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On Using Soil Wisely

THROUGH MILLIONS of years nature built up a balance between animal, vegetable and mineral life. She tied the mixture in place on the earth's surface by the interlacing of grass roots on our prairies and tree roots in our forests. The leaves she discarded in autumn became part of the soil that produced them.

But we humans came and broke the prairies and cleared away the forests. We upset the balance of nature. Today, our earth is sick.

We had an abundance of resources when our forefathers came to live in this country. We acted like the people at Alice in Wonderland's mad tea-party: when the tea and cakes were exhausted at their places the Mad Hatter and the March Hare moved on to the next seats. When Alice asked what would happen when they came to the end of new seats, the March Hare changed the subject.

All through the ages we have struggled to wrest the land from nature, and our conquest has been disastrous. Nature does not submit willingly to conquest, and today you may read the dismal story of our "victory" in washed-out farm land, sand-blown pastures, and depopulated townships. We don't need to go back for examples to the deserts of Asia Minor, where 500 cities once flourished on a good agricultural base; we can see the beginnings of land exhaustion in an hour's drive from any town in Canada.

It would be unfair to blame our early settlers, as is so often done. They lacked the scientific knowledge we have. It may have been their only way of self-preservation to hew down trees so as to reach the soil on which to grow crops. There was a time when people believed in the agricultural destiny of forest land. And there were times in Canada's early history when food was hard to get.

That belongs to the past. Water and wind have flayed the skin off the unprotected earth, and that this has continued up to our own time is chargeable to our neglect and not to the actions of our forefathers.

Some of our tilled land should never have been broken to the plough, and we should return it to trees or grass. Some of our farm land needs rebuilding organically if it is to continue providing its owners with an adequate level of comfort. Some needs attention just to preserve it from destruction. All of our land needs careful management.

And what has this to do with people who live in cities? Merely this: a prosperous agriculture makes possible successful business, thriving trading centres, a high level of industrial activity, and health.

It was thirty years ago, around 1926, that articles in the popular press about soil erosion attracted wide public attention. Then followed the droughts of the 1930's, making every newspaper reader conscious of the damage being done to our soil and our people. Erosion moved to the forefront of interest when President Roosevelt established a soil erosion service in the United States Department of the Interior in 1933 with a mandate to stop erosion.

Human erosion

Just what, in plain terms, does this deterioration of land mean to us? One result of lack of conservation is a lowered level of living and the development of human erosion to be seen in various deficiency diseases and hidden hunger. It is conceivable that if wastage of land goodness continues we shall be faced, not with a struggle for markets, but with a struggle for food.

Health is so important to us that we should be well advised to spend relatively more on knowing our soils and seeing that they are healthy, and relatively less on our illnesses which are frequently merely the outward sign of an often unrealized soil deficiency.

In considering health it is misleading to separate men, animals and plants. All are part and parcel of the same nutrition cycle which governs all living cells. The earth's green carpet is the source of the food consumed by live-stock and mankind.

This all-embracing idea of the unity of nature is a comparatively new field of study. A report of a select committee on conservation to the Ontario Government in 1950 said that there were nine stations in the United States investigating the relationship between the soil and human health, while "in Canada, very little has been done on this important subject."

Science has now turned its eyes in a direction that may lead to betterment of the human race. Plants serve as intermediaries, drawing chemicals out of the earth into their sap and changing them into compounds that can be used by animals for building flesh, blood and bones. In their effort to aid in the production of food of high nutritional value, scientists are pursuing a noble objective.

Conserving soil

Conservation is the wise use without waste of our natural resources. It is not the job of scientists alone, nor of farmers alone, but of all of us.

On the farmer's field, conservation consists of mechanical methods, such as ploughing, to slow down the run-off of water, and chemical methods, to incorporate materials that build up the fertility of the soil. In the details of these practices, the farmer receives guidance from the Department of Agriculture at Ottawa, his provincial department, and his agricultural representative.

When land loses its fertility there are some simple steps to be taken: the addition of fertilizer and organic matter; the growth of sod crops; the adoption of rotations. To save soil it is necessary to hold rainfall, retard the flow of water, check wind erosion, and apply vegetative and mechanical controls.

Most conservation practices are simple. They consist only in adapting regular farming operations to nature's way. We don't have to turn our country over to grass and trees, but we do have to use grass and trees in the proper places and at the right times.

Hill-tops are vulnerable, because that is where water starts running. An effective cover of grass or trees to hold and absorb rainfall at the upper edge of a slope is the start of erosion control and flood control.

Just how serious is what we are talking about? It is one of the great problems of the day.

Conservation-minded authorities in central Canada are now surveying for reclamation and protection the land on which the first white settlers set up their homes in 1842, only 115 years ago.

Dr. Georges Maheux, of Laval University, told a meeting of the Royal Society last June that Canada needs a conservation policy to put an end to the "reckless squandering" of natural resources.

Dr. B. T. Dickson, who received his early training at Queen's and McGill universities, said to the American Academy for the Advancement of Science: "Today we know that Malthus was just ahead of his time, and we have to ask ourselves whether adequate food requirements of people can be provided from present sources with all the technologic experience available to us."

And Dr. Stanley A. Cain, botanist, warned that men everywhere must face the dual problems of the conservation of natural resources and the limitation of population "or continue along the path, at an ever-accelerating rate, toward self-destruction."

One third has been lost

We have passed the stage of looking upon plants and vegetation as inexhaustible resources, but we do not yet fully realize how perishable the earth's goodness can be. In the Vosges mountains soil that has been washed down to the valley during the growing season is carefully shovelled into baskets during fall and winter and carried on the backs of men to be replaced on the tilled ground. Authorities say that the United States, which founded its civilization on nine inches of top-soil, has lost a third of this soil.

There is, however, no need to take a gloomy view; there is no excuse for throwing up our hands. We have been sufficiently warned to prevent us from dismissing the subject as unworthy of attention, but active attention it must have.

What we seek from the land is that it provide the base of the highest possible standard of living for the people of Canada. We are inclined, in these technological times, to rely upon our ingenuity to make up for our wastefulness. But even technologists must eat, and we are not yet assured that essential food needs can be supplied synthetically. In any event, if we have failed to save our natural sources of food, what assurance have we that we shall make wise or effective use of chemical sources?

What we can do is use technology to expand our soil resources by increasing the soil's productivity.

Some evidence

Much of our land is marred by deep scars, plain for all to see as the evidence of neglect of conservation measures. But there is other evidence, visible only to the observing person: the hundreds of acres of stunted crops resulting from loss of fertility from the soil.

Water erosion occurs chiefly on sloping land, removing the soil in sheets (sheet erosion), or cutting it with many small streamlets (rill erosion), or gashing out deep gullies (gully erosion). Wind erosion occurs on

both sloping and level land. Both result from removal of vegetative cover.

If you dip up a pail of water that has flowed off a cultivated field and let the mud settle you will find as much as ten to 25 per cent of the volume to be soil. To take a measured example: the maximum flood flow in a section of the Appalachian region during a little over three years was only six cubic feet per second per square mile from forested watersheds; from abandoned agricultural land the flow was 403 cubic feet per second per square mile, and from gullied pasture land 785 cubic feet.

In another experimental section still more dramatic evidence of loss has been obtained. With an average annual precipitation of 35 inches, on a slope of eight per cent, the loss of soil from a clean-tilled field was 69 tons a year; from a field with dense cover provided by a thick-growing crop, the loss of soil averaged only .3 of a ton. The soil scientists estimate that on the clean-tilled field it will take only 16 years to remove seven inches of top-soil, while to wash away seven inches from the protected field would take 3,900 years.

These examples are not of merely academic interest, but throw into highlight a real and vital problem. A soil erosion and land use survey of 22,000 acres in Durham County, made by the Ontario Agricultural College and the Central Experimental Farms, gave statistical form to a sample of the present state of once-good farm land. Sixty-three per cent of the area was eroded in some degree. This is divided: 27 per cent slightly; 24 per cent moderately; six per cent severely, and six per cent very severely eroded.

The damage of erosion does not end at the farm. Dams, reservoirs, navigable streams, irrigation ditches and power plants are reduced in efficiency by sedimentation. Take as an example a power-house reservoir in Virginia: its capacity was reduced in 26 years from 4,000 acre-feet to 780 acre-feet, a loss of 80 per cent.

A drop of rain

The raindrop has been presented to us in song and story since our childhood as a friend. Perhaps this has made it difficult for us to believe that it would destroy our land.

Every falling raindrop that strikes the bare ground acts as a miniature bomb. It splashes soil into the air at its point of impact. It holds the soil in suspension to run off with the surface water. It puddles the surface, forming seals that practically waterproof the land.

Surface sealing causes poor aeration, destroys worm life, and interferes with microbial action within the soil. Splash erosion may wash out and float away the light

organic materials that are so important to soil health. Says the report to the Ontario Legislature: "A one-inch rain can move 100 tons of soil per acre."

The importance of the impact of raindrops is confirmed by tests at the Central Experimental Farm, Ottawa. The distribution and intensity of individual rainstorms are much more important factors than the total rainfall. In one growing season there was a loss of 28.7 tons of soil per acre on a corn plot on a ten per cent slope, while next year, with an almost identical total rainfall but more spread out, the loss from the same plot was only 2.3 tons per acre. In a test elsewhere it was found that during periods of most intense rain the surface flow from barren ground amounted to between 75 and 95 per cent of the rainfall.

Abusing the land

This is not to say that all the blame for soil erosion should be placed upon the lowly raindrop. It is when the raindrop strikes a place where human cultivation has removed nature's protective mantle that trouble occurs.

Some of our cut-over forest land is unfit for farming, inhabited only by stranded families squeezing a bare existence out of eroded soil, and no protective device will make it profitable for agriculture. Some land has been unwisely drained, and farms on that land, even if operated under the best possible management, would fail to provide the necessities of life. Some pasture land has been over-grazed, so that drought and water erosion take a heavy toll. It is true that millions of native big game mammals once existed on the western American plains, but their herds were part of a complex system of checks and balances that kept their numbers from getting out of hand. Says William Vogt pungently in his book *Road to Survival*: "Nature red in tooth and claw was a far kinder nature than that of modern man, who has destroyed indispensable environment beyond any hope of repair."

Misuse of soils is the product of ignorance or indifference. The first should be remedied by efforts now being made to survey our soil, and the second may be cured by education and, if necessary, regulation.

Aware of the need for soil information, Canada established a national soil survey committee about 1941. The provinces conduct intensive surveys of counties or watersheds or other divisions. Several conservation surveys have been published by the Ontario Department of Planning and Development, the outcome of joint action by the Ontario Agricultural College and the Dominion Experimental Farm Service. Early this year the Senate set up a 26-man committee charged with a widespread study of land use in Canada,

a job described in the Chamber as one of the most important the Senate has ever undertaken.

What practical use are these soil surveys? When they find expression in action they will direct wise land settlement, provide farmers with information upon which to plan enlightened farming activity, and guide provincial governments in setting up forest preserves.

Soil research will be able to determine the kind, yield and quality of plants that can be produced under various systems of management on the different types of soil.

Until only recently, farmers, gardeners and foresters learned about the soil through trial and error, with all its costly failures and headaches. Today, soil scientists are extracting facts and providing guidance about the behaviour of soils under many kinds of practices. Their goal is approached the hard way, through painstaking fundamental research and observation. Then comes applied research and demonstration.

The scientist who spends his life studying this dynamic thing, the soil, comes to have a profound respect for it. His is purposeful work, directed to the well-being of mankind.

But what the survey and the scientist find out to be good practice must be put into effect by individuals. Personal conscience is the beginning of conservation, and a forceful sense of community responsibility will bring about its greatest advancement.

Expression is given the aims of conservation through organizations like the adult conservation clubs, the 4-H clubs, school study groups, and others. Conservation was adopted as the theme for Canadian Scouting in 1956, and Boy Scouts across the country promised: "I give my pledge as a Canadian to save and faithfully to defend from waste the natural resources of my country —its soil and minerals, its forests, waters and wild life." More than nine million children in Canada and the United States had enrolled in Audubon clubs by 1952. In these efforts we have the nucleus of a great conservation movement, for these young people, some of them now grown up, have learned the need for conservation and some of its methods.

Co-operative effort

It is easier to preach conservation than to achieve it. Education, research and official planning are not enough. These must be supplemented and made effective by action programmes.

We cannot conserve our resources effectively if every man does it in his own way on his own piece of ground in his own narrow interests. This is a national, a provincial and a community as well as a personal problem.

As an example of the community nature of conservation, consider that nature's boundaries are not always land-ownership boundaries. The imperative unit for soil saving is a valley that may have a hundred homesteads on its slopes. An effective contour or terrace system cannot respect property fences. Your farm is affected by what is done farther up the slope, and what you do affects land lower down.

Nor are academic boundaries respected by the demands of nature. Research men of many disciplines need to pool their discoveries and recommendations: economists, biologists, botanists, chemists, physicists, agronomists, and many others. What results as an approved conservation practice is not the product of any one man or any one discipline, but a blending of all.

An action programme

This account of the problems and causes of soil misuse is not presented as a chamber of horrors at which to shudder. It outlines the existing situation so that we may see what obstacles we must overcome to insure better soil use.

It is time for Canadians to open a soil-saving account. The virgin land found in Canada up to a century ago was a very wealthy bank account, but it has been depleted by many withdrawals.

The conservation work that has been done during the past twenty-five years looks small against the backlog of things undone, but it is encouraging. We have been like adolescents supported by wealthy and indulgent parents, and now we are beginning to show prudence in approaching the wise handling of our limited resources.

We must preserve the best that has been attained, change practices that have proved wasteful and dangerous, and control new forces or provide for their assimilation.

Public opinion should support all who attempt this vital work. It might be a good idea for the deans of agriculture in our universities to gather around a table to sift out the facts about the needs and methods and response. That would be a great national service, one that cannot be done with the same detachment from self interest by any other body of men. Their pronouncement would be accepted widely, and could be the guide for national, provincial and community co-operative efforts.

The challenge is worthy of the best our scientists can give and of the exercise of the common sense and effort of every Canadian: to maintain nature's harmony, and to restore it when necessary.

We all have a stake in success. It is a shorter distance in time than we think from the splash of a raindrop on an unprotected hill-top to loss of a farm.