

ORGANIZATION OF THE KIT

The Soil Conservation Kit is intended to be a "potpourri" of ideas. Although lessons are based on specific concepts and objectives and can be presented as a whole, the assumption has been made that you will pick out activities that are most appropriate for your needs.

The kit is divided into seven units, a glossary and a resources section. Each unit consists of a set of lessons, background information and references.

A lesson includes several activities with both teacher summaries, and student handouts which can be photocopied for classroom use. Key concepts, objectives, skills and words are provided. Many lessons also include ideas for introductory activities or further investigation under the "Digging In" and "Digging Deeper" sections respectively.

The background information has been written for the teacher; therefore, in some cases it may not be at an appropriate level for your students. You will find some sections quite long. The extra detail has been provided with the intent of helping you feel comfortable teaching a subject you may not have much background in. The background information is also intended to support the objectives of unit lessons.

At the end of each unit is a list of references which were used to research the unit.

The glossary provides definitions for every word that appears in a key words list at the beginning of a lesson or a section of background information.

The resources section of the kit includes several materials. The two posters will be useful as a focus for a classroom display. Many resources such as the slides, script and soil samples are referred to in lessons. The "Resources for Soil and Water Conservation - An Annotated Bibliography" is also referred to frequently in units 1 to 7, particularly with respect to relevant audio-visual resources. Some of the other publications are supplementary material.

TABLE OF CONTENTS

UNIT 1 - THE NATURE OF SOIL

Lesson 1 - What is Soil?

- Activity 1.1 - What is Soil?
- Activity 1.2 - What is Soil Puzzler?

Lesson 2 - Spaces in the Soil

- Activity 1.3 - Spaces in the Soil

Lesson 3 - Soil Texture

- Activity 1.4 - Shake It All Up
- Activity 1.5 - Sizing Up Soil

Lesson 4 - Soil Organic Matter

- Activity 1.6 - Organically Speaking
- Activity 1.7 - Black Magic

Lesson 5 - Soil Formation

- Activity 1.8 - Soil Drama
- Activity 1.9 - Be A Soil Maker
- Activity 1.10 - Soil Formation Word Match

Lesson 6 - Soil Horizons

- Activity 1.11 - On the Horizon

Lesson 7 - Soil Classification

- Activity 1.12 - Classified Information
- Activity 1.13 - Soil Sleuths

Lesson 8 - The Soil Ecosystem

- Activity 1.14 - Soil Web of Life
- Activity 1.15 - Springtails, Centipedes and Dead Leaves
- Activity 1.16 - Soil Food Web

Lesson 9 - Soil Life

- Activity 1.17 - The Living Soil
- Activity 1.18 - Fun With Fungi

Background Information

- 1.1 What is Soil?
- 1.2 A Closer Look
- 1.3 Soil Formation
- 1.4 Soil Horizons
- 1.5 Soil Classification
- 1.6 The Soil is Alive!

References**UNIT 2 - SOIL AND PEOPLE****Lesson 1 - The History of Land Use**

- Activity 2.1 - Times Are a Changin'
- Activity 2.2 - Investigating Land Use

Lesson 2 - We Need Soil

- Activity 2.3 - Tracing It Back
- Activity 2.4 - Fun With Food
- Activity 2.5 - It Depends on How You Look At It

Lesson 3 - Interpretive Land Classification

- Activity 2.6 - Land Classification

Background Information

- 2.1 Our Changing Use of Soil
- 2.2 Soil and the Development of Ontario
- 2.3 We Need Soil
- 2.4 Soil As A Natural Resource
- 2.5 Land Classification

References**UNIT 3 - SOIL IN MOTION****Lesson 1 - Erosion As A Natural Process**

- Activity 3.1 - Splash Erosion
- Activity 3.2 - Splish-Splash
- Activity 3.3 - Soil In Motion
- Activity 3.4 - Soil Erosion Puzzler

Background Information

3.1 Erosion As A Natural Process

References

UNIT 4 - SOIL AT RISK

Lesson 1 - What is Soil Degradation?

- Activity 4.1 - Reading Assignment
- Activity 4.2 - Soil Awareness Survey
- Activity 4.3 - Compaction Action

Lesson 2 - Erosion - Losing Ground

- Activity 4.4 - Universal Soil Loss Equation Problems
- Activity 4.5 - The Moving Earth
- Activity 4.6 - The Forces of Wind and Water

Lesson 3 - The Threat of Urbanization

- Activity 4.7 - What's In the News?
- Activity 4.8 - Presenting the Facts
- Activity 4.9 - Meeting at the Townhall
- Activity 4.10 - Changing Land Use

Background Information

- 4.1 What is Soil Degradation?
- 4.2 Erosion
- 4.3 The Loss of Organic Matter
- 4.4 Acidification
- 4.5 Compaction
- 4.6 Soil Pollution
- 4.7 Soil Disruption
- 4.8 Urbanization
- 4.9 Salinization
- 4.10 Desertification

References

UNIT 5 - THE ENVIRONMENTAL IMPACTS

Lesson 1 - What Are the Environmental Impacts?

- Activity 5.1 - How Aware Are You?
- Activity 5.2 - Is It News to You?

Lesson 2 - The Environmental Impacts of Contaminated Soil

- Activity 5.3 - Up the Chain
- Activity 5.4 - Investigating Pesticides

Background Information

- 5.1 Impacts on Terrestrial Environments
- 5.2 Impacts on Aquatic Environments
- 5.3 Impacts on the Air

References

UNIT 6 - THE SOCIO-ECONOMIC IMPACTS

Lesson 1 - How Does Soil Degradation Affect You?

- Activity 6.1 - Some Socio-Economic Impacts
- Activity 6.2 - The Great Debate

Background Information

- 6.1 Social Impacts
- 6.2 Economic Impacts

References

UNIT 7 - SOIL CONSERVATION

Lesson 1 - What is Soil Conservation?

- Activity 7.1 - Get the Picture
- Activity 7.2 - Finding Solutions
- Activity 7.3 - Construction Site Erosion Control
- Activity 7.4 - King or Queen for the Day
- Activity 7.5 - Who Dunit?

Lesson 2 - What is Being Done?

- Activity 7.6 - What is Happening?
- Activity 7.7 - What Are Local Farmers Doing?

Lesson 3 - What You Can Do!

- Activity 7.8 - Hit the Campaign Trail
- Activity 7.9 - Working For Soil

Background Information

- 7.1 What is Soil Conservation?
- 7.2 What is Being Done?
- 7.3 Barriers to the Adoption of Soil Conservation
- 7.4 What Needs to Be Done?

References

GLOSSARY

RESOURCES

- 20 Slides and Slide Script
- 5 Soil Samples
- 2 Overheads - "A Soil Profile"
- "A Soil Ecosystem"
(Courtesy of United States Department of Agriculture)
- 2 Posters - "Farming for Tomorrow - Soil Conservation"
- "The Soil Ecosystem"
(Courtesy of Ministry of Agriculture and Food)
- Publications (Addresses are provided from pages 13 to 17 if you wish to order additional copies for class use)
 - "What You Should Know About Soil" - Agriculture Canada - Factsheet
 - "Soil Erosion: Causes and Effects" - Ministry of Agriculture and Food - Factsheet
 - "Index of Soil Surveys in Ontario" - Ontario Institute of Pedology - Brochure

LESSON 1

The History of Land Use

RESOURCES

Background information in sections 2.1 and 2.2, pages 2.43 to 2.51 of this unit.

The Canadian Oxford School Atlas

CONCEPTS

Throughout history, people have used the soil to grow food and supply the raw materials for the many products we use in our daily lives. Although these basic dependencies on soil have persisted, our use of land has changed as technology has progressed and the world population has grown.

The distribution of different soil types influences settlement patterns and land use activities.

OBJECTIVES

To recognize how land use changes through time.

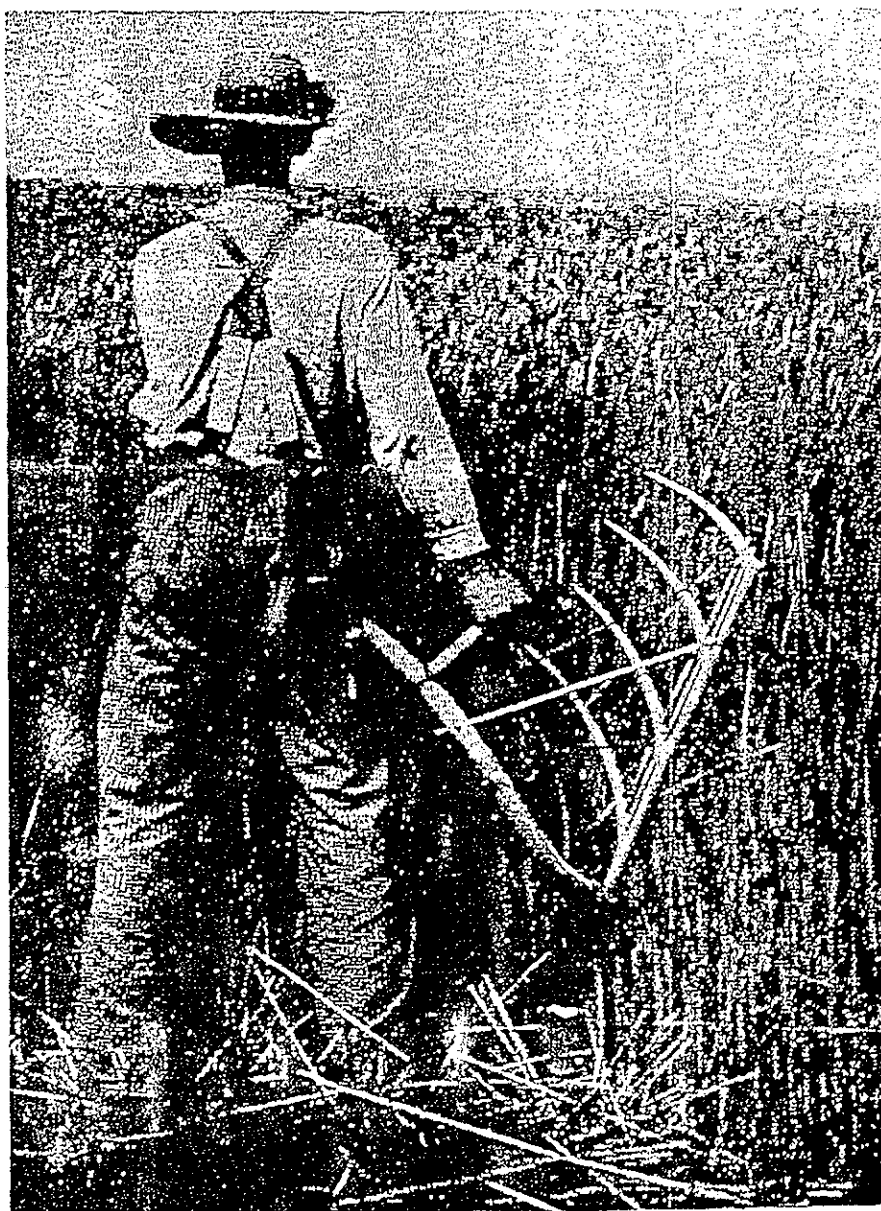
To understand how land use and population growth in Canada have been influenced by soil distribution and other geographical characteristics.

SKILLS

comparing, formulating questions, inferring relationships, observing, preparing maps, recording impressions, researching, summarizing

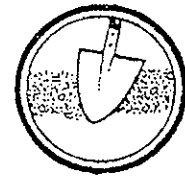
KEY WORDS

ancient civilizations, nomadic, overlay, pastoral, physiographic region, pioneer



Ontario Ministry of Agriculture and Food

Digging In



TEACHER SUMMARY

- Have students interview a senior farmer, or invite one to speak to your class. Find out how farming has changed in the past 50 to 60 years.
- Phone the local library and find out how many different newspapers they receive. Have students look back in the papers for the past three weeks, and photocopy any articles related to land and soil use. Assign groups of students to different papers over the three weeks. Have them summarize what they read. Who is using the land for what? What are the uses, problems, issues and solutions?
- Make overheads of the following pictures:
 - Early Nomadic Hunters and Gatherers (Pre-10,000 BC)
 - Early Pastoral Society
 - The Period of Great Civilizations
 - Pioneer Ontario - The Early 1800's
 - Land Use in the 1980's

With the aid of these overheads and the background information in section 2.1, pages 2.43 to 2.51 of this unit, introduce students to the different aspects of land use from these time periods in history. (see also *Canada: Land of Diversity* and *Across Canada: Resources and Regions* in references list, p. 2.60).

Have students imagine themselves to be a person from one of the time periods, and write a passage that would represent what their use of land would be.

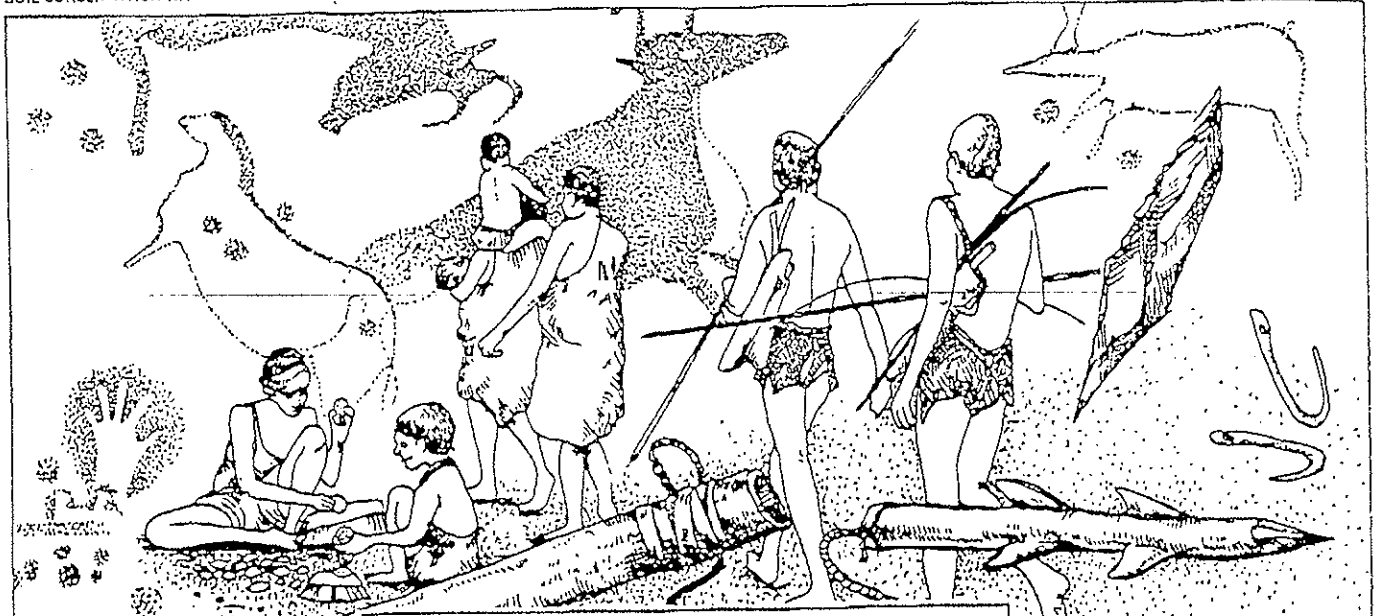
- Photo-enlarge a section of a map of your community. Take a bus trip through the community making sure to drive through the city centre and along the rural-urban fringe. Have students trace the route on their maps and mark:
 - a) present land uses (e.g. parkland, parking, residential, abandoned)
 - b) areas where the use of land is changing (e.g. construction sites)
 - c) general observation of the landscape (e.g. cliffs, flat land)
 - d) places where bare soil is exposed, or erosion is a problem.

Discuss:

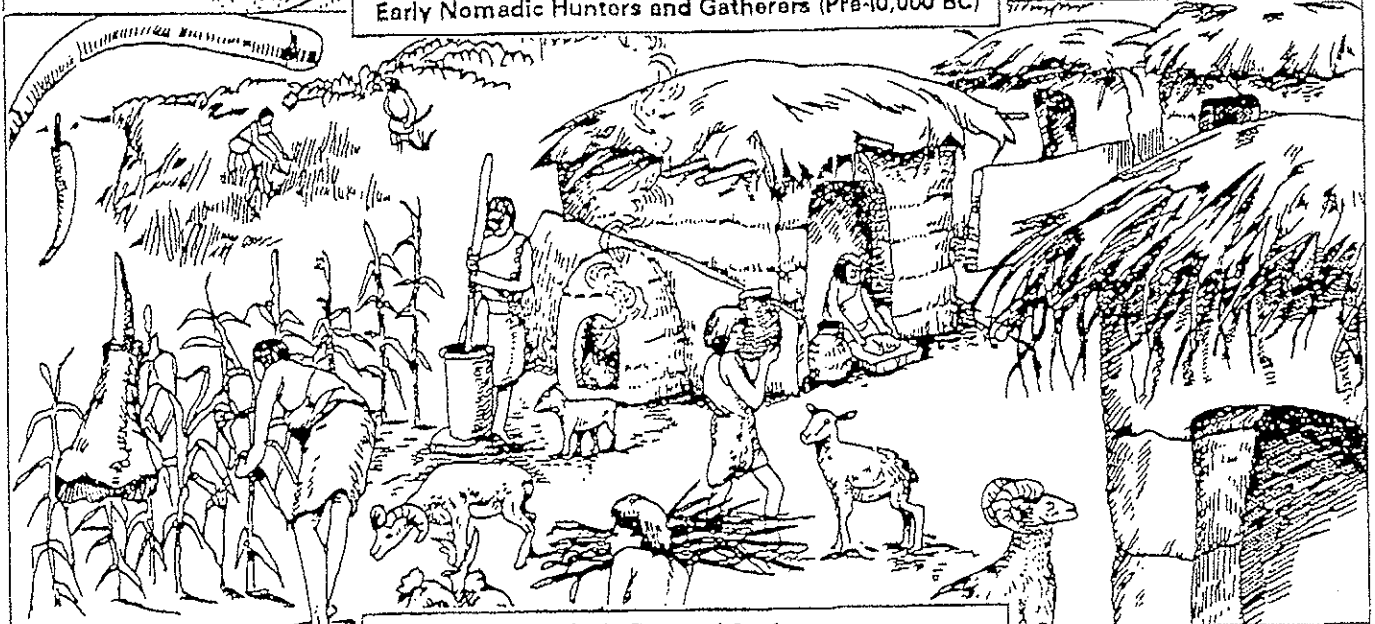
- Our many uses of soil.
- How soil is dealt with in urban settings.
- The impacts of human activity on urban soil resources.
- How land use is affected by topography.

The same activity can be done on a smaller scale by instructing students to walk through their neighbourhood. On returning to the classroom, have students prepare a good map identifying their observations.

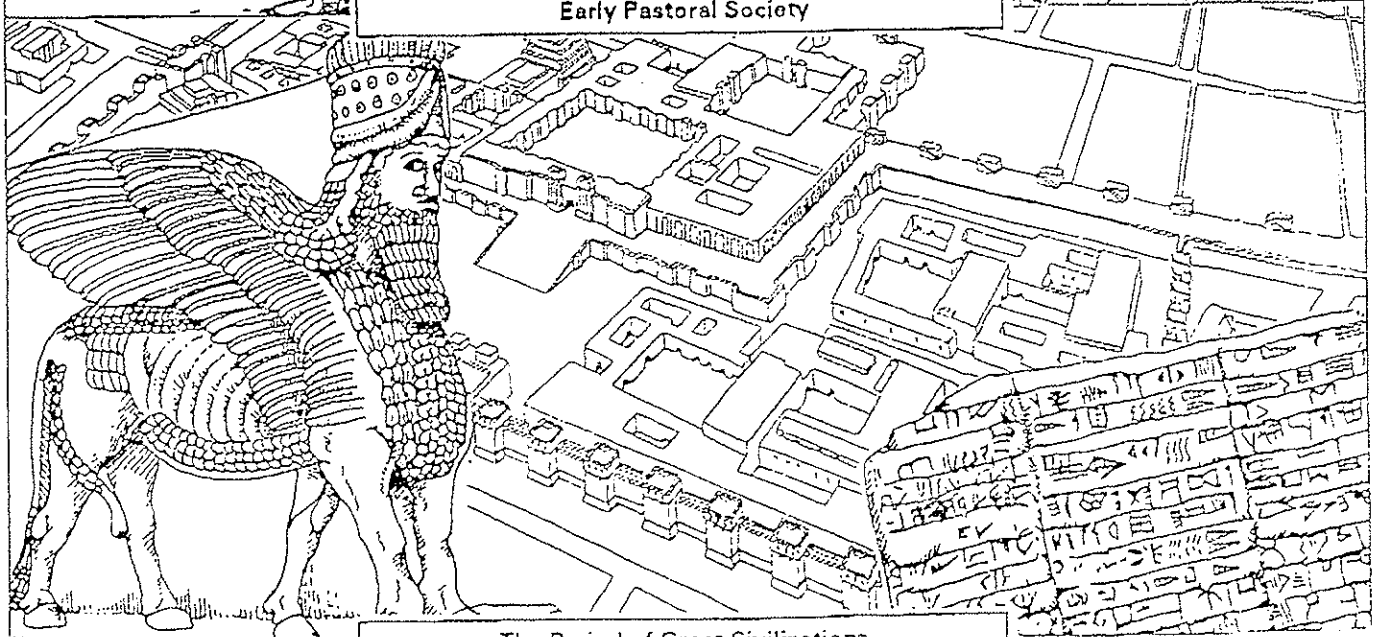
SOIL CONSERVATION KIT



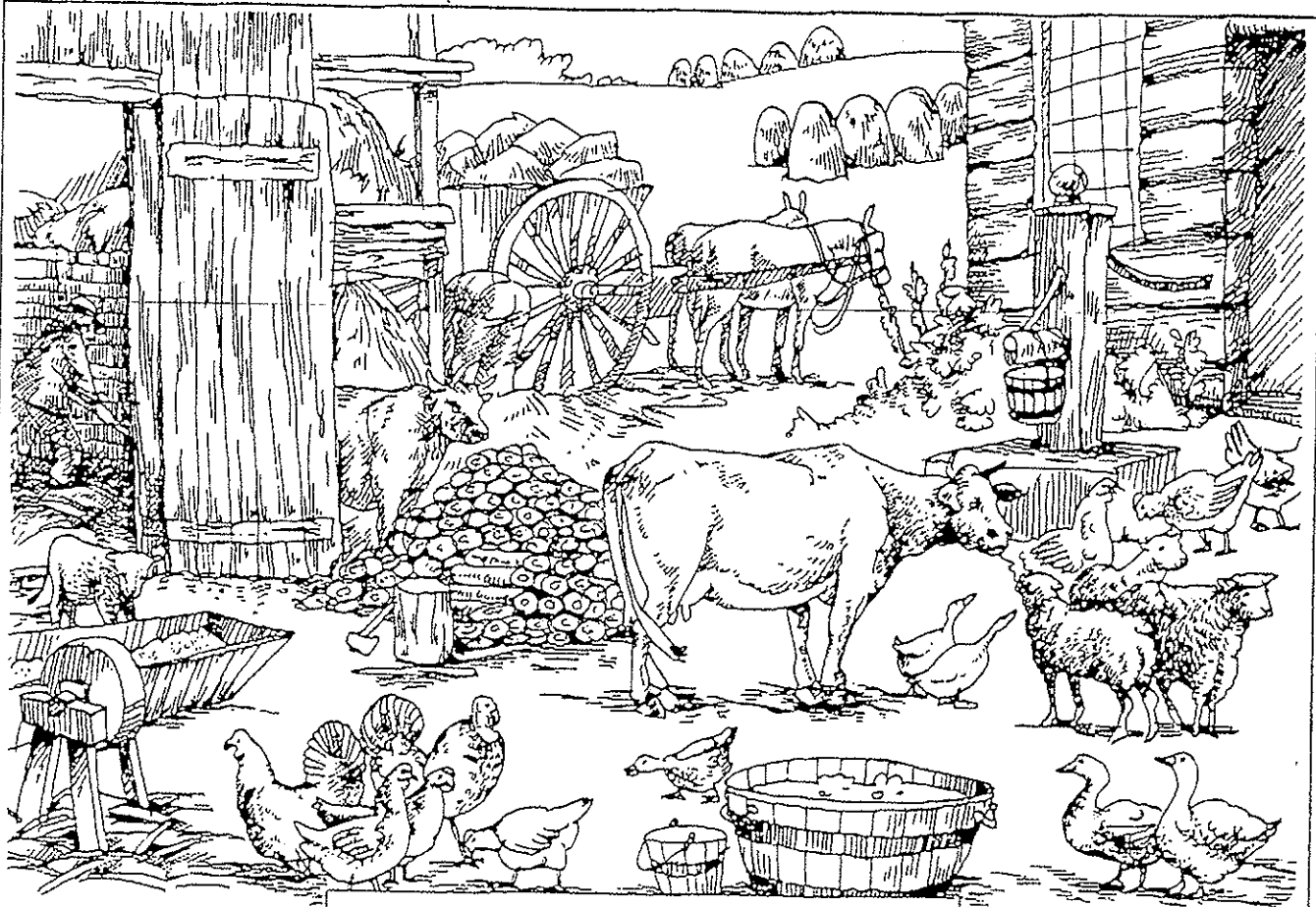
Early Nomadic Hunters and Gatherers (Pre-10,000 BC)



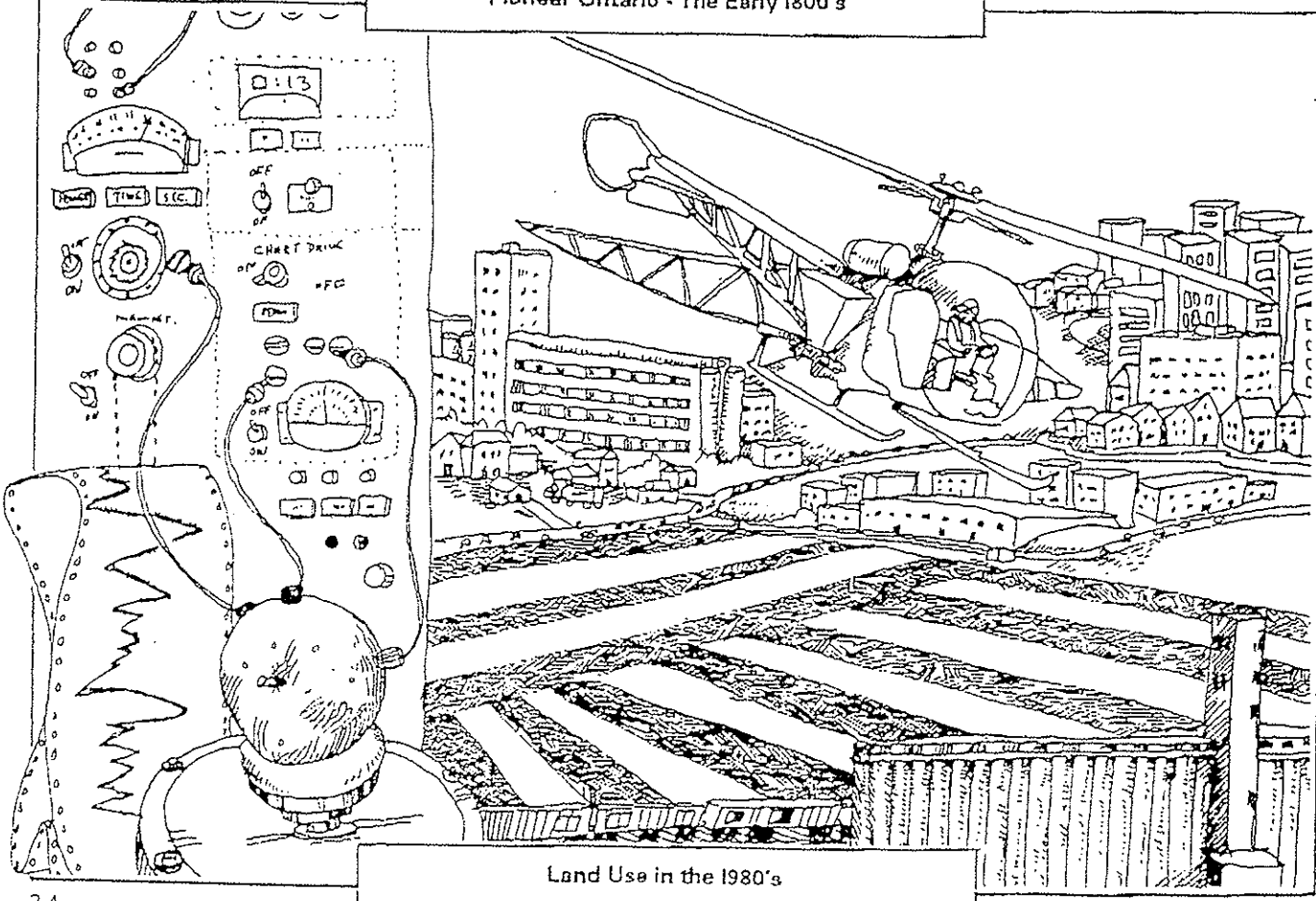
Early Pastoral Society



The Period of Great Civilizations



Pioneer Ontario - The Early 1800's



Land Use in the 1980's

ACTIVITY 2.1

Times Are A Changin'

TEACHER SUMMARY

Objectives

To identify how land use changes over time.

To express opinions related to these changes.

Procedure

In this activity, students will compare photographs a) and b), and c) and d). Each pair represents a separate scene, at two different time periods in history.

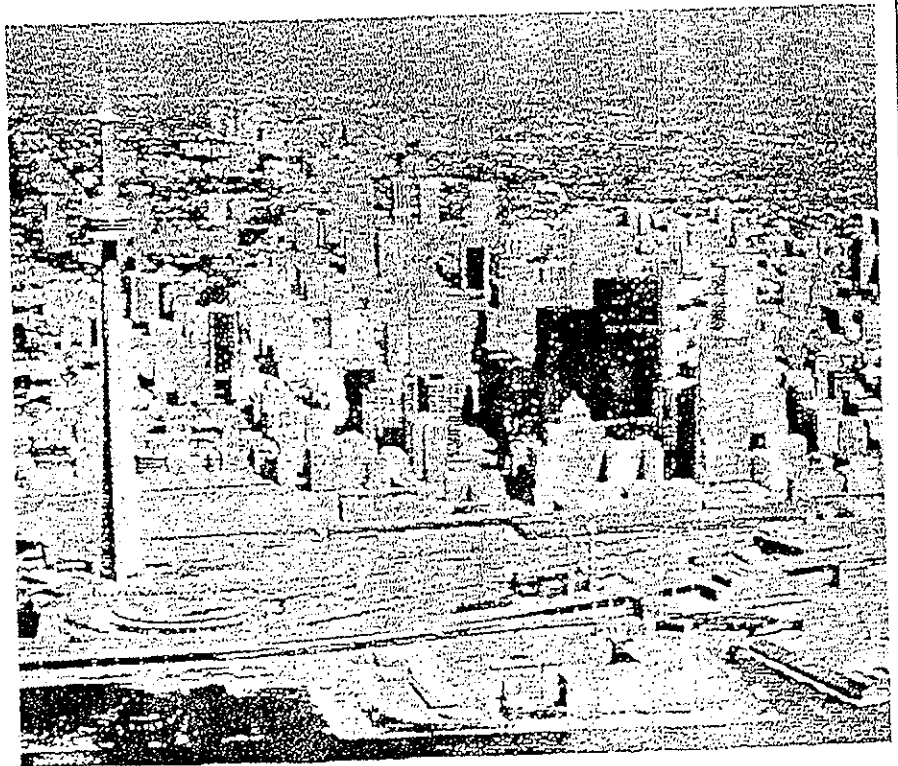
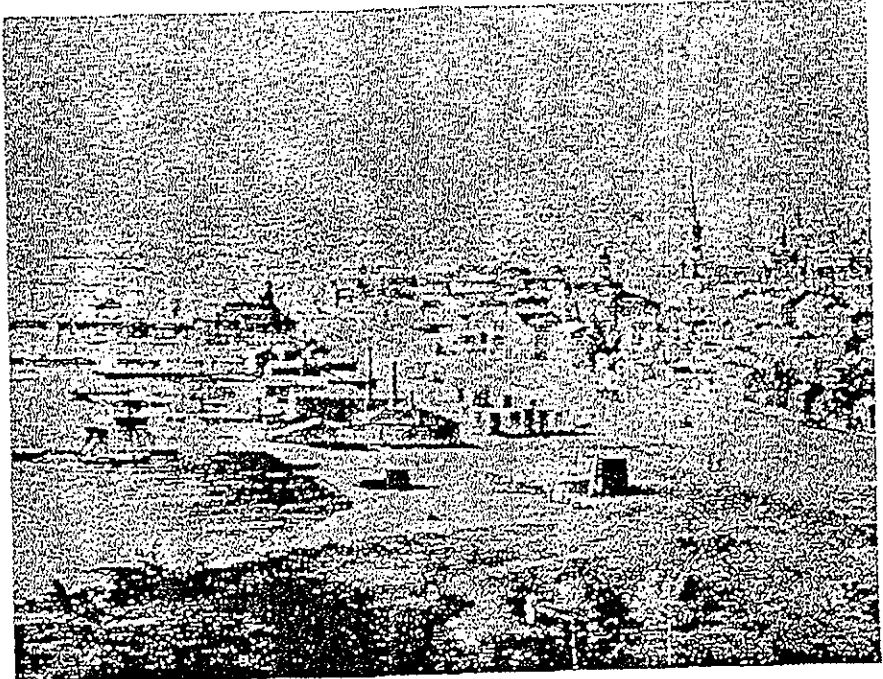
To compare the pairs of photographs, students will list factual differences first. Then, they will record their differences in impressions.

Discussion Questions

Answer the following questions for each pair of photographs.

1. List the likely factors to have caused the changes in land use.
2. In your opinion, were the changes positive, negative or both? Explain your answer.
3. What characteristics of the land would have been important to people in the earlier photograph? What characteristics of the land do you think are important to people now?
4. List any questions you have about the changes that have taken place.

Try to answer any questions students have as a class. Some questions may lead to the need for further research.



Compare Toronto's Lakeshore from the early 1800's (above) to present (below)!

ACTIVITY 2.1

Times Are A Changin'

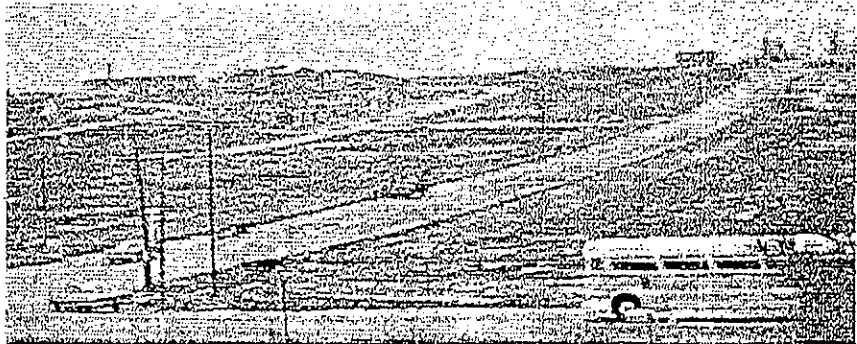
STUDENT HANDOUT

A

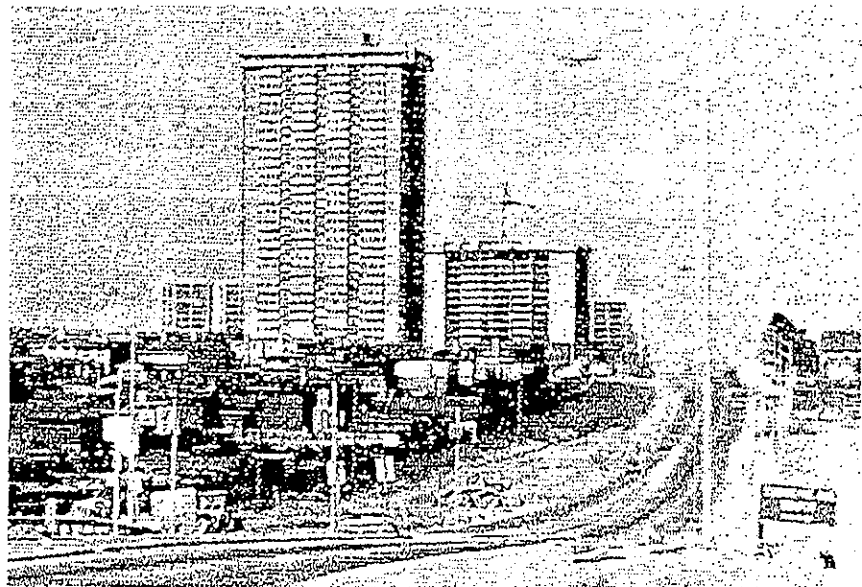
Introduction

Pictures a) and b) are two photographs of the same scene, at two different time periods in history. Pictures c) and d) are also photographs of the same scene from two different years.

The purpose of this activity is to identify changes in land use between a) and b), and between c) and d).

**Instructions**

1. Compare photos a) and b) in the chart provided. On the left hand side, list all the differences you observe. You should include factual observations such as there are three houses in one picture and twenty in the other. On the right hand side, record differences in your impressions. For example, you might describe one photograph as busy and the other as quiet.
2. Repeat for photos c) and d).



B

Discussion Questions

Answer the following questions for each pair of photographs.

1. List the likely factors to have caused the changes in land use.
2. In your opinion, were the changes positive, negative or both? Explain your answer.
3. What characteristics of the land would have been important to people in the earlier photograph? What characteristics of the land do you think are important to people now?
4. List any questions you have about the changes that have taken place.



C



D

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<i>Impressions</i>		<i>Observations</i>	
Photo A	Photo B	Photo A	Photo B

SOIL CONVERSATION KIT

SOIL AND PEOPLE

<i>Observations</i>	
Photo D	
Photo C	

<i>Impressions</i>	
Photo D	
Photo C	

ACTIVITY 2.2

Investigating Land Use

TEACHER SUMMARY

Introduction

Soil distribution and other physical geographic characteristics in Canada have influenced the distribution of population and economic activities. This activity is designed for students to draw some relationships between these factors by gleaning information from maps provided.

Objective

To explain the relationship between Canada's population and economic activities, and its physical geography including soils.

Materials

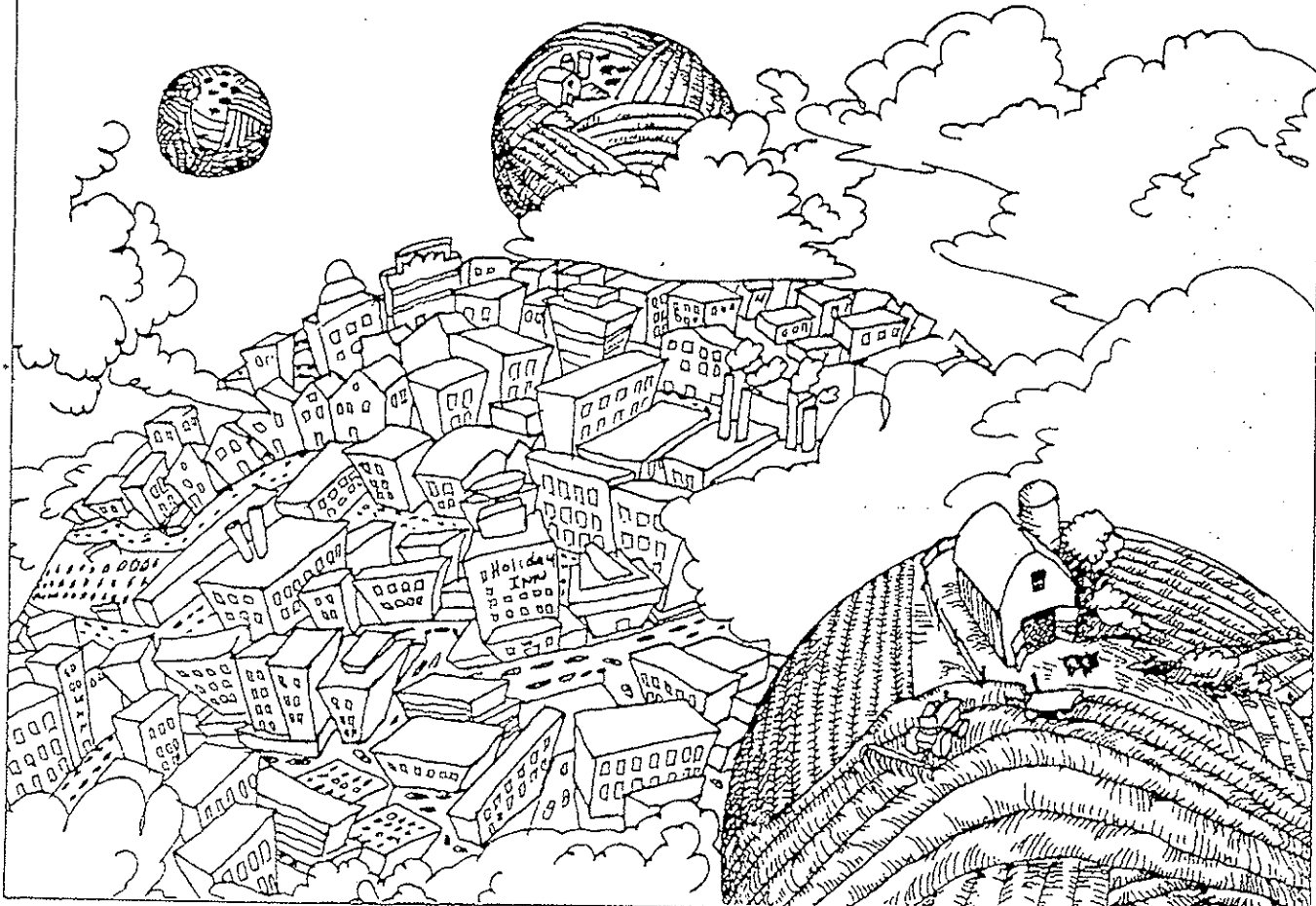
- student handouts
- tracing paper
- coloured pencils

Preparation

In this activity, students are to transfer information from four physical geography maps of Canada to overlays that can be placed on top of each of the following maps:

- Canada - Population Distribution
- Canada - Major Economic Activities: Farming, Mining and Forestry

Questions are provided to prompt the students to draw relationships.



BACKGROUND INFORMATION

2.1

Our Changing Use of Soil

CONCEPT

Ever since people have inhabited the earth, they have used and depended on soil. In fact, the location of fertile topsoil has influenced settlement and growth patterns throughout history. Many early civilizations grew and flourished because they were endowed with fertile soil resources. Just the same, people of modern day society reap the benefits of comfortable lives wherever the land produces abundant crops.

Our use of land has changed as new discoveries have been made, tools invented, and as the world population has grown. However, our attitude towards the land has not changed appreciably. We have exploited land to its fullest advantage for our survival. Only in the past 100 years have people started to see topsoil as a limited resource, and become interested and active in conservation.

KEY WORDS

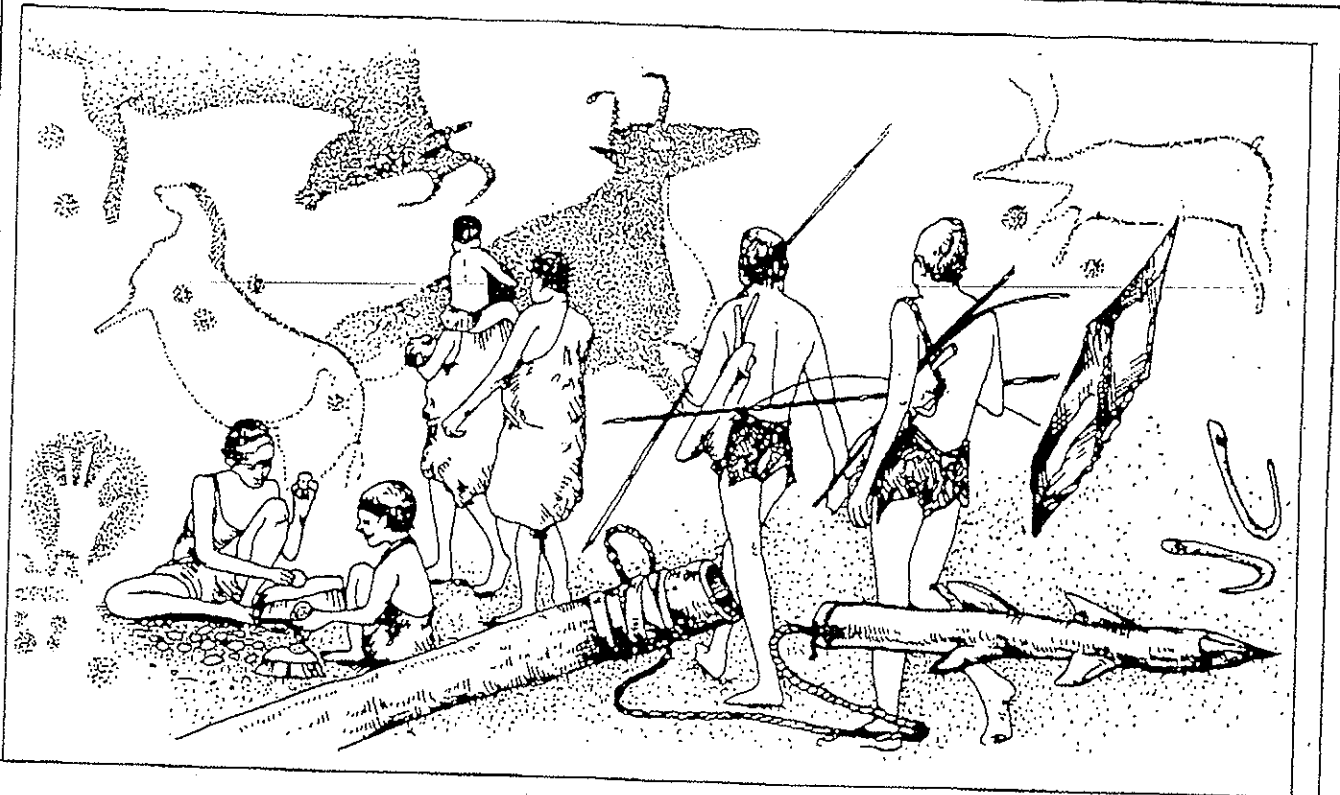
domestication, neolithic, nomadic, pleistocene epoch

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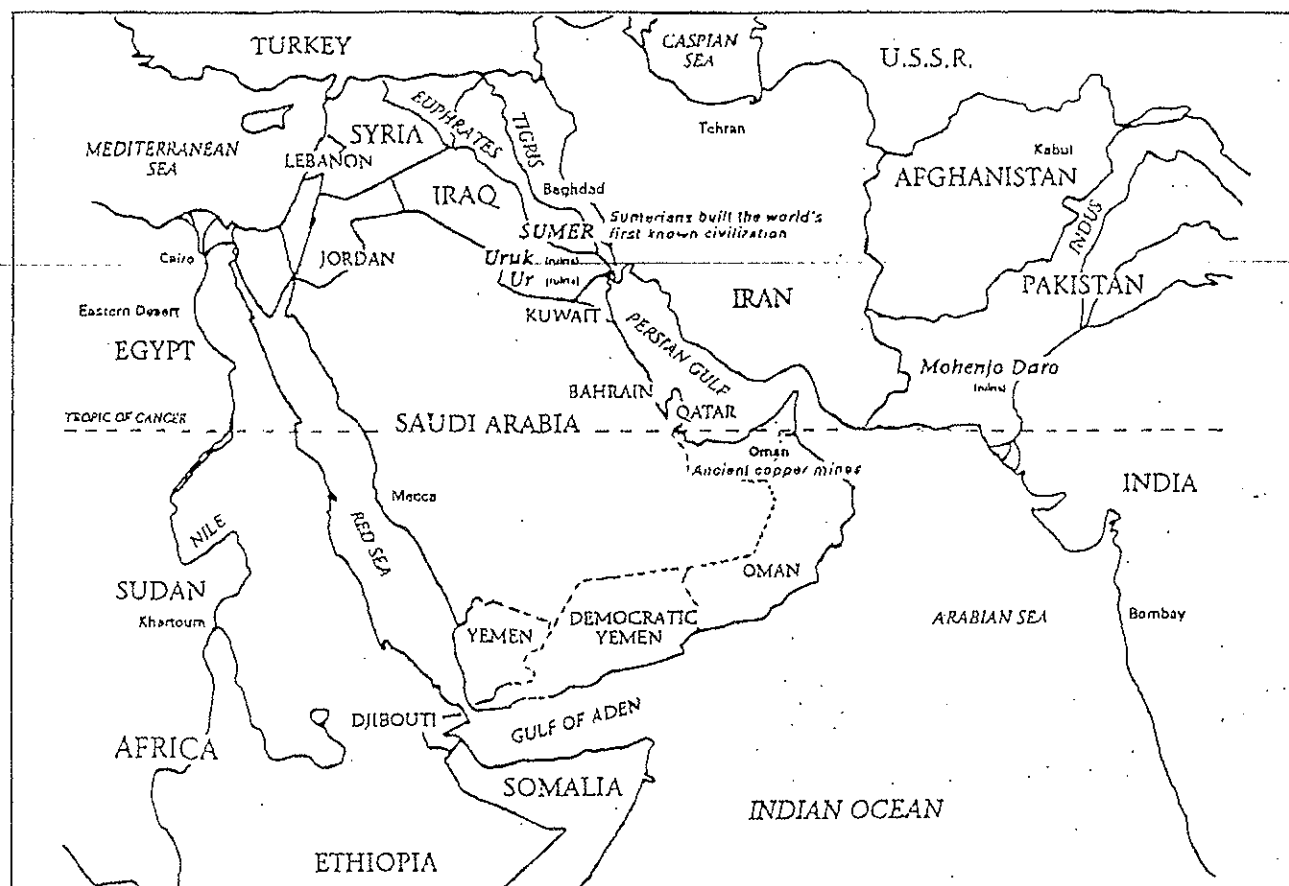


Early World History

Early societies (before 10,000 BC) consisted of nomadic hunters and gatherers who depended on the fertile soil of their surroundings to produce abundant plants and animals. As one area became exhausted of food supplies, they picked up and moved to another location.

Because early societies depended on the natural environment for their day to day survival, they developed an intimate relationship and knowledge of its resources. This ecological relationship is one that relatively few people in modern society possess. Although we still depend on the environment for our survival, most of us are removed from direct interaction with the soil, and the food production system.

Contrary to popular belief, there is no evidence that people living before 10,000 BC used their ecological knowledge to conserve resources. Rather, evidence suggests that they exploited the environment to its fullest advantage for their survival, and they probably did not starve. Their understanding of nature helped them know where and when to find food. Some scholars believe the overzealous hunting of early nomadic people was one of the primary reasons for the extinction of many animal species from the Pleistocene epoch.



Neolithic Period

In the years from about 10,000 BC to 6,000 BC, (the Neolithic Period of history) people began to develop a pastoral and agricultural way of life. A significant ecological achievement was discovered which made permanent villages possible. This achievement was the domestication of plants and animals. From this time onwards, and up until present, people have settled wherever there have been several centimeters of fertile topsoil, and a favourable climate for crop growth.

Because cultivated plants and domestic animals gave people more control over day to day survival, room was made for other roles in society - such as potters, weavers, and tool makers. The fertility of the soil and the abundance of other resources determined the availability of raw materials for their work. Therefore, people started to use the land for more than just food and shelter.

The Period of Great Civilizations

Many historians refer to the approximate time period between 5,000 BC and 200 AD as the "period of great civilizations". Archaeologists have pieced together descriptions of flourishing societies on the banks of the Mediterranean Sea, and the Tigris, Euphrates and Nile Rivers. Historians describe this period as a time of extraordinary achievement in the fields of literature, art, science, and self-government.

But, evidence also proves this time period to be one of major changes in land use. Large tracts of forest and field were cut, and extensive areas were grazed and planted. The successes of societies like Babylonia, Egypt, Greece, Mesopotamia and Rome were in no small way due to the abundance of natural resources at their disposal. The ancient civilizations of Rome and Greece are described as having been endowed with the greatest superiority of soil, water, climate and geographic position.

The fertile land allowed more people to live well-nourished and abundant lives.

Unfortunately, none of this happened without leaving significant scars on the landscape. Deforestation increased erosion and lowered water tables. It is believed that many of the barren lands of our modern world developed during this time of intense environmental use, and that they have never since recovered.

For example, as late as 7,000 BC, the headwaters of the Tigris and Euphrates Rivers were covered in forest and grassland. Then domestic cattle appeared around 6,300 BC. As more people and larger herds came to the valley, in the period from 5,000 to 3,000 BC, more forest was cleared. Elaborate canals were built as transportation routes. At first the silt in the canals was manageable, and the deposits near the mouth were fertile. But, eventually slaves were used to keep the canals free of silt, which was

eroding into the water from deforested land upstream. After 3,000 BC the silt from the two rivers was recorded to have filled the Persian Gulf 180 miles from its origin. Today, this once well watered and productive land (now occupied by the countries of Iraq and Turkey), is quite arid and hot. (Southwick, p. 69)

Similar histories are recorded for the Indus Valley (now Pakistan), and the Sahara desert in Africa. And, if we carry the theme of people's influence on the soil environment through history, we can see that even up until present time, our actions have accelerated the degradation of many productive lands:

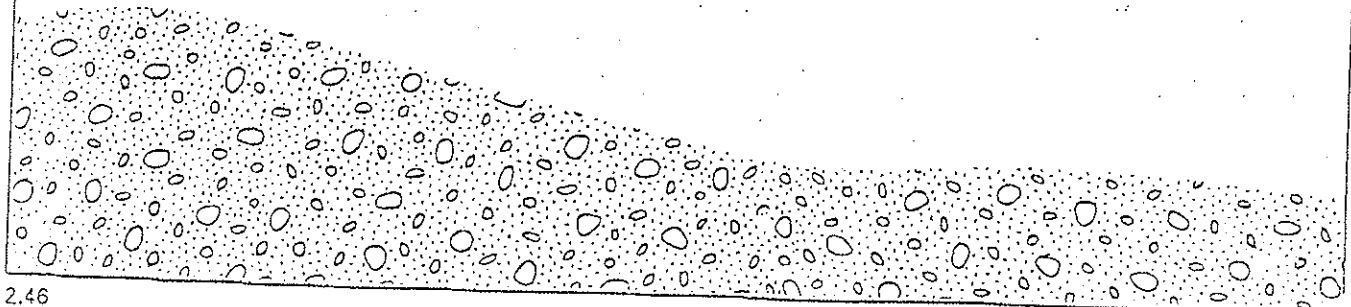
- The shifting sand areas of the Colorado River were rich grassland as late as the seventeenth century.
- Forest destruction, overgrazing and burning have increased wind erosion in Australia and extended the deserts.
- The dustbowl in North America in the 1930's was worsened by the mismanagement of land during the settlement of North America.
- In tropical rain forests, soils are thin. The slash and burn

approach to clearing land for settlement and agriculture in South and Central America, denudes the forest and burns off soil organic matter, leaving the earth susceptible to rapid leaching and erosion. The soil ecosystem can be destroyed in less than a decade.

- The deforestation and overgrazing of steep lands in India, Malaysia and Indonesia have led to severe soil erosion and the loss of extensive areas of productive land.

There are two theories about how today's barren lands developed. The first is that they were caused by major climatic changes. The second theory describes people as being the key desert making force through history. Forests naturally recycle water back into the atmosphere where it will form clouds and fall again as rain. The result of land use practices such as extensive deforestation led to increased soil erosion and a decrease in atmospheric humidity.

The development of deserts and barren lands are probably due in part to the laws of nature; but, there is no doubt that through history our actions have accelerated processes which exhaust the fertility of the land.



Early Ontario History

About 10,000 years ago, nomadic hunters and gatherers inhabited what we now call Ontario. Today's North American natives are descendants of these early peoples. They were the first to use the soil resources in the province. Then around 3,000 BC, they began cultivating soil and growing crops - their main staple being maize or "indian corn".

Natives from both South and North America were extremely successful at plant breeding and cultivation. From their efforts came corn, potatoes, peanuts, beans, cotton, squash, pumpkins, sunflowers, peppers, tobacco and tomatoes. They also domesticated strawberries, grapes, raspberries, gooseberries and several kinds of nuts. At least one third of our agricultural crops today are derived from the produce of early native people.

The following are the words of a North American native:

"The old people came literally to love the soil and they sat or reclined on the ground with a feeling of being close to a mothering power. It was good for the skin to touch the earth and the old people liked to remove their moccasins and walk with bare feet on the sacred earth. Their teepees were built upon the earth and their altars were made of earth. The birds that flew into the air came to rest upon the earth and it was the final abiding place of all things that lived and grew. The soil was soothing, strengthening, cleansing and healing."

Chief Luther Standing Bear

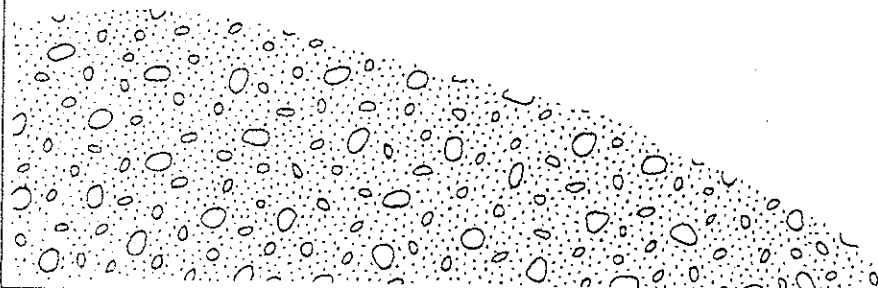
European Settlement in Ontario

Aside from scattered native villages, a few forts, trading posts and missions established along major waterways, most of the permanent settlement of what we now call Ontario has occurred since 1800. In the early 1800's, people came to Canada primarily from Britain and Europe. Word from overseas was that land in North America was unlimited and inexpensive - the only cost was the time it took to clear a few hectares of land so crops could be planted. However, establishing a farm was a very labour intensive job. Only a few hectares of land could be cleared by a family per year.

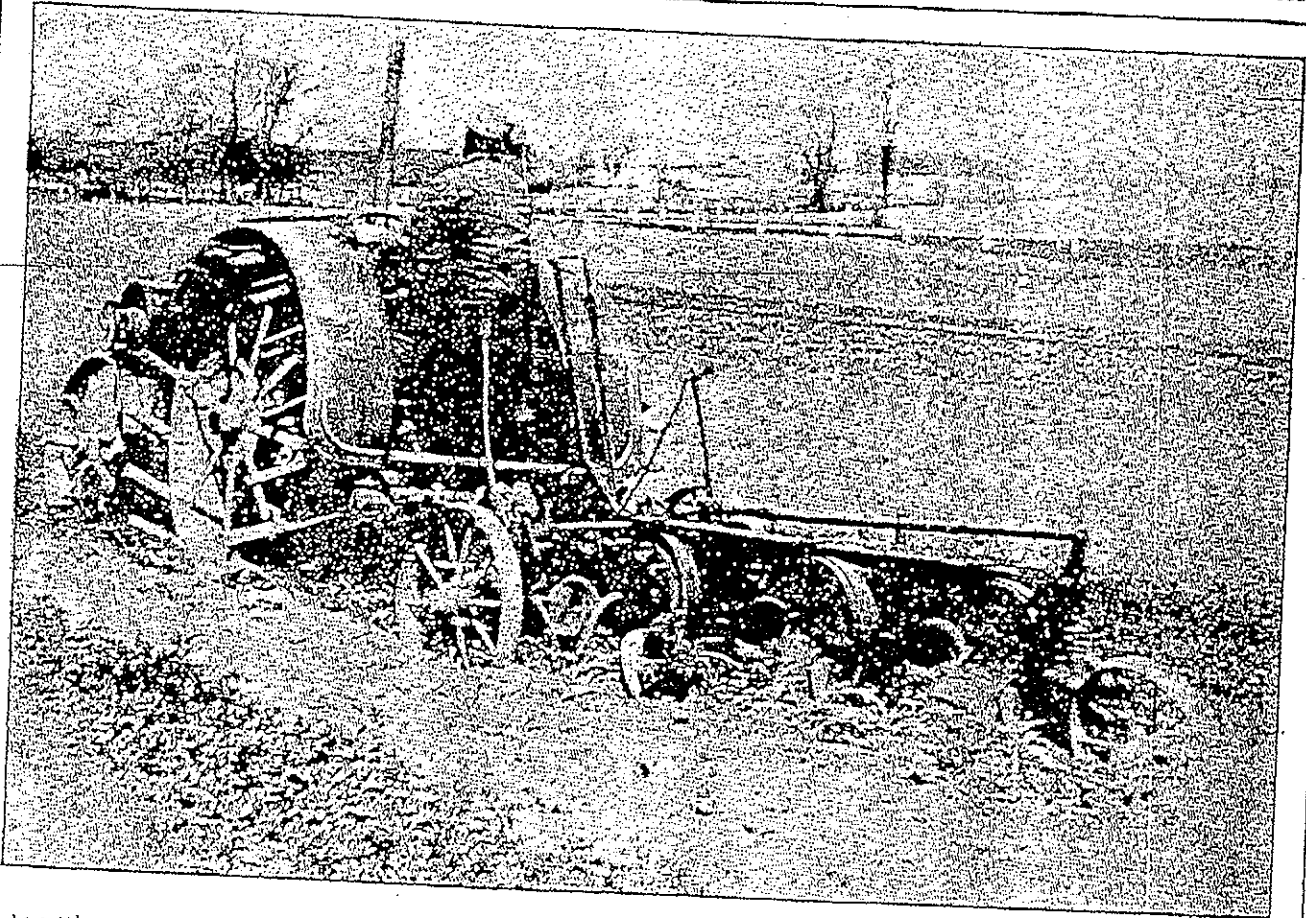
When Europeans began to settle in North America, farming practices were well established in their home countries, and they brought what they knew with them. Oxen and horses were used to plough and cultivate the land. There were several approaches to field management. One method was to grow wheat on the same field every year until it became exhausted. The field would then be left fallow until its fertility was regained. A second method was to rotate fields between crop and summer fallow. A third technique used was to plant clover or buckwheat in the fall, plow it under as a natural soil fertilizer in the spring, and finally plant and harvest wheat.

Because the emphasis was on self sufficiency, farms were mixed operations. Families grew a variety of crops including wheat, barley, rye, peas and flax. They also raised enough livestock for their use. The manure was used as a natural fertilizer for the soil.

When pioneers came to Ontario, they usually settled on a piece of property they had only ever seen on a government survey document. Essentially, they had to make the best of what they were given. But, sometimes the land was not suitable for growing crops for their family. Stone piles along some old wooden fences in Eastern Ontario are evidence today of what some early settlers did to make their land suitable for cultivation.



Ontario Ministry of Agriculture and Food



As settlement progressed in the 1800's, more and more forest was cleared regardless of slope or soil type. On the most fertile and flat land, there were no visibly adverse impacts on the soil. However, on steeper and poorer quality land, erosion began to take its toll. Some pioneers diversified from growing crops, and switched to agricultural operations that were more suited to the land. However, by the late 1800's, several areas had been abandoned. The removal of trees began to be seen as a nuisance to some farmers because it caused wind erosion, and heightened the impact of drought on crop growth.

Fortunately, some good came out of the soil degradation events of the late 1800's. As people began to recognize the changing state of the land, they became interested in reforestation. In 1871, the provincial government formulated the Tree Planting Act. By 1905, several nurseries were established to grow tree stock and there was a government assisted tree planting program underway for private citizens to rehabilitate their land.

Later in the 1920's, county and demonstration forests were planted on larger scales. Many of the white pine county forests seen in southern Ontario today are products of these early conservation efforts, most of which succeeded in stabilising an eroding soil base.

In the 1900's, new technologies brought change to agricultural land use and forestry practices. The introduction of mechanized equipment and tractors meant land could be cleared faster and fields tilled more intensely. By the mid-1930's, a combine could cut, thresh, clean and blow grain. Now it can store up to 100 bushels of grain and release it in two minutes. This technology has replaced the equivalent of 300 pioneer laborers.

Today, land use in Ontario has changed dramatically. In agriculture, the primary goal is to produce the highest yield per hectare for the greatest economic profit. The emphasis on mixed farming to provide for the family is gone. It has been replaced largely by specialized operations which sell

agricultural products to urban and world markets.

The common agricultural trends that have emerged in the past 30 years are row cropping, monoculture farming, intense tillage, and a dependency on chemical fertilizers and pesticides. These practices have led to the degradation of some agricultural soils in all parts of Ontario. The impacts of these practices are described in more detail in units 4, 5, and 6.

2.2

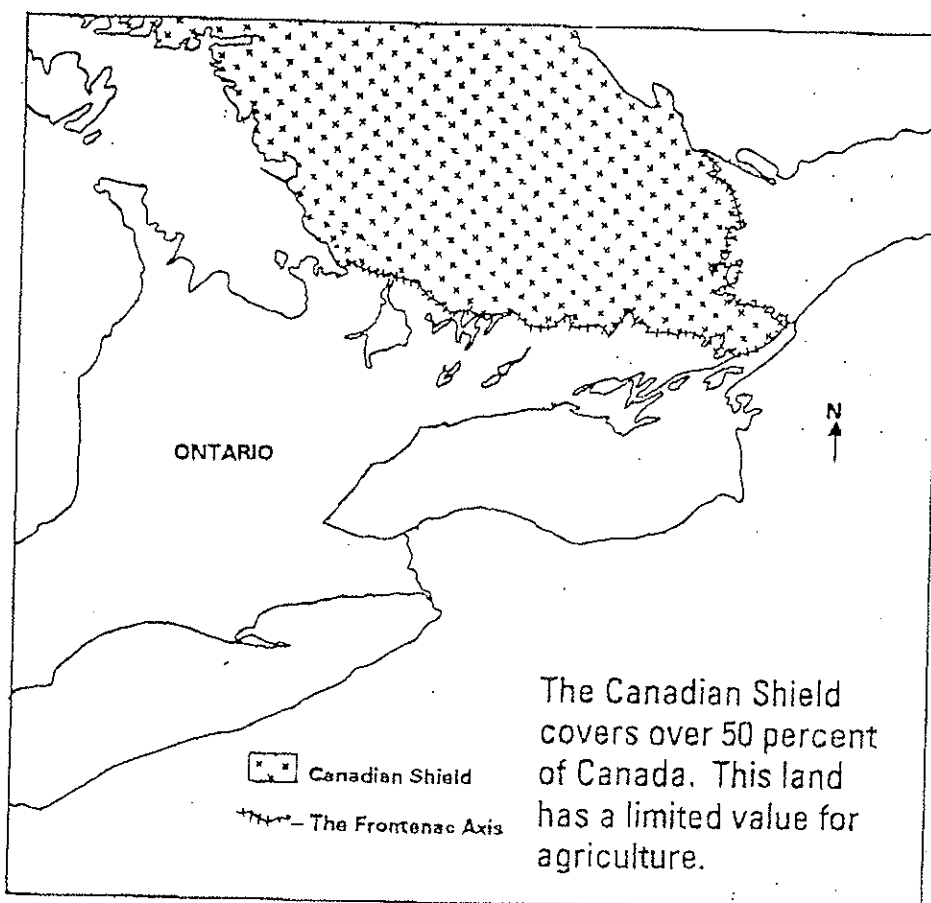
Soil and the Development of Ontario

CONCEPT

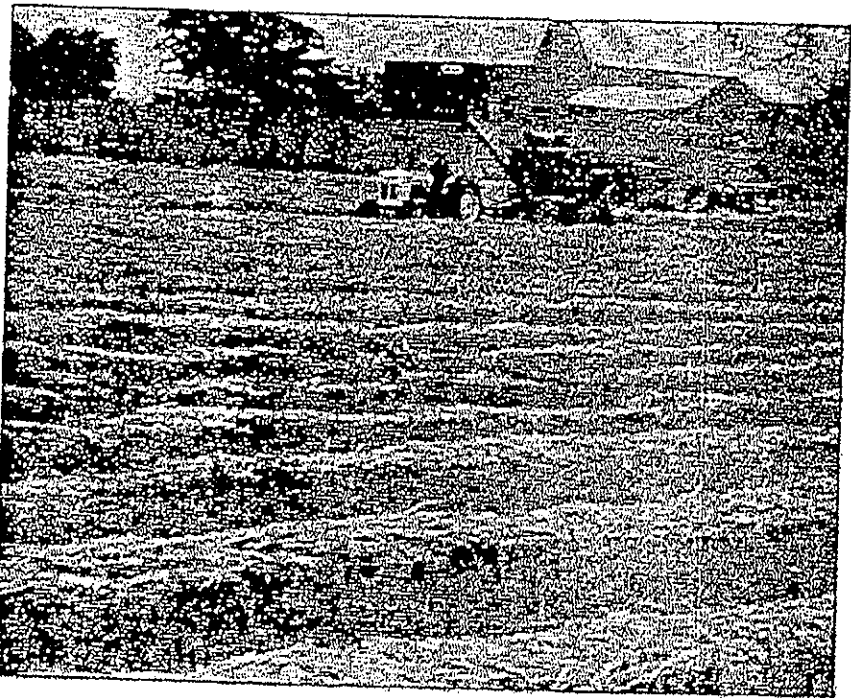
The natural distribution of soils in Ontario has influenced settlement patterns and economic development throughout the province's history.

KEY WORDS

Canadian shield, Frontenac axis, outcrop



The natural distribution of soil in Ontario has influenced settlement patterns and economic development throughout the province's history. When the glaciers retreated from Ontario over 10,000 years ago, they left two distinctive regions. The area south of an imaginary line between Kingston and Parry Sound - the Frontenac Axis - was left covered with deep glacial deposits of clay, sand and stone upon which fertile soils developed. North of the Frontenac Axis, the glaciers scraped away most loose material, leaving only a thin layer of small pockets of soil amid outcrops of igneous and metamorphic rock. This exposed rock, which characterizes most of northern Canada - is what we call the Canadian Shield.



FON Archives

Although farming was attempted in Northern Ontario, settlers found it to be possible in only a few districts (i.e. the clay belts around Cochrane, Thunder Bay, Rainy River and Dryden). Even then, these areas were limited because of shorter growing seasons. Most of the north was found to be more suited to lumbering.

Naturally, agriculture was more successful in the south because of the deeper and more fertile soils as well as the favourable climate. Dairying became established between Lake Simcoe and the Ottawa Valley. This region which lies on the southern edge of the Canadian Shield had very shallow soils, poorly drained pockets of land, and several bare rock outcrops. Although unsuitable for crop farming, it proved adequate grazing land for cattle.

Central and Western Ontario emerged as the areas for raising beef cattle. Corn for feed was easily grown in the soil and there was plenty of land available for grazing. South Western Ontario between Waterloo and Goderich, specialized in hog raising. Soils and climate permitted this area to grow more feed grains than in Eastern Ontario.

Also, Goderich was a shipping port for western grain, so feed was cheaper and more easily available in this area.

Today's economic activities reflect these early settlement patterns. Mining, tourism and forestry support most of Northern Ontario's population. Small communities plus a few larger administrative centres (e.g. Thunder Bay and Sudbury) supply the labour force and urban services needed to support these industries. The roads, railroad and Great Lake Waterway system provide the transportation network to link northern resource industries to Southern Ontario and other parts of Canada.

Population has continued to concentrate in Southern Ontario where food supply is more accessible. Although technological advances and expanding urban populations have forced out many small farming operations, the general pattern described above still exists. Dairy farming, for example, still predominates in Eastern Ontario. A drive through this region reveals a delightful number of independent cheese and ice cream factories!

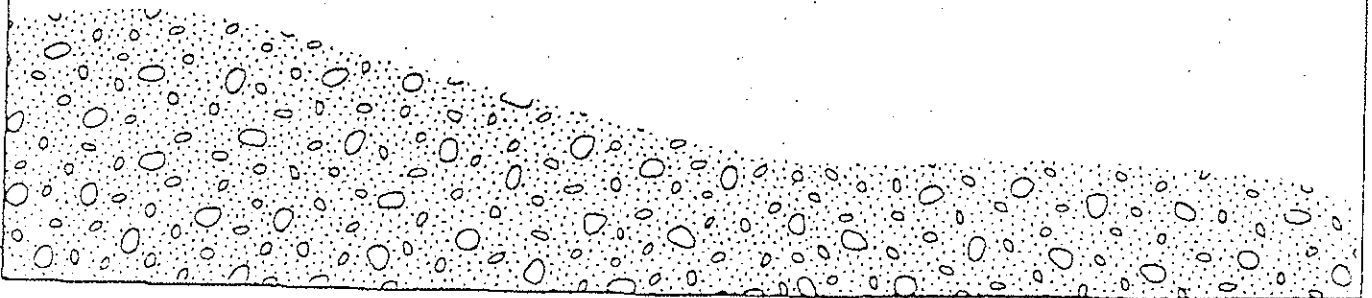
A number of specialized agricultural areas have also developed in the province. A major wetland area - the Holland Marsh - has been drained and developed as a key vegetable producing area for the Toronto market. Other marsh areas such as Pelee, Thedford and Erieau have been developed in similar ways.

The Niagara Fruit Belt has become a major grape and tender fruit (peaches, plums, apricots) producing area. The south-western tip of Georgian Bay, and the shores of Lakes Erie and Ontario are important apple growing areas. These regions have rich, well-drained soils for growing fruits, as well as favourable climates.

Note: The drainage of wetland areas for agricultural production is a major cause of wetland loss in Ontario. Wetlands are valuable for wildlife habitat, as water storage and recharge areas, for water purification, recreational enjoyment, and for their pure aesthetics. The Federation of Ontario Naturalists has produced various educational materials related to wetland conservation. (see Teacher's Guide)

The sandy soils of Simcoe County have been developed for growing tobacco, although changing market factors have forced some tobacco farmers out of business or into different agricultural operations. Any farmer today will tell you that market conditions influence land use changes significantly.

The geological resources and glacial deposits in Southern Ontario have attracted a variety of other land uses. Limestone is extracted from the Niagara Escarpment to make cement. Gypsum is mined in Hagersville and Caledonia. Sand and gravel pits are evident everywhere, and salt is mined in Goderich and Windsor.



2.5

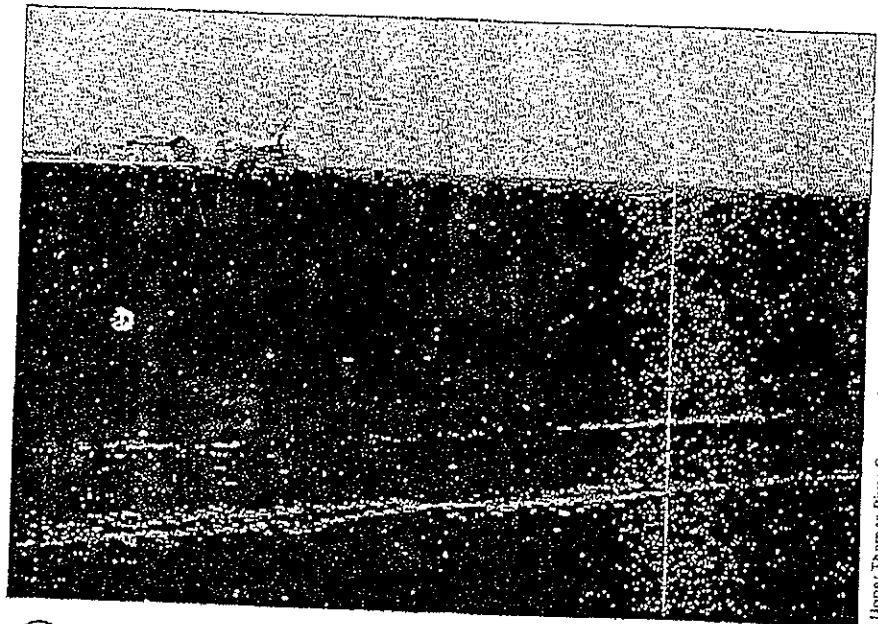
Land Classification

CONCEPT

In response to tremendous competition for land for different uses in the 1960's, the federal and provincial government classified land in Canada in terms of its suitability for agriculture, forestry, recreation and wildlife. This type of information would help solve land use conflicts, make sound decisions, and maintain the quality and productivity of the soil environment at the same time.

KEY WORDS

Canada Land Inventory (CLI), capability



Upper Thames River Conservation Authority

One of the ways that land use has changed in Ontario since the pioneers arrived in the province, can be summed up by the immense conflict to use land for a variety of activities. In Southern Ontario in particular, there is pressure to use land for urban growth, agriculture, industry, aggregate extraction, landfill, recreation, wildlife preservation, transportation and industry. The list goes on.

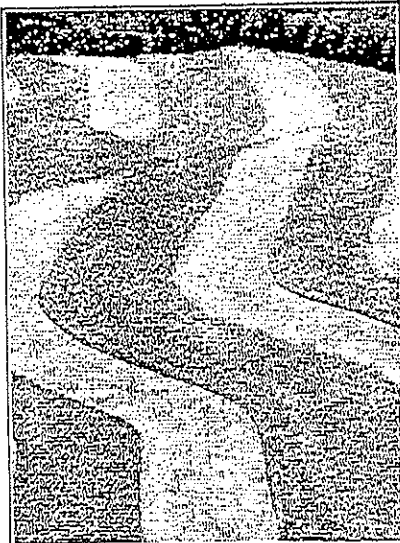
During the 1960's, the competition for land for alternative uses brought about by a growing population, and rapid urbanization resulted in widespread land use conflicts across Canada. It became clear that a classification system to evaluate the suitability of land for various uses was needed. Such a system would be used to help make difficult land use decisions. The result was a Federal and Provincial Government program called the Canada Land Inventory (CLI), carried out on over 2.5 million square kilometers of land.

The CLI consists of more than 15,000 published maps ranking the capability of Canadian lands for agriculture, forestry, recreation and wildlife.

While the series is a powerful land use planning tool, it is not without limitations. The maps are large scale (1:250,000) and, therefore cannot be used to identify small parcels of land. Also, the maps do not say what land should be used for, but only the kinds of activities it is capable of supporting. For example, the fact that an area of land is rated Class 1 for agriculture and Class 3 for forestry doesn't necessarily mean that it should be reserved for farming. Other factors such as present land use, location, or public demand also need to be taken into consideration.

The CLI classification systems for both agriculture and forestry are based primarily on soils. They are outlined in Tables 2.1 and 2.2.

Andy Graham



Agricultural Soil - A Threatened Resource

Less than 0.5 percent of Canada's land is rated Class 1 for agriculture. Half of this land is in Ontario.

Thirty seven percent of the prime agricultural land in Canada (Class 1) is within 160 km of the centre of Toronto, and on a clear day can be seen from the top of the CN Tower.

Urban growth is concentrated in southern Ontario where the soils and climate are most suitable for agriculture.

Table 2.1 CLI Land Classification for Agriculture

The land capability classification for agriculture uses soil and climatic data to provide information on the ability of land to support agriculture. Soils are grouped into 1 of 7 classes, depending on their degree of limitation for agriculture. Classes 1 to 3 are considered capable of the sustained production of common field crops.

Class 1

Soils in this class have no significant limitations for agricultural use. They are level, deep, well-drained, have good water-holding capacity, and a better than average reserve of plant nutrients.

Class 2

Soils of this class have moderate limitations that restrict the kinds of crops that can be grown. They are deep and have good water holding capacity, and most crops can be grown with little difficulty. The limitations of soils in this class may be for example, adverse climate, moderate erosion, poor soil structure, or low fertility. Class 2 soils may require moderate conservation practices.

Class 3

Soils of this class have moderately severe limitations that restrict the kinds of crops that can be grown. Limitations may include rough topography, shallowness, stoniness, poor drainage, frequent surface runoff, or low fertility which is correctable. Class 3 soils may require special soil conservation practices.

Class 4

Soils in this class have severe limitations that restrict the range of crops that can be grown. They are considered to be only marginal for agricultural production. Limitations are similar to but more severe to those of Class 3. Special conservation measures are required to support agriculture.

Class 5

Soils of this class have very severe limitations that make them unsuitable for the cultivation of field crops. Their limitations are similar to those of Classes 2-4, but more severe. Class 5 soils will produce perennial forage crops such as clover and alfalfa. With improvement, they may be made capable for use as permanent pasture.

Class 6

Class 6 soils are capable of producing only perennial forage crops like clover or alfalfa. They have such severe climatic or physical limitations, that the application of improvement practices is impractical.

Class 7

Soils of this class have no capability for agricultural production.

Table 2.2 CLI Classification for Forestry

The land classification system for forestry uses soil and climatic data to rank land according to its ability to grow commercial timber. Soils are grouped into one of seven classes, depending on the degree of limitation present.

Classifications are also based on the capacity of one or more indicator species adapted to the region to produce timber in commercial quantities. An indicator species is a tree that is typical of the physiographic region.

Class 1

Lands in this class have no significant limitation to the growth of commercial forest. Soils are deep, of medium texture, well drained, with good water-holding capacity, and are naturally high in fertility. They are not subject to extremes of temperature or evapo-transpiration.

Class 2

Lands in this class have slight limitations to the growth of commercial forests. Soils are deep, of medium to fine texture, and have good water-holding capacity. The most common limitations are restricted rooting depth, adverse climate, soil moisture deficiency, and/or slightly low fertility.

Class 3

Lands in this class have moderate limitations to the growth of commercial forests. Soils may be shallow, imperfectly drained, slightly low in fertility, or suffer from periodic moisture imbalances. The most common limitations are adverse climate, restricted rooting depth, deficiency or excess of soil moisture, low fertility, exposure (in maritime areas), and/or occasional flooding.

Class 4

Lands in this class have moderately severe limitations to the growth of commercial forests. Soils may be moderately shallow, with poor drainage and water-holding capacity, and low natural fertility. The most common limitations are adverse climate, deficiency or excess of soil moisture, restricted rooting depth, poor structure, exposure, and/or low fertility.

Class 5

Lands in this class have severe limitations to the growth of commercial forests. Soils are often shallow, stony, poorly drained, and have poor water-holding capacity and low fertility. Limitations are similar to those of Classes 3 and 4, but are more severe.

Class 6

Lands in this class have very severe limitations to the growth of commercial forests. Soils are frequently shallow, stony, excessively drained, or poorly drained, and low in fertility.

Class 7

Lands in this class have severe limitations which preclude the growth of commercial forests. Most soils are extremely shallow, subject to regular flooding, or contain toxic levels of soluble salts. Most of this land consists of poorly drained organic soils.



REFERENCES

- Bekele, M. et al. *FAO Studies in Food and Population*. Rome: Food and Agriculture Organization of the United Nations, 1976.
- Blaikie, P.M. *Land Degradation and Society*. New York: Methuen, 1987.
- Clark, B.W. and Wallace, J.K. *Canada: Land of Diversity*. Scarborough, Ontario: Prentice-Hall Canada, Inc., 1983.
- Chou, M. and Harmen, D.P. Junior, Edit. *Critical Food Issues of the 80's*. New York: Pergamon Press, 1979.
- Coons, C.F. *Reforestation and Private Lands in Ontario*. Toronto: Ont Ministry of Natural Resources, February, 1981.
- Evans L.J. et al. *Soil Science: A Study Guide and Laboratory Exercise Manual*. Fourth Edition. Guelph, Ontario: University of Guelph, 1983.
- Food and Agriculture Organization of the United States. *Food and Population*. Rome: 1976.
- Foth, H.D., and Schaffer, W. *Soil Geography and Land Use*. New York: John Wiley and Sons, Inc., 1980.
- "Getting From Here to There" in *Highlights*. Vol. 11, No. 2, June, 1988. Guelph, Ontario, Ontario Ministry of Agriculture and Food.
- Hannell, C. and Harshman, R. *Across Canada: Resources and Regions*. Toronto: John Wiley & Sons, 1980.
- Harris, R.C. and Warkentin, J. *Canada Before Confederation*. New York: Oxford University Press, 1974.
- Heiser, Charles B. Jr. *Seed to Civilization: The Story of Food*. 2nd edition. San Francisco: W.H. Freeman, 1981.
- Helfman, E. *Our Fragile Earth*. New York: Willam Morrow Publishers, 1972.
- Henderson, J.S. and Ruel, J. *Canada Farm Economics*. Vol. 20, No. 2. Ottawa: Agriculture Canada, 1986.
- Kay, B.D. "Stewardship of Land and Water Resources: Choices & Challenge" in *Notes on Agriculture*. Vol. XXII, No. 1. University of Guelph, June, 1988.
- Kay, B.D. and Sheard, R.W. "Reversing the Trends: Cropping Systems to Improve Soil Structure" in *Highlights*. Vol. 11, No. 2. Guelph: Ontario Ministry of Agriculture and Food, June 1988.
- Lambert, R.S. and Pross, P. *Renewing Nature's Wealth*. Ottawa: Department of Lands and Forests, 1967.
- Lands Directorate. *Agricultural Land Use Change in Canada: Processes and Consequences*. Ottawa: Environment Canada, 1982.

- Lawrence, James, edit. *The Harrowsmith Sourcebook*. Camden East, Ontario: Camden House Publishing Ltd., 1979.
- Mather, A.S. *Land Use*. New York: Longman Inc., 1986.
- Miller, M.H. et al. "Stewardship of Soil & Water Resources In the Food production System" in *Notes on Agriculture*. Vol. XXII, No. 1. University of Guelph, June, 1988.
- Ontario Ministry of Agriculture and Food. *How to Rate Farm Soils*. 4H Paper 4-H-532-77.
- Reaman, George Elmore. *A History of Agriculture in Ontario*. Volume 1. Aylesbury, England: Hazell, Watson and Viney Ltd., 1970.
- Richardson, A.H. *Conservation By the People: The History of the Conservation Movement in Ontario to 1970*. Toronto: University of Toronto Press, 1974.
- Schut, L.W. *Soil Capability Classification For Agriculture (CLI) Fact Sheet*. OMAF Agdex No. 524. For: OMAF, March, 1985.
- Select Committee on Conservation, *Report of the Select Committee on Conservation*. Toronto: March, 1950.
- Southwick, Charles H. *Ecology and the Quality of our Environment*. New York: D. Van Nostrand Co., 1972.
- The Canadian Oxford School Atlas Fourth Edition*. Don Mills, Ontario: Oxford University Press Canada, 1977.
- Warkentin, John, edit. *Canada: A Geographical Interpretation*. Toronto: Methuen, 1970.
- Zavitz, E.J. *Fifty Years of Reforestation in Ontario*. Toronto: Ontario Department of Lands and Forests, 1953.