 20 years if current rates of land degradation continue.

Soil is a crucial life-support system, since the bulk of all food production depends on it. Soil erosion is a natural and continuous process, but in undisturbed ecosystems with a protective cover of plants the soil is usually regenerated at the same rate it is removed. If soil and vegetation are not in balance, as often they are not when influenced by poorly managed human activities, erosion is accelerated with disastrous consequences.

Even under natural conditions of vegetation cover, nature takes from 100 to 400 years or more to generate 10 millimetres of top soil; and 3,000 to 12,000 years would be needed to generate soil to a depth of the length of this page. So once the soil has gone, for all practical purposes it has gone for good.

Soil loss has accelerated sharply throughout the food-hungry tropics, which are generally more susceptible to erosion than the temperate zone, due to the topography of the land and the nature of the

SOURCE
UNITED NATIONS CONFERENCE ON DESERTIFICATION 1977.
DESERTIFICATION MAP OF THE WORLD
UNEP/FAO/UNESCO/WMO

Figure 2. Deserts and areas subject to desertification.

soils and rainfall. More than half of India, for example, suffers from some form of soil degradation through flooding, salinity and alkalinity.

The productivity of agricultural ecosystems depends not only on maintaining soil quality but also on retaining the habitats of beneficial insects and other animals, such as crop pollinators and the predators and parasites of pests. Effective pest control is no longer a matter of heavy applications of pesticides, partly because of the rising cost of petroleum-derived products but largely because excessive pesticide use promotes resistance (the number of pesticide-resistant insects and mites has doubled in 12 years), destroys natural enemies, turns formerly innocuous species into pests, harms other non-target species, and contaminates food and feed. Instead pesticides should be used to supplement a battery of methods integrated in appropriate combinations: these methods include introduction of pest-resistant crop varieties, special planting combinations and patterns, mechanical methods, the use of repellents and hormones, and encouragement of natural enemies.

Forests — Besides supplying timber and other products, forests have a vital effect on processes of great significance for people. They influence local and regional climates, generally by making them milder, and they help to ensure a continuous flow of clean water. Some forests, notably tropical cloud forests, even increase the availability of water by intercepting moisture from clouds.

Watershed forests are particularly important because they protect soil cover on site and protect areas downstream from excessive floods and other harmful fluctuations in streamflow. By thus reducing the silt load of rivers, watershed forests also help prevent the clogging of reservoirs, irrigation systems, canals and docks, and the smothering by sediment of coral reefs.

Yet watershed forests are being widely devastated — by clearance for agriculture, by logging and cutting for fuel, by overgrazing, and by badly managed road building. The results can be extremely expensive. It costs Argentina $10 million a year to dredge silt from the estuary of the River Plate and keep Buenos Aires open to shipping: yet 80% of the 100 million tonnes of sediment that every year threaten to block the harbor comes from only 4 per cent of the drainage basin — the heavily overgrazed catchment area of the Bermejo River 1,800 km upstream.

Sedimentation as a result of careless use of watershed forests can cut drastically the economic life of reservoirs, hydroelectric facilities and irrigation systems. The capacity of India's Nizamsagar reservoir has been more than halved.

Such problems are not confined to developing countries: for example, it has been estimated that more than 1,000 million m^3 of sediment are deposited every year in the major reservoirs of the United States. Although they have not been calculated (indeed, probably cannot be), the global costs of sediment removal, river dredging, reconstruction of irrigation systems and loss of investment in expensive structures like dams must be huge. Only 10% of the world's population live in mountainous areas, but another 40% live in the adjacent plains; so the lives and livelihoods of half the world directly depend on the way in which watershed ecosystems are managed.

In areas under shifting cultivation forests also act to restore soil fertility. More than 200 million people occupying about 30 million m^2 of tropical forests live by practising shifting cultivation — cropping an area for a few years, then clearing another area, leaving the first one fallow to revert to scrub and forest.

This is a stable, productive practice if the population itself is stable; but if populations are growing, which nowadays they usually are, the pressure on land increases, fallow periods shorten, the soil has no chance to regenerate, and wider and wider tracts of otherwise productive forest land are destroyed. Almost two-thirds of the land under shifting cultivation is upland forest, much of it on steep slopes, and the resulting erosion is severe.

Coastal and freshwater systems — Coastal wetlands and shallows — especially estuaries and mangrove swamps — provide food and shelter for waterfowl and for fishes, crustaceans and molluscs utilized by an estimated two-thirds of the world's fisheries. Seagrass meadows also act as nurseries and nutrient suppliers for economically important fish species. Coral ecosystems are of more local, but nonetheless vital, significance — providing habitats for the fish on which many coastal communities in developing countries depend. Many freshwater wetlands and floodplains support important inland fisheries, while floodplain agriculture has long relied on the regular supply of nutrients by floodwaters.

Wetlands, floodplains, seagrass beds and coral reefs are being destroyed the world over, with severe effects on the economies that depend on them most closely. For example, the cost of damage to US marine fisheries caused by degradation of coastal wetlands has been estimated to be almost $86 million a year. In many parts of the world the construction of dams has blocked the passage of migrating fish and drowned or otherwise destroyed the habitats of others; and although the new reservoir may support a new fishery this does not always compensate for the loss of the floodplain.

These are typical effects of the impacts on coastal and freshwater ecosystems everywhere: impacts such as industrial and agricultural pollution; the construction of dams; siltation from eroded uplands; filling to provide sites for industry, housing, recreation, air-ports and farmland; dredging to create, deepen or improve harbors; quarrying; and cutting of mangroves for fuel. As the commercially valuable fisheries for fish, crustaceans and molluscs become more fully exploited, so the effects of habitat destruction and pollution — particularly on those species depending on coastal wetlands and shallows or on inland wetlands and floodplains for nutrients or for spawning grounds and nurseries — will become more evident.

Mr. Clark is with Information Services, Agriculture Canada, Ottawa.

FOOD OF ANIMAL ORIGIN

J.W.G. NICHOLSON

Les produits d'origine animale occupent une place importante dans l'alimentation humaine. Ils figurent parmi les aliments les plus complets, répondant à plus de la moitié de nos besoins en protéines, calcium, phosphore, et fournissant plusieurs vitamines. Les protéines sont de qualité supérieure et renferment, dans des proportions semblables à celles présentes dans le corps humain, tous les acides aminés.

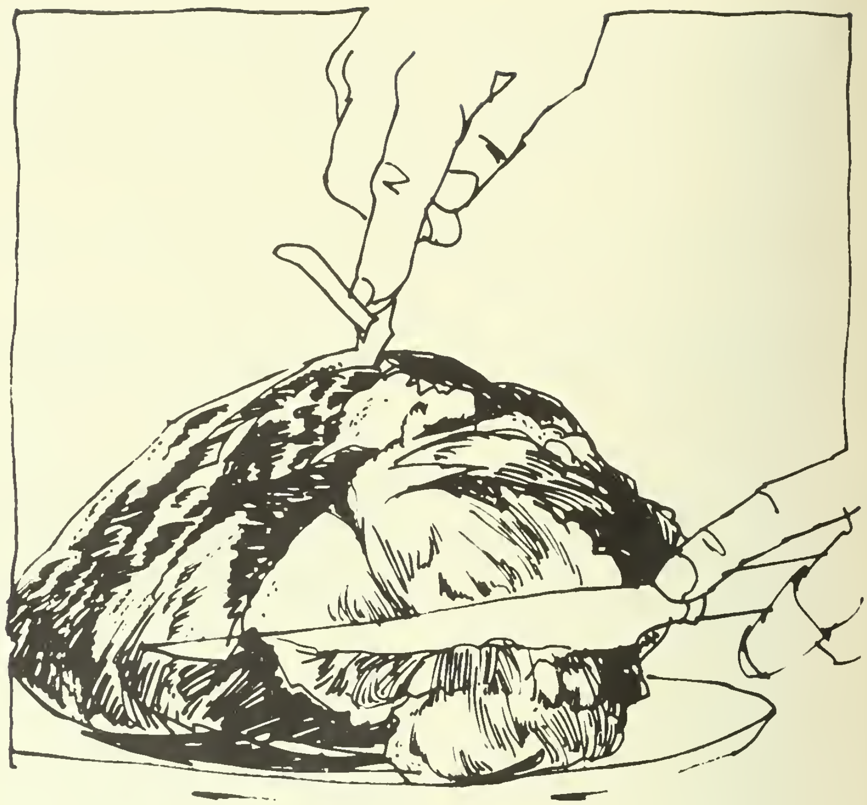
La crainte selon laquelle les maladies du coeur ne soient occasionnées par une forte absorption du cholestérol présent dans les aliments d'origine animale demeure injustifiée. On pense à l'heure actuelle qu'elles découlent plutôt d'une consommation abondante d'aliments de diverses origines.

Domesticated farm animals are a major source of food and clothing.

The fate of man and animals has been interwoven since the dawn of time. Over the centuries man learned to manage the wild flocks of animals he hunted and certain species became domesticated. Domesticated farm animals, cattle, pigs, poultry, horses, sheep, goats, etc. have made major contributions to human welfare as sources of food, clothing, transportation, power, soil fertility, fuel and pleasure. The most important of these is food.

Historically, as it is today, human food has been derived from both plant and animal sources. It is likely that in prefarming times meat provided a higher proportion of total food intake than it does today. The craving of people throughout the world for foods from animals is emphasized because the proportion of personal income spent for such foods increases as total income increases.

Foods from animals are among the most complete known. They supply more than half of the protein, calcium, phosphorous and several of the vitamins in our diet. Protein is of high quality as it contains all the amino acids required for human nutrition in proportions similar to those in the human body. Meat and poultry are especially good sources of available iron.



In North America there is little competition between people and animals for food. We are exporting all the grain that the world can buy and that our transportation system can deliver. If some grain was not fed to livestock it would only add to the surplus. Most of the grains fed to livestock is of lower grade and from plant species not widely used for human food. The highest proportion of feed grains and other concentrates, such as oilseed meal, is used in rations for pigs and poultry. Some grain is fed to cattle and sheep because the practice is currently profitable. If the price of grain goes up too far these animals can be raised exclusively on forages and food processing by products that man cannot, or will not, use as food. Much of our land is only suitable for growing forage crops and without animals to convert it into food the energy value of this production could not be used by man. Clearly, without the use of ruminant animals as food producers, total available food would be less not more.

The high productivity of our agricultural industry has resulted in low food prices. Regardless of how fast food prices seem to be going up, we spend less than 20% of our disposable income on food. In many parts of the world it takes 50-70% of disposable income to buy food. Part of the efficiency of modern animal agriculture results from the use of feed additives including nutrient supplements, antibiotics, hormones and other growth-promoting substances. Feed additives are used to increase growth rate, improve feed efficiency, reduce subclinical infections and decrease death losses. Although the use of antibiotics and growth stimulants is currently controversial, people who oppose their use cite only potential problems, not documented problems. Very detailed tests are required before a new feed additive is approved. In risk-benefit analyses, the benefits of the use of currently approved feed additives far exceed any potential risk.

Much of the enjoyment of eating comes from the use of foods from animal origin. The smell of hamburgers on a barbecue or bacon frying in the morning is enjoyed by many people. Most meals are planned around the meat dish and many desserts are based on dairy products.

Without foods of animal origin we would lose valuable sources of many essential nutrients and much of the joy of eating. However, some food faddists would like to see foods from animals banned. They claim that animals are inefficient in converting feed to food, that the use of feed additives and chemical preservatives of meat is dangerous, and that consumption of animal fat causes heart disease.

In the early 1950s, it was hypothesized that high dietary intakes of cholesterol and saturated fats cause atherosclerosis and coronary heart disease. The evidence for this was purely circumstantial and not based on any direct observations that could establish a cause and effect relationship. Saturated fats and cholesterol are both found in foods of animal origin so it was recommended that the consumption of animal foods be reduced to lower the daily intake of these lipids. However, saturated fats and cholesterol are produced in the human body and cholesterol is an essential constituent of all body cells.

Research over the past 25 years has not clearly shown any connection between consumption of animal foods and heart disease. Neither has it clearly shown that reducing intake of these foods will reduce incidence of heart disease. The incidence of heart disease in North America has risen greatly since the early 1900s. However, over this period of time the amount of fat consumed per person per day from animal foods has decreased, while the intake of fat from plant sources as well as total fat has increased.

It would seem that the total intake of fat, and more particularly total calories, should be restricted rather than suggesting that only fats of animal origin need be restricted. Because of the highly nutritious nature of foods of animal origin, they form a very important part of the diet of most Canadians. Evidence to date does not show that their consumption is harmful in any way to humans. It is still wise advice to eat a varied diet and to eat it in moderation.

Dr. Nicholson is an Animal Nutritionist at Agriculture Canada Research Station, Fredericton.

WATERFOWL DAMAGE TO CEREAL GRAIN

L.G. SUGDEN

Chaque année dans les provinces des Prairies, la sauvagine cause des dégâts aux céréales non récoltées. Bien que ces dommages soient relativement faibles par comparaison avec les pertes causées par la grêle, les ravageurs et les maladies, ils n'en soulèvent pas moins beaucoup d'inquiétude de la part des céréaliculteurs touchés. Certaines associations de chasse et pêche et agences de conservation de la faune ont assumé une part de responsabilité pour le gibier à plume qui relève de leur compétence. Plutôt que d'en faire une question de responsabilité, l'auteur suggère l'adoption d'une approche de coopération face au problème. Il propose par exemple la mise sur pied de projets parrainés par le gouvernement, comme l'utilisation de cultures de diversion et l'installation de stations-appâts. Pour leur part, les céréaliculteurs peuvent utiliser des méthodes de prévention comme les épouvantails et les détonateurs au gaz propane, et modifier leurs façons culturales comme l'ensemencement de cultures moins sensibles, le recul de l'andainage plus tard dans la saison et le moissonnage-battage direct des céréales. L'utilisation de brise-vent est également indiquée comme mesure de prévention.

Each year in prairie Canada, waterfowl damage some unharvested grain crops. Mallard and pintail ducks, four goose species, and sandhill cranes are the principal species that feed in grain fields. Mallards cause the most damage because they are relatively numerous and widespread, and do not migrate south until late autumn. Swathed barley and wheat sustain most of the damage from birds eating, trampling and fouling the grain. Damage is more severe when harvesting is delayed, particularly if wet weather keeps grain in the swath for lengthy periods. Damage also tends to be chronic and severe near large wetlands that harbor concentrations of waterfowl during harvest.

Although grain damage by waterfowl is small compared with losses from hail, insect pests and disease, it is of considerable economic importance to affected producers, and generates considerable reaction from them. Because waterfowl are not considered to be a natural hazard like hail and insect pests, and have value to another segment of society, there is a tendency to hold users, mainly waterfowl hunters and the wildlife agencies, responsible for the damage. A share of the responsibility is accepted by hunters and wildlife agencies. It is an unfortunate coincidence that the ducks that eat grain are also the most popular game species. Waterfowl eat the grain because it represents a good quality food readily available in areas that they have used for thousands of years. Evidence indicates that if, for some reason, mallards ceased to be popular game birds the problem would worsen because there would be more of them. Moreover, wetlands preserved and managed for waterfowl will provide alternate sites for mallards to feed on natural foods, and also help to disperse crop damage when it does occur.

Debating the question of responsibility cannot reduce the impact of waterfowl on grain crops. A cooperative effort by all concerned will have the best results. In areas with chronic, severe damage, government sponsored projects such as lure crops and bait stations reduce waterfowl damage by providing alternate grain-feeding sites for the birds. Lure crops may be grown on Crown land or purchased from farmers in high damage areas. Bait stations are sometimes operated on the shores of large wetlands with concentrations of mallards. Threshed grain is spread on a prepared site near water. Damage compensation and crop insurance programs sponsored by both federal and provincial governments help to remove some of the grain farmer's financial burden.

Straight combining reduces waterfowl damage.

Old-fashioned scarecrows still do the job.

Many farmers develop their own damage prevention methods. In most cases the individual is in the best position to control damage on his own land. Installing scarecrows on swathed fields is the most common technique and is often successful if done before the birds start feeding in the field. Propane-fired exploders with or without scarecrows are also useful, though not as popular.

Modifying land use or farming practices can reduce or eliminate crop damage by waterfowl. Trees damaged it may be more economical to produce an alternate crop such as rapeseed or forage. Resorting to straight combining and grain drying would allow the farmer to grow barley or wheat on high risk fields without threat of waterfowl damage.

There is no simple solution to the overall problem of waterfowl tend to deter waterfowl; therefore, shelterbelts may reduce crop damage as well as soil drifting. Mallards seem to start field feeding sooner when a field adjacent to their wetland is swathed early in the season. Delayed swathing or even growing an unsusceptible crop could reduce the impact of local mallard flocks. Waterfowl may feed in harvested grain fields even when swathed grain is still available. Use of such fields should be encouraged by deferring cultivation and preventing disturbances.

A more modern approach is the propane-fired exploder.

If a grain field is chronically damage to prairie grain crops. Affected grain growers may be able to reduce or eliminate damage by implementing, where possible, preventive measures in their farming practices.

Lawson G. Sugden is a research scientist with the Canadian Wildlife Service at the Prairie Migratory Bird Research Centre, Saskatoon.

THE PUZZLE OF ENZOOTIC BOVINE LEUKOSIS

KENNETH R. CLARK

Les autorités canadiennes responsables de la santé parmi la population animale cherchent actuellement des moyens de combattre la leucose bovine dont le virus se retrouve fréquemment au Canada, aux États-Unis et dans quelques pays d'Europe. L'infection, par ce virus, provoque rarement le développement d'une maladie ce qui en rend la détection difficile. Ce n'est cependant pas l'Amérique du nord qui se montre la plus préoccupée par la question mais plutôt certains pays européens dont le Canada dépend pour ses exportations de bovins.

La suppression complète du virus représenterait des dépenses très importantes et c'est pourquoi un programme est en cours qui tend à encourager les propriétaires de troupeaux à adopter des mesures permettant d'élever des bovins exempts du virus.

Canadian animal health authorities concerned with cattle are pondering appropriate ways of dealing with enzootic bovine leukosis (EBL), a virus partly noted for causing a proliferation of white cells in the blood of infected animals. The EBL virus is widespread (enzootic connotes this characteristic) in the Canadian cattle population. It is similarly common in the United States, present in European cattle and indeed in cattle in some other parts of the world. Its incidence varies markedly from country to country and region to region. The resulting virus-caused disease is leukosis.

It is important, in assessing leukosis, to distinguish between virus and disease. Most species of animals are infected with viruses of one kind or another which may or may not induce disease. In cattle, infection with the EBL virus only rarely develops into disease since some factor other than the virus is necessary to cause tumours or leukemia. In other words, EBL-infected cattle seldom become sick and usually live out their productive lives in much the same manner as non-infected animals.

The no-disease characteristic of the EBL infection makes it a nebulous enemy as compared with, say, brucellosis, widespread among cattle in the 70s. Cattle afflicted with brucellosis develop serious symptoms, including abortions and loss of milk production in the case of dairy cattle, although death rarely results. Brucellosis is also transmissable to humans (as leukosis apparently is not) and that is an added hazard.

The concern about EBL arises not so much from within as from outside the country, notably in Europe, where leukosis has come to be regarded in a more serious light by the authorities. More refined testing techniques in the past few years have led to the discovery that some Canadian breeding cattle exported to Europe may have carried the virus.

As health standards improve around the world, governments tend to increase the restrictions on movement of cattle suspected of carrying the EBL virus. Restrictions in Belgium, for example, are now so tight that Canadian breeding cattle are prohibited from entry. Trade with the United States, where the bulk of Canadian breeding cattle are exported, remains unaffected because EBL tests are not required between these two countries. But Europe is an important market and the anti-leukosis emphasis there and elsewhere could eventually have a downward effect on Canadian exports.

The disease is spread in a variety of ways. It is believed that about 20 per cent of the offspring of infected mothers become infected from the mothers after conception. It is also thought that blood-sucking insects carry the virus between animals.

Because transmission is not thought to occur through artificial insemination there is no legislative requirement in Canada that semen sold in Canada be collected from bulls certified free of the virus. Nonetheless, the industry can expect increasing pressure to halt the sale of semen from infected bulls, to be on the safe side. Some semen is still sold from bulls with the virus, but this is normally high-quality breeding stock for which there is great demand. Even in these cases, proper collection and preparation of semen could eliminate even the possibility of transmission.

Many investigations have looked at the possibility of a link between animal leukosis and human leukemia, because of certain similarities in the diseases, but no evidence has been found to support a transmission connection. The animal EBL virus therefore does not represent a public health hazard. The virus, however, can be transmitted across animal species barriers, from cattle to sheep, for example, and perhaps to subhuman primates.

Since virus transmission is primarily through direct animal-to-animal contact, eradication of the virus from a particular herd can often be carried out by good herd management and accurate identification of infected animals and their prompt removal from the herd. Recently-developed tests involving laboratory examination of serum in blood samples are the best identification method. Among these serological tests, the so-called radioimmunoassay test is considerably more sensitive than the others in picking up virus presence.

In leukosis terms, good management for a dairy farmer could involve breeding his own additions to the herd, if he is satisfied it is free of the disease, rather than purchasing new stock. If a purchase is made, the buyer should try to find out as much as possible about the health status of the herd from which the animal comes. The alert owner, anxious to keep his herd virus-free, should also try to keep his herd from contact with other herds. There appears to be uniform agreement that the virus is transmitted from herd to herd and from one area to another by movement of infected cattle.

Talk of eradication on an individual herd basis is one thing, but eradication of the disease from the Canadian cattle population as part of a national program is another less feasible proposition in terms of cost to the taxpayer and the disruption and economic loss caused the herd-owner through the slaughter of infected animals. The numbers are simply too large. If all 12 million cattle in the country were tested at $6 a head, the bill for that alone would be $72 million. Government compensation to farmers for slaughtered cattle under the brucellosis eradication model would add many millions more to the bill.

Perhaps 20 per cent of Canadian cattle herds contain at least one animal with the virus present. The United States has no reliable data on the virus prevalence in American herds. And more precise information on prevalence in Canada is unavailable because leukosis, unlike brucellosis, is not a "reportable" disease under federal animal health regulations. Brucellosis and other diseases considered menacing enough must be reported to the appropriate authorities when found in order to permit implementation of counter-measures.

At this stage, the federal government is wary of elevating leukosis to the "reportable" level and treating the virus as something to be eradicated. The country lives with many diseases in its animal population, preferring to control rather than eradicate. Leukosis in cattle appears to be in this category.

One possibility related to control is the establishment of a program to encourage herd-owners, particularly those wishing to export, to take steps to officially declare their herds free of the virus. A variation on this theme was used with some degree of success to help deal with brucellosis. With leukosis, the federal government could pass the regulations, establish the rules, keep the records and be responsible for officially certifying herds free of the disease. Herd operators themselves could use all the available devices to achieve this goal.

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REMOTE SENSING: AN APPLICATION TO RANGE INVENTORY IN BRITISH COLUMBIA

E. KENT WATSON AND
A.L. VAN RYSWYK

Une cartographie appropriée et de bons systèmes d'inventaire sont indispensables au zonage des terres agricoles. Le relevé de ces terres peut à présent être effectué rapidement grâce à de nouvelles techniques de télédétection que décrit l'article qui suit.

Plant community inventories of the cattle ranges of British Columbia are almost non-existent. In the Williams Lake-Chilcotin area the most recent inventory maps available were produced in 1932. Since then the development of range inventory has been slow. Two classes, bunch grasses and weeds were mapped on a 1941 inventory map of the Lac-du-Bois Range. The Lac-du-Bois Range is a range research test area north of Kamloops, where, in the last 40 years, more range research has been done than in any other rangeland segment in British Columbia. In 1956-57 the Tranquille Stock Range, now called the Lac-du-Bois Range, was mapped. This map separated timbered range from open and semi-open grasslands. Within the open grassland area three units were mapped which generally correspond to the Brown, Dark Brown and Black Chernozemic soils found on the Lac-du-Bois range.

The recent explosion of new Remote Sensing techniques and data sources provide a tool whereby inventories can be readily conducted over large tracts of the land surface. In 1972 the first of the LANDSAT satellites was launched into a 900 km orbit. LANDSAT B and C are now in orbit with only C still

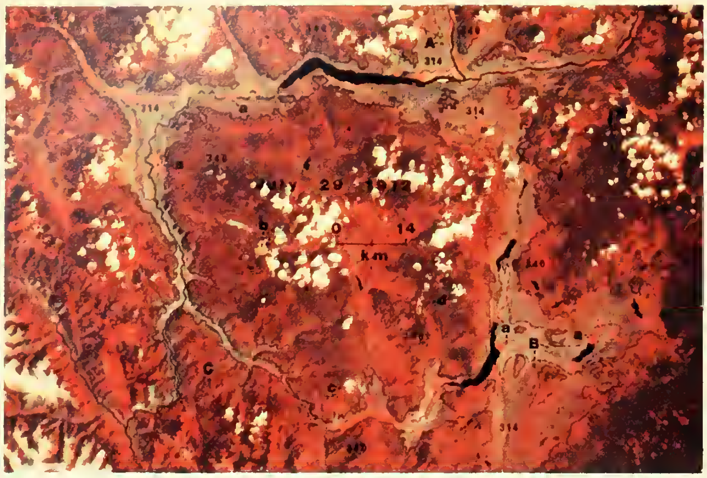

Figure 1. July 29, 1972. 1:500,000 LANDSAT color composite showing Grass Types 314 and Forest Types 340.

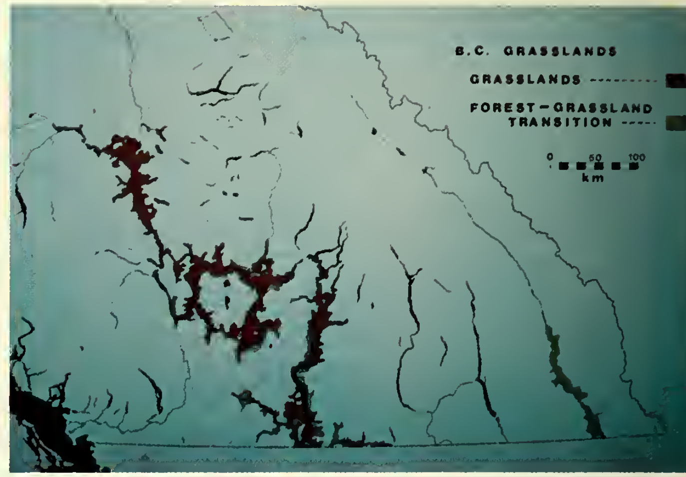

Figure 2. Map of Grassland ranges compiled from twenty-one LANDSAT images.

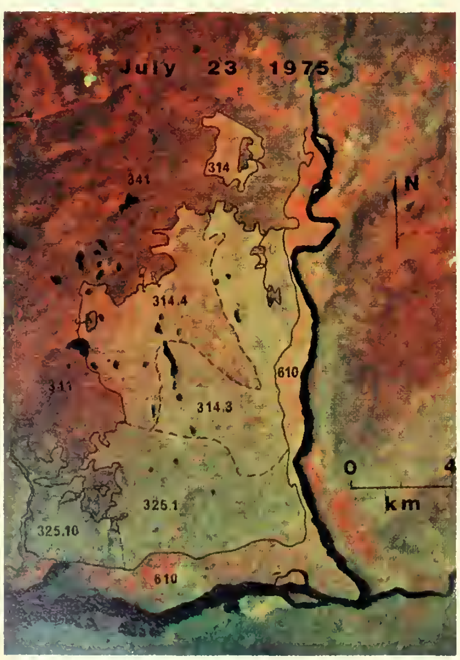

Figure 3. This July 23, 1975, 1:150,000 LANDSAT scene of the Lac-du-Bois range shows subdivisions within the Grass Types along with residential areas of Kamloops (610) and Conifer Forest Types (341).

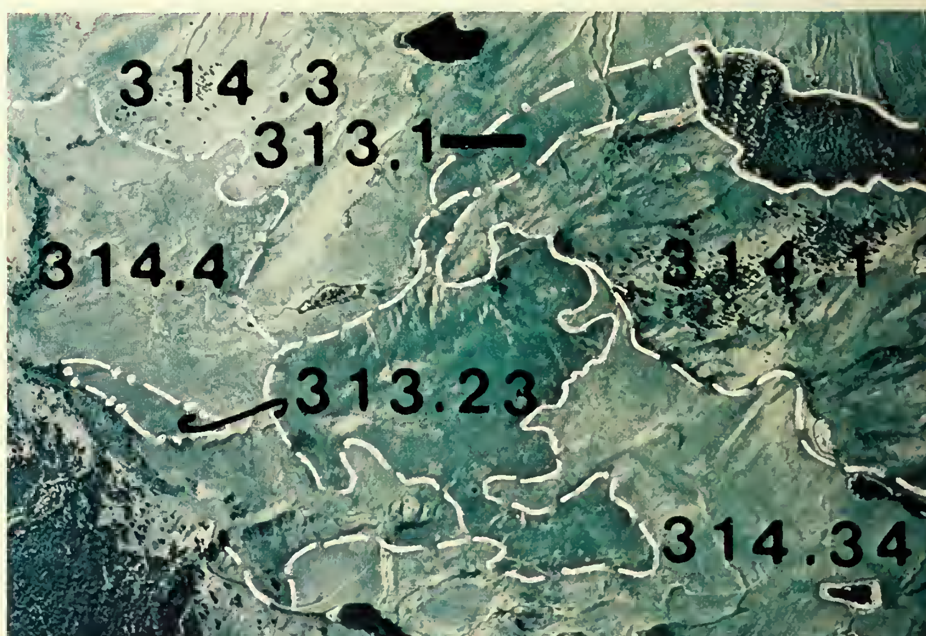

Figure 4. A 1:20,000 June 9, 1975 color aerial photograph showing different range communities. Only the dark green *Astragalus miser* 313.23 unit can be positively identified at this scale. Remaining plant species had to be determined in the field.

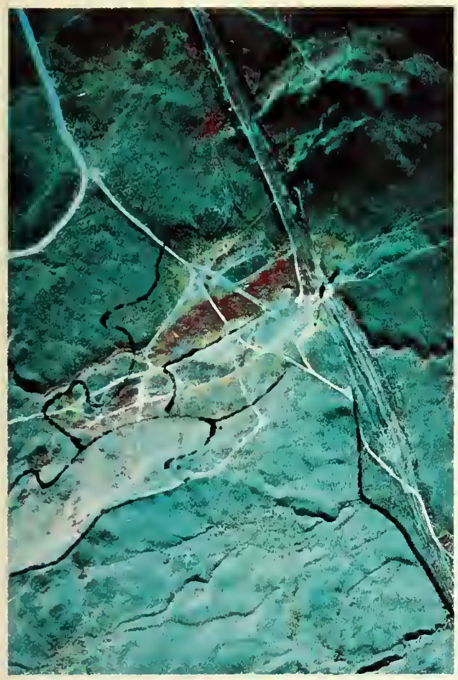

Figure 5. A June 10, 1977, 1:12,000 color-infrared aerial photograph. *Artemisia tridentata*, black shrubs, *Bromus tectorum*, bright yellow, *Elymus condensatus*, red and *Festuca scabrella*, bright pink on north slopes, can be identified by size and/or color. *Agropyron spicatum* (314.11 and .13) is not identifiable at 1:12,000 but is at scales of 1:10,000 and larger.

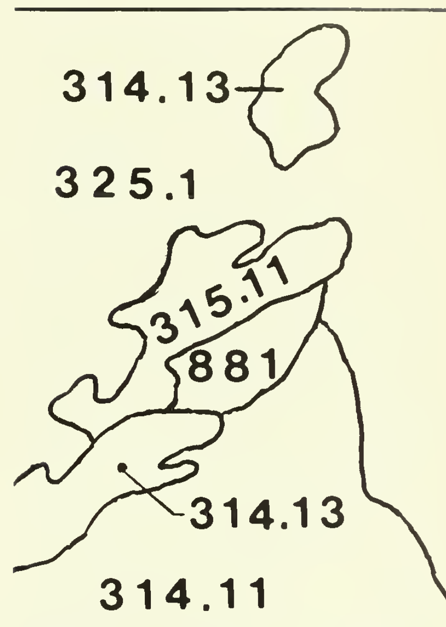

Figure 6. A line drawing map of figure 5.

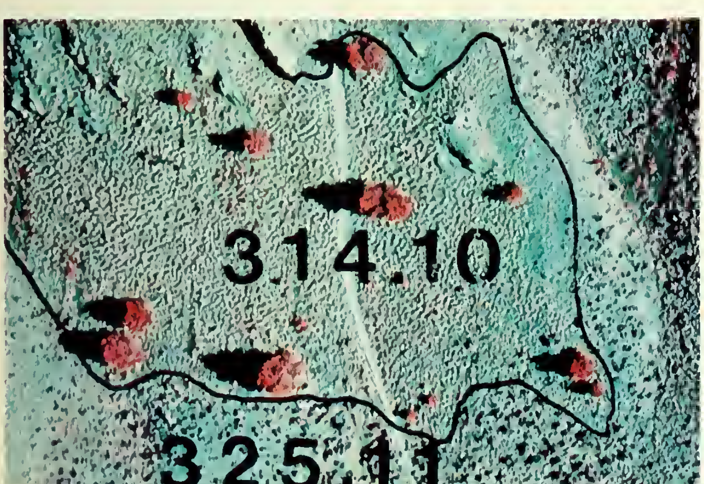

Figure 7. A 1:4,000 June 10, 1977 color infrared aerial photograph illustrating the clumping pattern of the light magenta *Agropyron spicatum* (314.10) plants. *Artemisia tridentata* shrubs appear as larger greyish pink plants within unit 325.11.

Figure 8. A portion of the new 1:20 000 Lac-du-Bois inventory map.

operational but imagery from all three satellites is available. The Lac-du-Bois range served as a pilot project for range inventory mapping. In the following example LANDSAT Imagery and color and color-infrared aerial photography, taken from fixed-wing aircraft, will be used to illustrate the development of range classification, and subsequently, a detailed range inventory for the Lac-du-Bois grasslands. An infrared false-color composite of a LANDSAT image taken on July 29, 1972 provided the basic data (Figure 1). The large black lake at the center top is Kamloops Lake. Kamloops is situated at the eastern end of the lake at the junction of the North and South Thompson Rivers. The original mapping scale was 1:500,000. The blue-green color of the Grass Type (314 in Table 1) can be easily separated from the redder hued Forest Types (340) (Figure 1).

The Lac-du-Bois range, last inventoried in 1956-57, is located at "A". At "B" two separate zones can be mapped within the grasslands. A forest grassland transition area is evident at "C" where blue-green grassland colors are intermixed with the redder hues representative of forest cover. The small bright red areas "a" are irrigated alfalfa fields. Open pit copper mines are located at "b" and "c" and a power line is visible at "d".

Mapping at this scale provides a broad overview of grassland ranges. A Grassland/Forest-Grassland transition map was produced by interpreting twenty-one LANDSAT scenes (Figure 2). By enlarging the LANDSAT imagery from 1:500,000 to 1:150,000 the initial Grass Type (314) can be subdivided and classified into Grass Types (314) and Shrub Types (325) (Figure 3). The first number after the decimal point represents the dominant species. Thus the number 314.3 implies an area of grassland dominated by the grass *Stipa comata* (needle-and-thread grass), while 314.4 represents a grassland community dominated by *Poa pratensis* (Kentucky bluegrass). The two Shrub Type areas, 325.1 and 325.10, are dominated by *Artemisia tridentata* (big sagebrush) where the 325.1 unit can be subdivided further but the 325.10 implies a monotypic stand of *A. tridentata*. The 1:150,000 LANDSAT map provides the same level of detail as did the 1:31,360 1956-57 Tranquille Stock range map.[1]

TABLE 1. A PORTION OF THE REMOTE SENSING CLASSIFICATION LEGEND DEVELOPED FOR THE LAC-DU-BOIS RANGELAND.

300	— Natural Vegetation
310	— Herbaceous Types
313	— Forb Type
313.1	— *Balsamorhiza sagittata* -undifferentiated
313.23	— *Astragalus miser* (serotinus)/*Poa pratensis*
314	— Grass Type
314.1	— *Agropyron spicatum*
314.10	— *A. spicatum*
314.11	— *A. spicatum / Artemisia tridentata*
314.13	— *A. spicatum / Festuca scabrella*
314.132	— *A spicatum / F. scabrella / Chrysothamnus nauseosus*
314.17	— *A. spicatum / C. nauseosus*
314.20	— *Festuca scabrella*
314.3	— *Stipa comata* — undifferentiated
314.34	— *Stipa comata / Poa pratensis*
314.4	— *Poa pratensis* -undifferentiated
314.5	— *Bromus tectorum* -undifferentiated
315.1	— *Elymus condensatus* -undifferentiated
315.11	— *E. condensatus / Bromus tectorum*
325	— Shrub Type
325.1	— *Artemisia tridentata* -undifferentiated
325.10	— *A. tridentata*
325.11	— *A. tridentata / Agropyron spicatum*
325.12	— *A. tridentata / Stipa comata*
340	— Forest Type
341	— Conifer Forest
610	— Residential
881	— Motorcyle / All terrain vehicle destructive use area.

The grasses and shrubs have not been identified directly from LANDSAT Imagery. Different colored units were mapped from the LANDSAT color composite. For example, (1) the *Artemisia tridentata* (325.1) appears grayish hued while (2) the other *A. tridentata* unit (325.10) is a darker shade of grey because there is more *A. tridentata* present, and (3) the 314.3 appears a yellowish red while the 314.4 unit displays redder hues. Identification of the actual plant species present in each unit depends either on field checking a representative portion of the area, and/or using larger scale photography to directly identify the plant communities.

Using a 1:20,000 scale normal color aerial photograph (Figure 4), it is still not possible to identify the species directly from the photographs. The only plant species community identifiable at this scale is *Astragalus miser* (timber milkvetch) (313.23) which appears dark green on normal color photographs and dark reddish-orange on color-infrared photographs. Extensive field traverses or larger scale aerial photography are still required to identify the species composition of the units. Several boundary line types (Figure 4) are used and are described[2], which indicate precision and reliability of the map produced.

Color and color infrared original diapositives at 1:10,000 provide the required detail to identify range species and communities. To date, 30 individual species have been identified on 1:10,000 and 1:4,000 aerial photographs, and 90 plant communities have been recognized and delineated. A 1:12,000 color infrared photograph (Figure 5) was used to produce a corresponding map (Figure 6). Unit 315.11 is dominated by *Elymus condensatus* (giant wild ryegrass), the red area in the center of the unit, and *Bromus tectorum* (downy brome grass) identifiable by its bright yellow hue. The area 881 is a motorcycle-damaged area comprised mostly of bare soil. Unit 325.1 is dominated by *A. tridentata*, black shrubs, while area 314.11 is dominated by *A. spicatum* (bluebunch wheatgrass) and has a minor association of *A. tridentata*. *A. spicatum* and *Festuca scabrella* (rough fescue) are the components of unit 314.13. The *Festuca* appears light pink. At this scale the clumping pattern indicative of *A. spicatum* is difficult to discern. The pattern does become evident at scales of 1:10,000 and larger.

A number of large red *Pinus ponderosa* (yellow pine) trees, and a motorcycle trail are seen on a 1:4,000 color infrared photograph (Figure 7). The clumping pattern of the light magenta hued *A. spicatum* plants, (314.10) is evident. At 1:4,000 it is possible to count the individual 50 cm tall *A. spicatum* plants. Below this unit is 325.11 with a composition of *A. tridentata*, greyish shrubs and *A. spicatum*.

After the units and grasses had been delineated on the photographs the information was transferred to the new 1:20,000 Lac-du-Bois inventory map (a portion is shown in Figure 8). It was completed in 1977 using 1:20,000 color photographs supplemented with one summer's field work.[3] These data were used to sharply update the 1956-1957 Tranquille Stock Range inventory map.

Good inventory data and maps are a must for planning good range management. With new and updated inventory maps, using appropriately dated color and color infrared photographs at scales of 1:10,000 and larger, the job of range management could be made easier and much more effective.

The experience gained in this pilot project will serve as a basis for mapping most of the grassland ranges of British Columbia. The map units identified here are representative of the province. Extrapolation of this system to other areas will provide more accurate maps produced with less field time than has been possible.

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[2] Watson, E.K., P.A. Murtha and A.L. van Ryswyk. 1978. A remote sensing rangeland classification for the Lac-du-Bois grasslands, Kamloops, British Columbia. Proc. Fifth Con. Symp. Remote Sens. Con. Aeronautics and Space Institute. Ottawa, Canada, pp 16-28.

[3] Watson, E.K. 1977. A remote sensing-based multilevel rangeland classification for the Lac-du-Bois rangelands, Kamloops, British Columbia. M. Sc. Thesis. Dept. of Soil Science, University of British Columbia, Vancouver, Canada. 85 pp.

PLUGGING OF SOIL DRAINS BY MICROORGANISMS

K.C. IVARSON AND
M. SOJAK

Une partie importante des terres agricoles au Canada est mal égouttée. Les drains utilisés à cet effet se couvrent souvent d'une substance boueuse, problème auquel on tente d'apporter des remèdes dont font l'objet le présent article.

Of the many thousands of hectares of agricultural land in Southern Ontario, approximately 60 per cent is poorly drained. In the past few years the water in the tiles that drain these soils (Figure 1) is often found to contain a red, slimy substance. This material, also called ochre sludge, is responsible for sealing tile drains and rendering them inoperative in one or two seasons. Ochre sludge seems to occur chiefly in sandy soils and in muck soils underlain with sand; problem sites tend to be in the lower depressional parts of the field.

Two bacterial genera, *Gallionella* and *Sphaerotilus*, both researched in depth here and in other countries, have been found to play a major role in the formation of this slimy substance. A gallon of tile water may contain 40 billion of these bacteria. Each bacterium, measuring about 1/20,000 by 1/2,000 of an inch (Figure 2) attaches itself to surfaces inside and outside the tiles where it (Figure 3) adsorbs large quantities of red iron oxides that are suspended in the flowing water. The heavily iron-encrusted bacteria accumulate to form a wade of gelatinous red material which seals the drain openings (Figure 4) surrounding the plastic, clay or concrete tiles. This impedes the water flow into the tile so that the water table above the drains persists, seriously interfering with crop planting and growth.

Despite the fact that this type of tile clogging has been known for more than 100 years, no practical management methods are known to prevent its formation.

In Florida and California, a variety of techniques such as flushing of problem tile lines with water under pressure, acid treatment, liming of trenches and fields to raise the pH, and a myriad of filter combinations have been tried by researchers without lasting success. Our investigations suggest that if organic matter is placed adjacent to tile, bacterial growth and deposition of the red, slimy substance is promoted. Therefore, the time-honored practice of blinding with topsoil is now being discouraged. To date, farmers or contractors are not being discouraged from tiling in suspect areas. If a suspect area is quite large, the installation of a few trial lines and waiting for up to two years to gauge the extent and severity of the problem are recommended. If the suspect area is small it is recommended to proceed with tiling. The important thing is that if clogging problems, big or small, are suspected the farmer and contractor are made aware of the situation as fully as current knowledge permits.

If an already tiled field has an ochre problem, the installation of one or more catch basins or blind inlets to the tile at the lowest point of depression is advised. This will

Figure 1. Close-up view of a tile outlet showing red, slimy effluent.

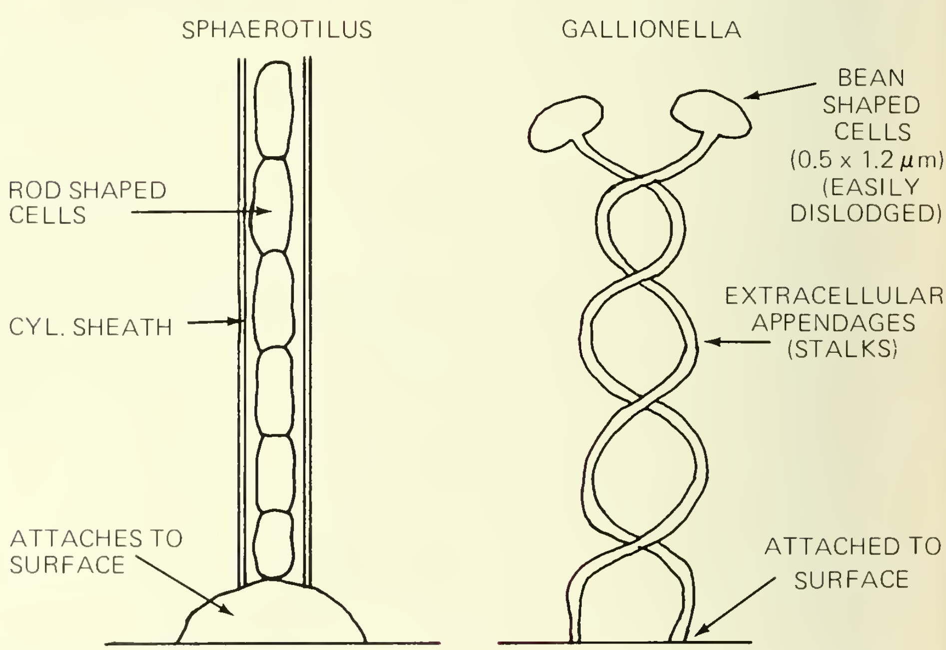

Figure 2. Schematic illustrations of the bacteria *Sphaerotilus* and *Gallionella*, showing method of attachment.

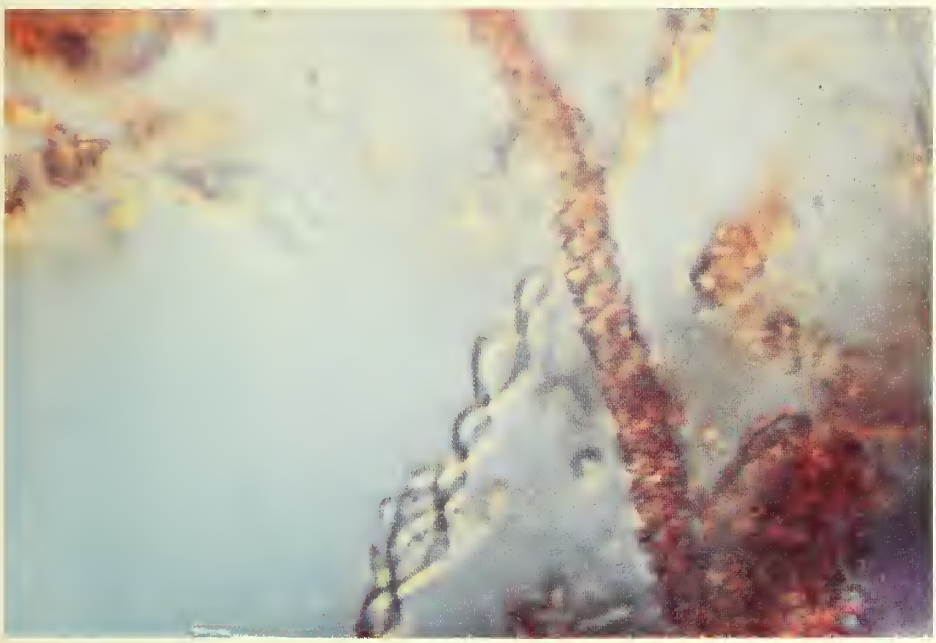

Figure 3. Photomicrograph of *Gallionella* stalks, with and without adsorbed red iron oxides.

Figure 4. An exposed tile (3 yrs. old) at Aylmer, Ontario, showing the drainage holes being plugged with iron-encrusted bacteria

provide the drainage of ponded surface water. If a filter had been used on the tile, it should be cut open along the top of the tile and laid flat along the bottom of the trench. After openings to the tile are cleared of obstruction, backfill the trench to the top with gravel. Farmer and contractor experience to date has shown that a clean washed gravel with all particle sizes included does a good job. Good pit-run gravel which has a wide range of particle sizes and is free of clay and organic matter is very satisfactory and probably most economical. Crushed stone is expensive and has a tendency to be too uniform in size. For instance one inch crushed stone may not have enough small diameter particles in it to act as a good filter in keeping out the sand or silt that may be present in the field soil. For a more technically correct matching of gravel filter to parent soil the reader is referred to recommendations adopted by the Soil Conservation Service of the United States Department of Agriculture. (Ref. Drainage Materials, Special Publication SP-01-67, page 25, American Society of Agricultural Engineers, St. Joseph, Mich.).

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AFFAISSEMENT DES SOLS ORGANIQUES AU QUÉBEC CAUSÉ PAR LEUR MISE EN CULTURE

J.A. MILLETTE,
J.A. CAMPBELL, B. VIGIER

Les propriétés chimique et physique des sols organiques en font un milieu approprié à la culture et, de ce fait, très apprécié des horticulteurs. Cependant, certains des avantages qu'ils offrent à la croissance des plantes, comme leur facilité de pénétration par les racines constitue un inconvénient pour leur exploitation lorsqu'on utilise de la machinerie lourde. La Station de recherches du ministère de l'Agriculture du Canada à Saint-Jean (Québec) a axé ses travaux sur la gestion et la conservation des sols organiques dans le sud-ouest de la province.

Les sols organiques résultent de la décomposition incomplète de débris végétaux dans un milieu humide et anaérobie. Dans le sud-ouest du Québec, ils se sont formés principalement dans les étangs et les lacs peu profonds laissés par le retrait de la mer de Champlain. L'action combinée de facteurs géologiques, pétrographiques, topographiques, biologiques et climatiques a participé à l'accumulation de ces dépôts.

À l'ouest du Richelieu, on trouve huit dépôts importants dont les superficies varient de 360 à 6 500 hectares. En 1971, 20 000 hectares environ ont été prospectés: 13 000 hectares avaient une profondeur de sol organique de 0,6 mètre ou davantage et 8 500, de 1,2 mètre ou davantage. De cette surface, près de 6 500 hectares servent à la production légumière, le reste est soit boisé ou en friche ou encore utilisé pour d'autres cultures et autres usages. Tous se situent dans un rayon d'environ 56 kilomètres de Montréal.

Le drainage et la culture favorisent la décomposition des sols organiques et conduisent, par conséquent, à un affaissement de la surface — phénomène connu sous le nom de subsidence. En d'autres termes, la subsidence est le résultat de la perte de volume du sol à la suite du drainage, de l'oxydation et de la compaction résultant de la culture et de pertes directes dues à l'érosion par le vent et l'eau et au brûlage des terres.

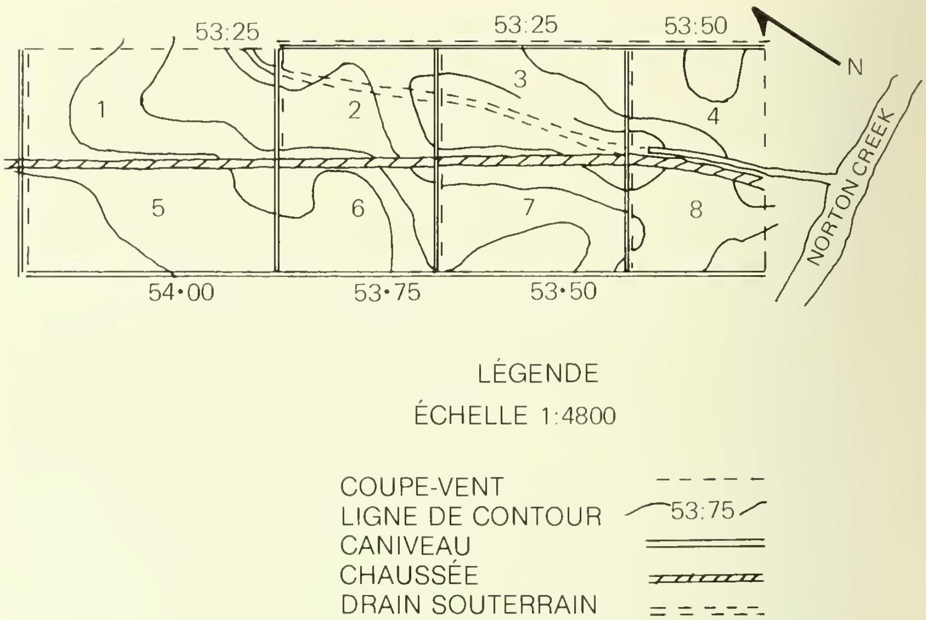

Figure 1 Carte en courbes de niveau de la sous-station d'Agriculture Canada à Ste-Clothilde, Québec.

L'inquiétuide suscitée par la subsidence des sols organiques utilisés pour la production légumière n'est pas nouvelle. Des études effectuées à travers le monde montrent que le taux de subsidence varie de 0 à 10 cm par année selon certains facteurs comme le climat, le type de sol, sa profondeur, le niveau de la nappe phréatique et la durée des relevés.

Au départ les taux de subsidence ont été observés à la Sous-station fédérale de Sainte-Clothilde en 1974. L'étude menée à l'époque, après 38 ans de culture, ne portait que sur une partie seulement de l'étendue de sols organiques. Les données venues s'ajouter en 1978 révèlent que ce taux varie d'un champ à l'autre.

La Sous-station se divise en huit champs (figure 1) qui, en 1974 et en 1978, ont tous été arpentés. Les données recueillies en 1974 ont été comparées à celles d'une étude antérieure menée en 1936 (les résultats sont consignés dans le tableau 1).

Chaque année, de 1974 à 1978, l'extrémité nord des champs 1 et 5 a été ensemencée en avoine. Cette pratique a ralenti le taux de subsidence qui n'a accusé que de légères augmentations par rapport à la moyenne. En revanche, les données recueillies sur l'autre partie du champ 1 indiquaient toujours une chute annuelle moyenne de 1,9 cm par année, taux légèrement moindre toutefois que pour les 38 années précédentes. Dans le champ 5, le rythme s'est stabilisé considérablement, tombant à moins de la moitié de ce qu'il était durant cette même période.

Dans les autres champs, la subsidence s'est accélérée. Dans trois d'entre eux, le rythme a plus que doublé entre 1974 et 1978 (tableau 1). Cela tient à ce que durant les crues printanières, le niveau de l'eau atteint les champs 3 et 7, le sol encore gelé se détachant alors en grandes plaques pour être entraîné par le courant. Durant l'été, le ruissellement superficiel provenant des fermes environnantes lessive une bonne partie de la couche de sol organique qui est bien humifiée et riche en éléments nutritifs. Ces deux phénomènes se soldent par la perte de quantités considérables de sol dans les champs non protégés.

Afin de ralentir les taux excessifs de subsidence, des mesures de conservation ont été prises pour contenir les pertes dues à l'érosion par l'eau et le vent. La plupart des friches ont été ensemencées en avoine que l'on coupe une à deux fois durant l'été. Les champs 2 et 3 ont été protégés par une rigole qui intercepte l'eau de ruissellement provoqué par les crues-éclair au printemps et en été et on a installé de nouveaux dispositifs de drainage souterrain dotés de puits de contrôle dans les champs 6 et 7.

La Station fédérale de recherches de Saint-Jean (Québec a mis en

TABLEAU 1. TAUX DE SUBSIDENCE À LA SOUS-STATION FÉDÉRALE DE STE CLOTILDE (QUEBEC)

Champ	Taux moyen de subsidence (cm/année) de 1936 à 1974	de 1974 à 1978
Portion ensemencée en avoine (1et5)	2.1(12)	0.1(10)
1*	2.2(15)	1.9(15)
2	2.1(13)	5.1(15)
3	2.2(8)	4.1(18)
4	1.9(3)	4.8(11)
5	2.0(15)	.8(8)
6	1.9(14)	4.6(14)
7	2.0(6)	2.4(9)
8	—	3.4(6)

* non compris dans la partie en avoine
** les chiffres entre parenthèses représentent le nombre de lectures par champ

Érosion du sol organique causée par l'eau lors dégel au printemps.

oeuvre plusieurs travaux sur la conservation et la gestion des sols organiques. Mais si les solutions mentionnées plus haut ralentissent le phénomène, il nous faut des solutions à long terme. La fréquence et la gravité des inondations s'accroîtront au fur et à mesure que le sol s'affaissera et que les superficies drainées augmenteront. Par conséquent, si l'on veut prolonger la vie de ces terres organiques, il faudra pratiquer les mesures de drainage contrôlé et combattre par des méthodes culturales, l'érosion excessive due au vent et à l'eau.

Les auteurs sont des chercheurs de la Station fédérale de Saint-Jean au Québec.

SUBSIDENCE AS RELATED TO ORGANIC SOIL MANAGEMENT IN QUEBEC

J.A. MILLETTE, J.A. CAMPBELL, B. VIGIER

The chemical and physical properties of organic soils make these soils a suitable medium for plant growth, and thus very valuable to the horticultural industry. Some of the advantages that organic soils possess with respect to plant growth, such as easy root penetration, constitute a disadvantage from a management point of view such as when heavy machinery is used. Efforts of the Agriculture Canada Research Station at St-Jean, Quebec have been directed towards the management and conservation of organic soils in south western Quebec.

Organic soils are produced by the incomplete decomposition of vegetable debris under wet anaerobic conditions. In south western Quebec, these organic soils were formed mostly in shallow lakes and ponds that were left behind as the waters of the Champlain Sea retreated. The combined action of geology, petrography, topography, biology and climate were factors that assisted in the formation of these deposits.

West of the Richelieu River, eight principal deposits are found ranging in size from about 360 ha to over 6,500 ha. In 1971, approximately 20,000 ha were surveyed. The survey showed that there were 13,000 ha with a depth of soil of 0.6 m or more and 8,500 ha with a depth of 1.2 m or more. Of this surveyed area, nearly 6,500 ha are used for vegetable production, the remainder is either wooded and uncultivated, or used for other crops and purposes. These areas are within a radius of about 56 km of Montreal.

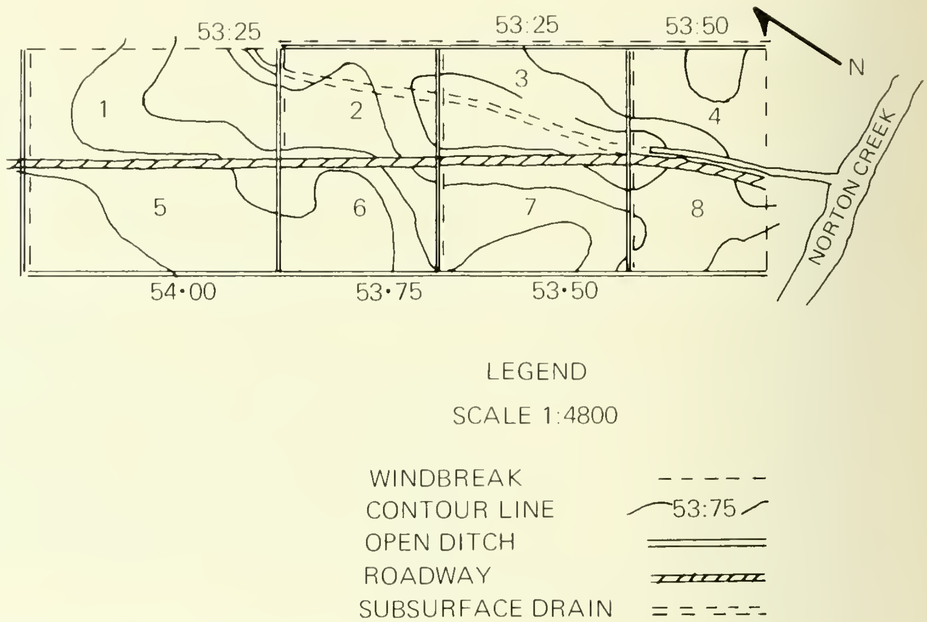

Figure 1. Contour map of Agriculture Canada Sub-station at Ste. Clothilde, Quebec.

Drainage and cultivation are instrumental in stimulating the decomposition of organic soils, and as a result the surface elevation is lowered — a condition known as subsidence. Therefore, subsidence is a result of soil shrinkage after drainage, oxidation, and compaction after cultivation, and direct loss by wind and water erosion and burning.

Subsidence of organic soils used for vegetable production has long been a major concern. Studies throughout the world have shown the rate of subsidence varies from 0 to 10 cm per year, depending on such factors as climate, soil type, soil depth, water table depth and length of record.

Initially, subsidence rates were measured at the Agricultural Canada Sub-station at Ste. Clotilde in 1974. At that time, after 38 years of cultivation, only part of the organic soil area was surveyed. Additional data obtained for 1974 and 1978 reveal that subsidence rates vary from field to field.

The Ste. Clotilde Sub-station is divided into eight fields (figure 1). In 1974 and 1978 all of the fields at Ste. Clotilde were surveyed. The data obtained from the 1974 survey was compared with that of an earlier survey carried out in 1936. The results are reported in table 1.

Starting in 1974 until elevations were again taken in 1978, the north ends of fields 1 and 5 were seeded with oats every year. This practice reduced the subsidence rate to the extent that there were only slight increases in the average rate. Data from the other part of field 1, however, still showed an average annual drop of 1.9 cm a year. This was slightly less than the rate for the previous 38 years. In field 5 the rate stabilized considerably, dropping to less than half of what it was during the previous 38 years.

In the remaining fields subsidence rates increased. Three of the fields more than doubled their subsidence rate between 1974 and 1978 (Table 1). During spring floods the water levels reach fields 3 and 7, and the soil still frozen, breaks away in large chunks and is carried away. Surface runoff from neighboring farms during the summer has washed away a good part of the top portion of the organic soil, which is well humified and rich in nutrients. These two activities have resulted in the removal of large quantities of soil from the unprotected fields.

Attempting to reduce the excessive rates of subsidence, conservation measures were taken to reduce soil losses from water and wind erosion. Most of the uncultivated areas were seeded with oats which is cut once or twice during the season. Fields 2 and 3 were protected by a ditch that intercepts overland flow from the spring and summer flash floods. New subsurface drainage systems equipped with a drainage control outlet were installed in fields 6 and 7.

TABLE 1. SUBSIDENCE RATES AT THE AGRICULTURE CANADA SUB-STATION AT STE. CLOTILDE, QUEBEC

Field	Average Subsidence Rate, cm/year Period 1936-1974	Average Subsidence Rate, cm/year Period 1974-1978
Oat portion of 1 and 5	2.1 (12)**	+0.1 (10)
1*	2.2 (15)	1.9 (15)
2	2.1 (13)	5.1 (15)
3	2.2 (8)	4.1 (18)
4	1.9 (3)	4.8 (11)
5*	2.0 (15)	.8 (8)
6	1.9 (14)	4.6 (14)
7	2.0 (6)	2.4 (9)
8	-	3.4 (6)

*not including oat portion
**values in brackets are the number of readings taken per field

Organic soil erosion caused by heavy rainfall.

Agriculture Canada Research Station at St-Jean, Quebec has initiated several projects related to organic soil conservation and management. Although practical solutions as mentioned above, restrain the problem, long term solutions are required. Flooding will become more frequent and severe as the soil subsides and additional farm land drained. Controlled drainage and protection against excessive wind and water erosion through cultural practices is essential if the life of these soils is to be prolonged.

The authors are research scientists at Agriculture Canada Research Station, St. Jean, Québec.

ESTIMATING CROP EVAPOTRANSPIRATION FOR IRRIGATION SCHEDULING

C.S. TAN

La production alimentaire est affectée par la sécheresse presque toutes les années. Pour réussir à obtenir un bon rendement lors de ces périodes de sécheresse alors que l'humidité dans les sols se perd par évapotranspiration, la saison de culture doit refaire ses provisions d'eau soit par la pluie ou l'irrigation. On obtiendra de bons résultats avec l'irrigation si l'on arrose avec la bonne quantité d'eau, au bon moment. Une bonne façon de faire un meilleur usage de l'eau et d'obtenir un rendement maximum consiste à faire une estimation rapide et exacte du taux d'évapotranspiration dans le sol pour ensuite ajouter la quantité d'eau adéquate.

The cost of energy for irrigation has been rising steadily. Applying the proper amount of water at the right time is important for reducing costs and maximizing profits.

Canada is a region with a high potential for food production during the summer growing season. Even in humid regions, there are periods of water shortage almost every year, which lead to a reduction in crop yield. Water depleted from the soil by crop evapotranspiration (total loss of water vapor to the atmosphere by vegetation and soil) during the growing season must be replenished by irrigation or rain in order to achieve maximum production. Maximum benefit from irrigation will result if water is added in an appropriate amount and at the right time to prevent excessive moisture stress in the crop due to high atmospheric demand. One way to improve water use and obtain maximum yields is to estimate rapidly and reliably crop evapotranspiration and add the required amount of water.

Crop evapotranspiration is influenced by the stage of crop growth, percentage of foliage cover on the soil, plant height and total leaf surface. It can be estimated from the product of maximum evapotranspiration (the maximum amount of water vapor which could be transferred from an area to the atmosphere under the existing meteorological conditions) and a crop factor. The crop factor varies with the crop development stage. For annual crops, such as potatoes, corn and tomatoes, the crop factor depends on the percentage of foliage cover over the soil. It increases from emergence to approximately 50 to 80 per cent of foliage cover, remains at a maximum value for about 2 to 5 weeks, and decreases thereafter, until the crop approaches maturity (Figure 1).

It is difficult to measure maximum evapotranspiration directly under field conditions, so various methods have been developed for estimating it from climatic variables. Most methods have been designed for specific local conditions and may not have application elsewhere. This is a general weakness of several evapotranspiration models in current use. Use, over a wide range of climatic conditions, of the simple product of air temperature times radiation has been compared with numerous other evapotranspiration models and direct field measurement of evapotranspiration using lysimeters. The results indicate that temperature times radiation is probably a better index of maximum evapotranspiration than any of the other models tested. This model has been adopted at Harrow and forms the basis of this paper.

In developing a methodology for estimating the maximum evapotranspiration consideration must be given to the availability of data, ease of computation and reliability of results over a wide range of climatic conditions. In Canada, radiation has been measured at about 25 stations and daily bright sunshine at about 208 stations. In order to have sufficient data it was necessary to derive relationships for estimating radiation from daily duration of bright sunshine. The prediction equation used at Harrow is similar to the finding of Baier and Robertson in 1965 (Can. J. Plant Sci. 45). This equation is often used elsewhere in Canada where radiation is not available for a particular region or area. The relationship is as follows:

$R_n = (0.114 + 0.365\ n/N)\ R_a - 0.039$ ---- (1)

where R_n is net radiation (mm/day), n is duration of bright sunshine (hours) and can be obtained from Meteorological Branch of the Environment Canada or can be measured. N is the maximum possible hours of bright sunshine (hours). R_a is downward solar radiation for the same latitude outside of the atmosphere (extraterrestrial radiation). Values for R_a and N at different latitudes and months are given in Table 1 and 2 or can be obtained from Canada Department of Agriculture Publication 1522. The latitude of different locations can be obtained from local weather stations or the Meteorological Branch of Environment Canada. A simple equation based on product of temperature times daily bright sunshine and crop factor for estimating crop evapotranspiration has been developed:

$ET_o = (0.605 + 0.013\ T_a) \times R_n \times K_c$ --- (2)

where ET_o is crop evapotranspiration (mm/day). T_a is the mean air temperature, for daily estimates calculated from $T_a = (T_a\ max + T_a\ min)/2$. R_n can be calculated from equation (1). K_c is the crop factor. For most purposes, generalized crop factors (table 3) can be used to estimate crop evapotranspiration. If locally determined values for K_c are available, they should be used in the calculation.

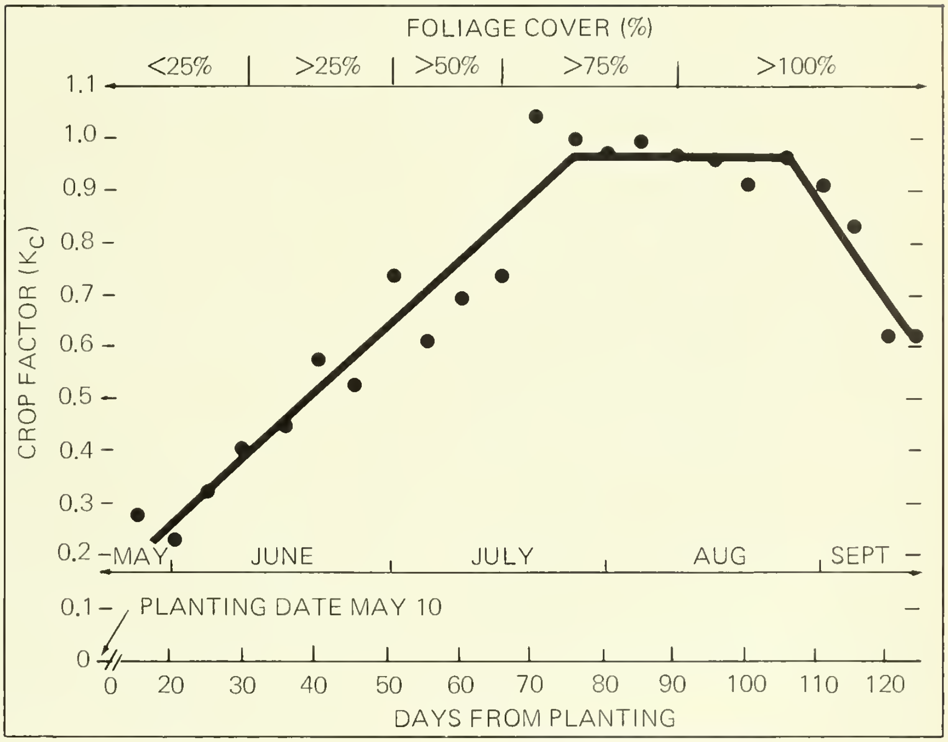

Figure 1. Example of crop factor curve for corn at Harrow in Southwestern Ontario. (Tan and Fulton, 1980. Can. J. Plant Sci. 60)

Example 1: Corn is sown in early May at Harrow (latitude 42°N). On August 15, the daily bright sunshine (n) is 12.0 hr/day, the maximum daily air temperature (T_a max) is 25°C, and the minimum daily air temperature is 15°C. Determine the daily crop evapotranspiration (ET_o).

Calculation: Value of maximum bright sunshine hours (N) for latitude 42°N and month of August from Table 1 is 13.9 hr/day. Extraterrestrial radiation (R_a) for latitude 42°N and month of August from Table 2 is 15.2 mm/day. Net radiation (R_n) calculated from equation (1) is (0.114 + 0.365 x 12.0/13.9) x 15.3 — 0.039 = 6.48 mm/day. Mean daily air temperature (T_a) is $\frac{12 + 15}{2}$ = 20°C. Locally determined crop factor for August 15 from Fig. 1 is 0.95. Crop evapotranspiration (ET_o) calculated from equation (2) is (0.605 + 0.013 x 20) x 6.48 x 0.95 = *5.32 mm/day.*

Example 2: Corn is sown in late May at Ottawa (latitude 45°N). On July 15, the daily bright sunshine (n) is 10.0 hr/day, the maximum daily air temperature (T_a max) is 20°C, and the minimum air temperature (T_a min) is 15°C. Determine the daily crop evapotranspiration (ET_o).

Calculation: Value of N for latitude 45°N and month of July from Table 1 is 15.3 hr/day. Extra-terrestrial radiation (R_a) for latitude 45°N and month of July from Table 2 is

TABLE 1. MEAN DAILY MAXIMUM DURATION OF BRIGHT SUNSHINE HOURS (N) FOR DIFFERENT MONTHS AND LATITUDES (SUMMARIZED FROM CANADA AGRICULTURE PUBLICATION 1522, 1974).

	Northern Hemisphere											
Latitude	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
60	6.7	9.2	11.7	14.6	17.2	18.8	18.1	15.7	12.9	10.2	7.5	5.9
58	7.2	9.4	11.8	14.4	16.7	18.1	17.5	15.4	12.8	10.3	7.9	6.5
56	7.6	9.6	11.8	14.2	16.3	17.6	17.0	15.1	12.8	10.5	8.3	7.0
54	8.0	9.8	11.8	14.0	16.0	17.1	16.6	14.9	12.7	10.6	8.6	7.4
52	8.3	10.0	11.8	13.9	15.7	16.7	16.3	14.7	12.7	10.7	8.8	7.8
50	8.6	10.1	11.8	13.8	15.4	16.3	15.9	14.5	12.6	10.8	9.1	8.1
48	8.8	10.3	11.9	13.7	15.2	16.0	15.7	14.3	12.6	10.9	9.3	8.4
36	9.0	10.4	11.9	13.5	15.0	15.7	15.4	14.2	12.6	11.0	9.5	8.7
44	9.3	10.5	11.9	13.4	14.8	15.5	15.2	14.0	12.5	11.0	9.6	8.9
42	9.5	10.6	11.9	13.4	14.6	15.2	14.9	13.9	12.5	11.1	9.8	9.1
40	9.6	10.7	11.9	13.3	14.4	15.0	14.7	13.8	12.5	11.2	10.0	9.3
38	9.8	10.8	11.9	13.2	14.2	14.8	14.5	13.6	12.4	11.2	10.1	9.5
36	10.0	10.9	11.9	13.1	14.1	14.6	14.4	13.5	12.4	11.3	10.3	9.7
34	10.1	11.0	11.9	13.0	13.9	14.4	14.2	13.4	12.4	11.4	10.4	9.9
32	10.3	11.1	12.0	13.0	13.8	14.2	14.0	13.3	12.4	11.4	10.5	10.1
30	10.4	11.1	12.0	12.9	13.7	14.1	13.9	13.2	12.4	11.5	10.6	10.2

TABLE 2. EXTRATERRESTRIAL RADIATION (R_a), EXPRESSED IN EQUIVALENT EVAPORATION IN MM/DAY (SUMMARIZED FROM CANADA AGRICULTURE PUBLICATION 1522, 1974).

	Northern Hemisphere											
Latitude	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
60	1.4	3.6	7.1	11.6	15.3	17.2	16.3	13.1	8.8	4.8	2.0	.9
58	1.8	4.2	7.6	11.9	15.5	17.2	16.4	13.4	9.3	5.3	2.4	1.3
56	2.3	4.7	8.1	12.3	15.6	17.3	16.5	13.7	9.7	5.8	2.9	1.7
54	2.8	5.2	8.6	12.6	15.8	17.3	16.6	13.9	10.1	6.3	3.4	2.2
52	3.2	5.7	9.0	12.9	16.0	17.4	16.7	14.1	10.5	6.8	3.9	2.7
50	3.7	6.2	9.5	13.2	16.1	17.4	16.8	14.4	10.9	7.3	4.4	3.1
48	4.2	6.7	9.9	13.5	16.2	17.4	16.8	14.6	11.3	7.8	4.9	3.6
46	4.7	7.2	10.3	13.8	16.3	17.5	16.9	14.8	11.6	8.3	5.4	4.1
44	5.2	7.7	10.7	14.1	16.4	17.5	16.9	15.0	11.9	8.7	5.9	4.6
42	5.8	8.2	11.1	14.3	16.5	17.5	17.0	15.2	12.3	9.2	6.4	5.1
40	6.3	8.6	11.5	14.5	16.6	17.4	17.0	15.3	12.6	9.6	6.9	5.6
38	6.8	9.1	11.9	14.7	16.6	17.4	17.0	15.5	12.9	10.1	7.4	6.2
36	7.3	9.6	12.2	14.9	16.7	17.4	17.0	15.6	13.2	10.5	7.9	6.7
34	7.8	10.0	12.6	15.1	16.7	17.3	16.9	15.7	13.5	10.9	8.4	7.2
32	8.3	10.4	12.9	15.2	16.7	17.2	16.9	15.8	13.8	11.3	8.9	7.7
30	8.8	10.9	13.2	15.4	16.7	17.1	16.9	15.9	14.0	11.7	9.3	8.3

16.9 mm/day. Net radiation (R_n) calculated from equation (1) is (0.114 + 0.365 x 10.0/15.3) x 16.9 — 0.039 = 5.92 mm/day. Mean daily air temperature (T^a) is $\frac{20 + 15}{2}$ = 17.5°C.

Crop factor (K_c), using average seasonal value from Table 3 is 0.9. Crop evapotranspiration (ET_o) calculated from equation (2) is (0.605 + 0.013 x 17.5) x 5.92 x 0.9 = *4.44 mm/day.*

Crop evapotranspiration calculated from crop factors and maximum evapotranspiration derived from temperature and daily bright sunshine, provides for the estimation of irrigation require-

TABLE 3. GENERALIZED CROP FACTORS (K_c) FOR USE WITH MAXIMUM EVAPOTRANSPIRATION (HARGREAVES, 1974, ASAE TRANSACTIONS 17, NO. 4)

Crop	*Average KC for Full Crop Cover	**Average Seasonal KC
Field and oil crops including beans, castor beans, corn, cotton, flax peanuts, potatoes, safflower, soybeans, sorghum, sugar beets, tomatoes and wheat	1.15	.90
Fruits, nuts and grapes		
Citrus fruits (oranges, lemons and grapefruits)	.75	.75
Deciduous fruits (peaches, plums and walnuts)	.90	.75
Deciduous fruits with cover crop	1.25	1.00
Grapes	.75	.60
Hay, forage and cover crops		
Alfalfa	1.35	1.00
Short grass	1.00	1.00
Clover pasture	1.15	
Green manure	1.10	.95
Sugar cane	1.25	1.00
Summer vegetables	1.15	.85

* Recommended for designing system capacity
** To be used in estimating seasonal requirements and for economic analysis. Provides satisfactory results for irrigation scheduling for most soils with good capacity to store readily available moisture.

ments and for irrigation scheduling. At Harrow in Southwestern Ontario in 1979, estimates of crop evapotranspiration were successfully used to develop irrigation schedules for tomatoes grown on Fox sandy loam and peaches grown on Fox sand. Comparisons made with irrigation schedules based on soil moisture measurements indicated that this method of estimating crop water requirements for irrigation scheduling is not only effective but less expensive to use than soil moisture measurements.

A simple equation, requiring only temperature, daily bright sunshine and a crop factor, can be used to accurately predict the optimum time and amount of irrigation water a crop requires for maximum yield, and thereby increasing the potential net returns to the grower.

Dr. Tan is a research scientist at Agriculture Canada's research station at Harrow, Ontario.

VITAMIN D NUTRITION OF THE BOVINE

M. HIDIROGLOU AND
J.G. PROULX

La vitamine D est essentielle au développement des os des bovins. Cette vitamine joue un rôle important dans l'absorption du calcium et du phosphore par l'appareil digestif de l'animal. L'espèce bovine reçoit la vitamine D par radiations de rayons ultraviolets sur la peau ou par l'ingestion de plantes qui ont été exposées à ces rayons.

L'absorption de vitamine D sera évidemment beaucoup plus faible durant les mois d'hiver, spécialement dans les zones agricoles du nord du Canada. Des carences peuvent également se manifester quand le troupeau reste dans les étables et est alimenté au fourrage durant toute l'année. Il est souhaitable, dans ce cas, d'ajouter des vitamines D à la nourriture ou de les administrer par injections intramusculaires.

Vitamin D is essential for normal bone development of the bovine. This fat soluble vitamin plays an important role in the absorption of calcium and phosphorus from the digestive system of the animal. Vitamin D, while helping to maintain a normal serum level of these two minerals, is also necessary in the calcium and phosphorus deposition in the bone tissue of the growing animal as well as in the foetus.

The bovine species receive vitamin D either by ultraviolet radiation of the skin or from the ingestion of plants which have been exposed to this irradiation during field-curing. This conversion of vitamin D precursors is lower during the winter particularly in the agricultural areas of Northern Canada for example, Northeastern Ontario, Northwestern Quebec and the more northerly areas of Western Canada. Moreover, silage which often is the sole feed ingredient of pregnant beef cows and growing animals, will contain little vitamin D as the forage will not have been dried in the field. Thus, conversion by ultraviolet rays will not have happened.

At our latitude, 50° North, the average monthly ultraviolet irradiation between September and April, is much lower than during the period of May to August.

We compared the vitamin D serum levels (24-hydroxyvitamin D) of a group of yearling beef heifers which had been wintered outdoors without shelter to that of a group which had been wintered in a barn without access to daylight. As can be seen in Figure 1, the serum level was low in both groups during the period of December to May.

The 25-hydroxyvitamin D serum level of the heifers that had been wintered outdoors showed a marked increase in June; it was two to three times as high as during the winter or of those that were kept indoors during the summer period. This low level 25-hydroxyvitamin D during the winter is believed to be related to the fact that the active ultraviolet irradiation is very low when the sun's angle at the horizon is below 20°. At our latitude, this happens during fall, winter and early spring. For that reason, it is recommended that vitamin D be added to the mineral or salt supplement, even if the animals are wintered outdoors.

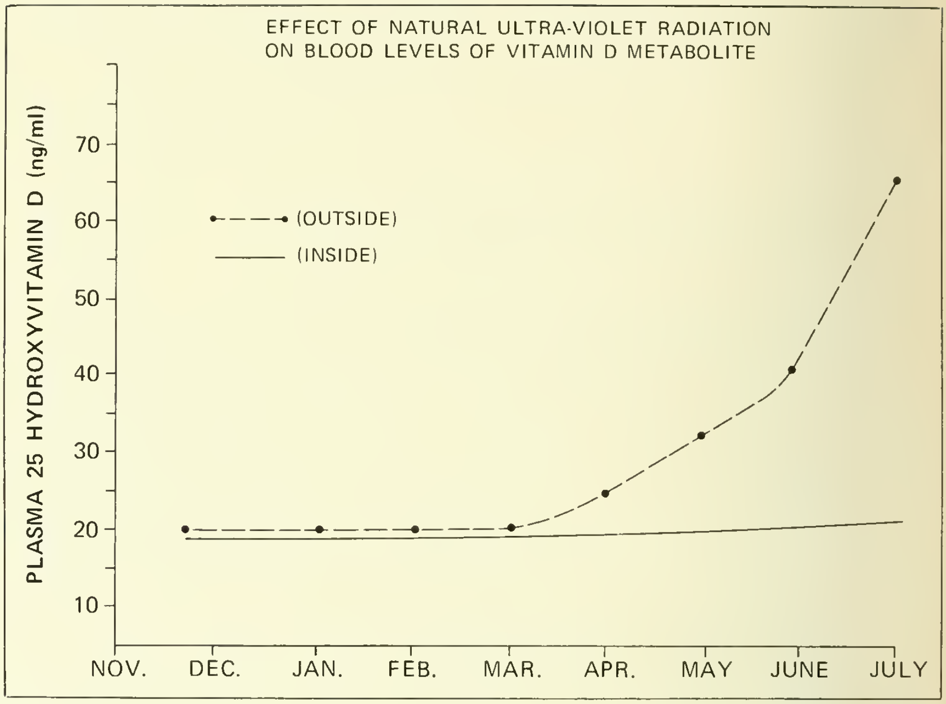

Figure 1.

In another experiment, good quality grass silage was fed ad lib to a group of heifers. This silage was ensiled directly after cutting (without wilting) and formic acid was used as a preservative. Since the vitamin D content of this silage was very low, as expected the serum level of those heifers was very low.

During another experiment, which was also conducted during the winter, different methods of vitamin D supplementation were compared on silage fed beef heifers. Vitamin D was supplied through the mineral supplement either by one massive oral dose or by one single injection. It was found that a single injection of vitamin D_3 (1,000,000 I.U.) to 300 kilograms, Hereford Shorthorn heifers maintained a normal blood level for 52 days. It was also found that the addition of vitamin D to the mineral supplement was more effective in maintaining a normal blood level than giving a single oral massive dose.

During the winter, when growing bovines are fed grass silage, vitamin D must be supplemented to the diet or supplied by intramuscular injection. Vitamin D which is essential for normal growth, is produced only during the summer when ultraviolet radiation of the animal's skin transforms the vitamin D precursors into the active form.

Our research in this area is continuing and other recommendations will be formulated later.

From these results, we suspect that dairy cattle which are fed silage year round could be very susceptible to vitamin D deficiency diseases. This would be specially probable when the herd has little exposure to ultraviolet radiation. It is therefore recommended that the dairy producer who keeps his replacement animals in the barn till the age of 8 to 12 months make sure that the vitamin D intake of his young bovines is adequate.

Dr. Hideroglou is a research scientist with the Animal Research Institute, Ottawa and Dr. Proulx is Superintendant at Agriculture Canada Research Station Kapuskasing, Ontario.

ECHOES
FROM THE FIELD AND LAB

ECHOS
DES LABOS ET D'AILLEURS

SALMONELLA CO-ORDINATING UNIT Agriculture Canada's newly formed Salmonella Co-ordinating Unit is drawing up an action plan to reduce the incidence of salmonella contamination in Canadian poultry and meats.

Consumers can control salmonella bacteria by proper food handling and cooking. However, both government and industry are working on more effective bacterial control programs for all sectors of the poultry industry.

Dr. J.R. Pettit and A.H. Bentley are the scientific and program co-ordinators of the unit in Ottawa.

Since the unit's formation in February, the two co-ordinators have begun cross-country consultations with representatives of the poultry industry, provincial and regional veterinarians and the regional directors of the Food Production and Inspection Branch.

On the basis of these discussions, recommendations will soon be made and pilot projects planned to test practical ways to reduce the numbers of salmonella bacteria now present in poultry products.

This first phase of the Salmonella Co-ordinating Unit's work will continue until September of this year. Then, if Agriculture Canada's Senior Management Committee accepts the unit's report, the testing and analysis of the recommendations will begin.

If test results are favorable, the cost of implementing the recommendations throughout Canada will be calculated. Assuming that costs are reasonable and that benefits outweigh costs, implementation in the poultry industry would begin in early 1982.

"We are not attempting to impose restrictive regulations," Mr. Bentley says. "Our approach is to find practical solutions to the salmonella problem. This will allow the meat industry to improve product quality."

RESEARCH TO AID WORLD HUNGRY An Agriculture Canada scientist is part of an international team helping to increase the world's food supply.

Rob Rennie of the department's Lethbridge Research Station, is a specialist in nitrogen fixation by bacteria in plants. Dr. Rennie and the other members of the team around the world advise about 20 developing countries on ways to use nitrogen fixation research to grow more high-protein food.

Nitrogen fixation can give immediate benefits to many developing countries, but it could also be important to Canadian farmers if nitrogen fertilizer prices continue to rise.

EVALUATING CANADIAN LAND USE Many nations envy Canada's wealth of agricultural land, but Agriculture Canada's land resource scientists stress that this wealth is far from limitless.

Only about 4.3 percent of Canada's billion hectares of land is improved, productive farmland. And less than one percent more is marginally useful to agriculture.

The conversion of some prime farmland to urban, transportation and industrial uses is continually limiting the land resource available for agriculture.

Agriculture Canada's Land Resource Research Institute in Ottawa has recently completed the computerization of all current soil inventory data into a program called CanSIS, the Canada Soil Information System. The project is aimed at providing information to help in evaluating land use.

CanSIS provides data on potential land uses and potential crop yields to those who make decisions and set policies regarding land use. It is integrated with climatic and economic data to enable a good evaluation of present and future land uses.

Land evaluation specialist Dr. Bruce MacDonald says the maps and other data provided by CanSIS are a tremendous new resource for farmers, engineers, urban planners, forestry specialists, parks and wildlife people, northern developers and a host of others.

CanSIS can produce simplified maps showing characteristics of the soil and terrain, either singly or in combination. The choice of characteristics may include soil texture, acid balance, depth and drainage, slope of the land, vegetation types, best adapted crops, and distribution of wildlife.

The CanSIS maps can be laid over standard maps drawn to the same scale to show residential areas, roads and railroads.

The most extensive use of this information is for agricultural evaluations and recommending to farmers which crops and fertilizers are most suited to their own areas.