



Where will your next meal come from?: Inquiries about food, people, and environment



Module Overview

This module includes three investigations dealing with agricultural systems and the environmental problems and opportunities related to these systems, including their capacities for sustaining human populations.

Investigation 1: Is there a future for subsistence agriculture?

Investigation 1 focuses on subsistence ways of life, which are based on ancient practices far removed from modern technology and urban industrial livelihood patterns. After looking briefly at three main types of subsistence agriculture, students investigate *intensive* subsistence agriculture, specifically Asian rice production, and they interpret satellite images for clues about challenges to the future of this type of agriculture. Students debate the proposition that subsistence agriculture will continue to play a significant role in feeding the populations of the developing world. In contrast to subsistence agriculture, Investigation 2 deals with the industrial, commercial agriculture common in the developed countries in North America and Europe.

Investigation 2: What is industrial agriculture?

The focus is on the high-energy- and technology-using system of commercial agriculture in the developed, industrial world. Students investigate industrial agriculture as a system of inputs and outputs, compare it to subsistence agriculture, examine its effects on human and physical landscapes, and consider how changes in technology are transforming the way it operates. A debate or forum about industrial agriculture enables students to argue its advantages and disadvantages and discuss the ability of agriculture to support future populations without degrading the environment.

Investigation 3: Who will feed the world?

Building on their knowledge of agricultural systems gained from the first two investigations, students look critically at the capacities of these systems for sustaining human populations in a world where one of six people suffers from hunger. Students work in groups to investigate population growth and agricultural production in major world regions and consider how developments in technology and monitoring systems will contribute to feeding people in the future. The investigation concludes with an investment challenge in Mozambique. Students work in groups to make recommendations for improving agricultural production in this country.

Geography Standards

The World in Spatial Terms

- **Standard 1:** How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective

Places and Regions

- **Standard 5:** That people create regions to interpret Earth's complexity

Human Systems

- **Standard 9:** The characteristics, distribution, and migration of human populations on Earth's surface

Environment and Society

- **Standard 14:** How human actions modify the physical environment
- **Standard 15:** How physical systems affect human systems
- **Standard 16:** The changes that occur in the meaning, use, distribution, and importance of resources

The Uses of Geography

- **Standard 18:** How to apply geography to interpret the present and plan for the future

Science Standards

Unifying Concepts and Processes

- Change, constancy, and measurement

Science and Technology

- Abilities of technological designs
- Understandings about science and technology

Science in Personal and Social Perspectives

- Population growth
- Natural resources
- Environmental quality
- Science and technology in local, national, and global challenges

Connection to the Curriculum

Where will your next meal come from?: Inquiries about food, people, and environment is an instructional unit—about 3 weeks in length—that can be integrated, either in whole or in part, into high school courses in world geography, demography, nutrition, population geography, economics and economic geography, agricultural geography, regional geography, and global studies. The material supports instruction about economic development and population growth, as well as the dynamic interactions between physical and human environmental change at both local and regional scales of analysis. Connections to mathematics skills are easily made because the material requires students to work with a large amount of quantitative data in graphic and tabular form.

Time

Investigation 1: Five to six 45-minute sessions

Investigation 2: Four to eight 45-minute sessions

Investigation 3: Four to eight 45-minute sessions

Mathematics Standards

Data Analysis and Probability

- Formulate questions that can be addressed with data; and collect, organize, and display relevant data to answer them

Measurement

- Understand measurable attributes of objects and the units, systems, and processes of measurement

Algebra

- Analyze change in various contexts

Representation

- Use representations to model and interpret physical, social, and mathematical phenomena

Technological Literacy Standards

Nature of Technology

- **Standard 2:** Core concepts of technology

Technology and Society

- **Standard 4:** The cultural, social, economic, and political effects of technology
- **Standard 5:** The effects of technology on the environment
- **Standard 6:** The role of society in the development and use of technology

The Designed World

- **Standard 15:** Agricultural and related biotechnologies



Is there a future for subsistence agriculture?



Investigation Overview

This investigation focuses on subsistence ways of life, which are based on ancient practices far removed from modern technology and urban industrial livelihood patterns. After looking briefly at three main types of subsistence agriculture, students investigate *intensive* subsistence agriculture, specifically Asian rice production, and they interpret satellite images for clues about challenges to the future of this type of agriculture. Students debate the proposition that subsistence agriculture will continue to play a significant role in feeding the populations of the developing world. In contrast to subsistence agriculture, Investigation 2 deals with the industrial, commercial agriculture common to the developed countries in North America and Europe.

Time required (as follows):

Introduction and Part 1: Two 45-minute sessions

Parts 2 and 3: One or two 45-minute sessions

Parts 4 and 5: Two 45-minute sessions

Materials

Briefing (one copy per student)

Log (one copy per student)

Computer with CD-ROM. The Mission Geography CD contains color graphics and links to the World Wide Web.

Reference materials such as encyclopedias

World atlases

Optional: Access to the Internet for data gathering

Content Preview

It is usually impossible to correctly answer questions about the future, such as the question posed in the title of this investigation. Rather, this question is meant to raise awareness and to encourage speculation and skepticism about the future capacity of subsistence agriculture to feed the rapidly growing populations in the developing world. Several arguments could be made based on the content of this investigation, but the central conclusion is most likely to be close to this: because of environmental constraints, primarily shortages of land and water, subsistence farming will be less and less able to support, in the long run, the rapidly growing populations in poor countries. The task of feeding future populations will probably require *both* the cessation of rapid population growth *and* a surplus-producing, high technology-based, and environmentally sustainable agriculture, such as is discussed in Investigation 2 of this module.

Geography Standards

Standard 14: Environment and Society

How humans modify the physical environment

- Explain the global impacts of human changes in the physical environment.

Standard 15: Environment and Society

How physical systems affect human systems

- Analyze examples of changes in the physical environment that have reduced the capacity of the environment to support human activity.

Standard 16: Environment and Society

The changes that occur in the meaning, use, distribution, and importance of resources

- Analyze the relationships between the spatial distribution of settlement and resources.

Geography Skills

Skill Set 4: Analyzing Geographic Information

- Make inferences and draw conclusions from maps and other geographic representations.

Skill Set 5: Answering Geographic Questions

- Evaluate the answers to geographic questions.

Classroom Procedures

Beginning the Investigation

- Hand out copies of the **Briefing** to each student and have them read the **Background** and **Objectives**. Draw out discussion with such questions as:
 - What do you know about subsistence agriculture?
 - What most surprised you in the Background?
 - The title of the investigation raises the question of whether subsistence agriculture has a future. Why would this be argued?
 - Why do you think subsistence agriculture might continue to be important?
 - What is the estimated number of people supported by intensive subsistence farming in the world? (This is the first question on the **Log**, so it can be used to draw attention to the need to give answers on the Log throughout the investigation. The answers to the Log questions are found at the end of this Educator's Guide. Give students a schedule for completing the Log.)
- Form students into FAO (UN Food and Agriculture Organization) teams.
 - Teams work together to collect information from the Briefing and answer questions on the Log.
 - Debate the proposition that subsistence agriculture will continue to play a significant role in feeding the populations of the developing world in the future.
 - Assign groups for the debate: half in favor and half opposed to the proposition.
 - Emphasize the importance of working together to gain the expertise needed to debate at the end of the investigation.

Developing the Investigation

- For Question 1 in **Part 1: Where is subsistence agriculture found?**, students are asked to describe the three types of subsistence agriculture in the world by completing the table. They should use atlases and print and/or electronic sources of information (see **Additional Resources**).
 - Have each group complete the whole table.
 - Or, to save time, divide the work: each group does only one type and then shares with the other groups.
 - Use the answers to the Log in this Educator's Guide to direct students' understanding of the questions.
- Figure 1 in the **Log** is a world map of the distribution of these three main agricultural practices. To answer Question 1, students will need political maps or atlases to locate the countries where these practices are found.
- Parts 2, 3, and 4 of the **Briefing** provide basic information about intensive subsistence agriculture.
 - Students can work through these parts in groups, independently, or as a class.
 - In any case, ask and answer questions to keep students on task and moving through the materials.
 - These parts provide the information needed to answer Questions 2 and 3 on the Log.
- In order to answer Question 4, students should see that Figure 9 contains a time series of three infrared images of Beijing and its surroundings.
 - The caption explains that the light blue color is the infrared signature of concrete, which roughly corresponds to the urban area of Beijing.
 - The surrounding area in red primarily represents agricultural land.
 - The caption also notes that each image is 35 kilometers wide.
 - With this information, challenge students to measure the urban area of Beijing in each of the three years. The following procedure can be used:
 - On the screen or on a color printout, measure the area of the blue core in the middle of each image.
 - Make a linear *scale* for the images by using a sheet of paper along the width of one of the images; tick off the image width and call that 35 kilometers.
 - Make ticks at half the width, which is 17.5 kilometers, 1/4th is 8.75 kilometers, and 3/4ths is 26.25 kilometers.
 - Using this scale, measure the blue core in each image by treating it as a square. For example, the blue area in 1976 was roughly 8 x 8 kilometers or 64 square kilometers, for 1984 it was 9 x 9 or 81 square kilometers, and for 1991 it was roughly 18 x 18 or 324 square kilometers.
- To answer Question 5, encourage students to speculate about what they observe in Figure 10.
 - They might guess that the streams of white are clouds or smoke.

- Actually, it is smoke from land-clearing fires.
- Forests are being burned to clear the land for intensive agriculture.
- Explain to students that to feed ever-increasing populations, more cleared land is required for agriculture.
- This results in rapid deforestation in many developing areas that are experiencing strong population pressure.
- Deforestation can be a serious problem because the soils of many tropical rainforests have too few nutrients to support intensive agriculture. (Students may have prior knowledge of this fact.)
- But in areas where recent volcanic eruptions have enriched the soils with nutrients, such as in this part of Indonesia, the soils may be able to support intensive farming.
- A lot of deforestation in Indonesia is leading to intensive subsistence agriculture, made possible by soils derived from volcanic ash.

Concluding the Investigation

8. In preparation for the debate, have each group answer Question 6, either for or against the proposition.
9. Conduct a formal debate as a whole class, with groups assigned to opposing positions on the proposition:
Resolved: Subsistence agriculture will continue to play a significant role in feeding the populations of the developing world in the 21st century.

Note: Students will not be able to develop, using only the Briefing, all of the possible arguments in this issue, so it is important that you direct their discussion with the points found in the Key to the Investigation Log.

10. Instead of a formal debate, you may wish to have students individually or in groups write down three reasons to support a “yes” answer and three reasons for a “no” answer. Post their reasons on the board in two columns and use them to direct class discussion.

Evaluation

- Evaluate the Investigation Logs using the answers in this Educator's Guide.
- Ideas suggested for extension and enrichment may also be used for evaluation.

Additional Resources

Images and information on the Sahel in Africa
http://kidsat.jpl.nasa.gov/kidsat/photogallery/africa_sahel.GIF

Excellent information on deforestation
<http://earthobservatory.nasa.gov/Library/Deforestation/>

Information on related environmental issues studied by Earth Observing System
http://eospso.gsfc.nasa.gov/eos_edu.pack

Images of Santa Cruz, Bolivia, deforestation that are detailed enough for analysis in a laboratory setting
http://svs.gsfc.nasa.gov/imagewall/LandSat/santa_cruz.html

An on-line class on global land use issues, many of which are related to this investigation
<http://see.gsfc.nasa.gov/edu/SEES/global/class/>

A good resource for students to see and read about the circumstance of families is:

Peter Menzel. 1994. *Material World: A Global Family Portrait*. San Francisco: Sierra Club Books. This book also exists on a CD.

Good overviews of the concepts presented in this investigation can be found in:

Getis and Fellmann. 1995. *Human Geography. Landscapes of Human Activities*. Fourth Edition. Dubuque, Iowa: Wm. C. Brown.
 Rubenstein. 1994. *An Introduction to Human Geography*. New York: Macmillan.

Log

1. Characteristics of major types of subsistence agriculture

Characteristic	Pastoral Nomadism	Shifting Cultivation	Intensive Subsistence
3 countries representative of type	Namibia, Kenya, Mali, Niger, Saudi Arabia, Iraq, Iran, Russia, Chad, Mongolia, Afghanistan, and others	Brazil, Venezuela, Columbia, Nigeria, Tanzania, Chad, Senegal, Indonesia, and others	India, China, Vietnam, Cambodia, Bangladesh, Pakistan, Mexico, Peru, and others
Climate	Hot and cold dry climates (tundra, steppes, savannas, deserts)	Humid tropical (rain forests)	Warm to temperate humid climates or dry climates with irrigation
Percentage of world land area covered	20%	25%	10%
Population density (high, medium, or low)	Low	Low to medium	High
Percentage of world population supported	<1%	5%	50%
Output per unit area (High, medium, or low)	Low	Medium	High
Output per unit of human effort (high, medium, or low)	High	Medium	Low
Other	Reliance on herd animals (cattle, sheep, goats, reindeer, horses); people move with herds	Clear plots in forest for planting; when soil loses fertility in 2-3 years, shift to other plots	Small, permanent, irrigated, fertilized plots, produce rice and vegetables

2. On the timeline below, write in the annual activities of traditional wet rice double cropping in China.

	Jan	
	Feb	
Turn soil with wooden plow and water buffalo; rake smooth, fertilize, and water the plot; transplant seedlings into plot	Mar	
Weeding and watering	April	
Weeding, watering, and fertilizing	May	
Allow rice to draw starch; let water out to dry rice; harvest in late June or early July	June	
Separate rice from stalks, vegetable gardening	July	Vegetable gardening
	Aug	Turn soil with wooden plow and water buffalo; rake smooth, fertilize, and water the plot; transplant seedlings into plot
	Sept	Weeding and watering
	Oct	Weeding, watering, and fertilizing
	Nov	Allow rice to draw starch; let water out to dry rice; harvest in November or early December
	Dec	Separate rice from stalks

3. Identify six important features of intensive subsistence agriculture on your own as you read the Briefing:
 - *Growing a variety of crops helps reduce risks from crop failure, which can be caused by poor weather or pests.*
 - *Labor is divided among the rice fields and the vegetable garden.*
 - *Supports large, densely settled populations in regions of the world with large populations like India, China, and Southeast Asia.*
 - *Families must produce enough food for survival on very small parcels of land.*
 - *The same fields are planted year after year.*
 - *Livestock are generally not permitted to graze in any area that could be used for crops.*
 - *Little grain is used for animal feed, and cattle are limited by lack of grazing land.*
 - *Subsistence farmers grow rice in much of Southeast Asia, Southeast China, and East India.*
 - *Fish are cultivated in aquaculture ponds integrated with intensive agriculture.*
 - *In drier areas where irrigation can be provided, a variety of crops are grown, including wheat, barley, oats, corn, sorghum, millet, soybeans, cotton, hemp, and flax.*
 - *As the need for expanded production rises, many farmers terrace the hillsides of river valleys.*
 - *Where intensive agriculture expands into tropical rain forests, special problems of deforestation may occur.*
 - *Land for cultivation is lost to expanding urban areas.*
4. Using the information on Figure 9, provide a quantitative description of the changes over the 15-year period shown by the three images. How do these changes challenge subsistence agriculture? *Since each image extends 35 kilometers from left to right, students should be able to make a rough estimate of the changing size of the urban core of Beijing—the blue area in the center of each image.*
5. What do you think is shown in Figure 10, and how might this be related to intensive subsistence agriculture?
 - *They might guess that the streams of white are clouds or smoke.*
 - *Actually, it is smoke from land-clearing fires.*
 - *Forests are being burned to clear the land for intensive subsistence agriculture.*
 - *Explain to students that to feed ever-increasing populations, more cleared land is required for agriculture.*
 - *This results in rapid deforestation in many developing areas that are experiencing strong population pressure.*
 - *This can be a serious problem because the soils of many tropical rain forests are too poor in nutrients to support intensive agriculture. (Students may have prior knowledge of this fact.)*
 - *But in areas where recent volcanic eruptions have enriched the soils with nutrients, such as in this part of Indonesia, the soils can support intensive farming.*
 - *A lot of deforestation in Indonesia is leading to intensive subsistence agriculture, made possible by soils derived from volcanic ash.*
6. List arguments, *either for or against* the proposition that subsistence agriculture will continue to play a significant role in feeding the populations of the developing world in the 21st century.

Arguments that support the proposition might include:

- If, by *significant role*, we mean millions of people, subsistence agriculture will continue to feed a significant number of people, although admittedly an increasingly large proportion of populations will depend on commercial, surplus-producing agriculture.
- Entire ways of life—traditional livelihood patterns such as Asian subsistence rice culture—will not quickly disappear; cultural and economic changes do not occur easily.

Arguments against the proposition *might* include the following:

- Populations in the developing world are increasingly dependent on the food surpluses produced by the developed world.
- Urban expansion will cause a loss of suitable farm land.
- Soil fertility will become depleted by deforestation on poor agricultural soils.

In 1976, Beijing occupied about 60 square kilometers; in 1984, about 80 square kilometers; and in 1991, about 300 square kilometers. These are rough estimates and students should not be held to exact figures, but they should be able to explain that urban growth of Beijing has severely eliminated many square kilometers of farmland. By extension, you should explain that Beijing is only one example. Cropland is being lost to urban expansion in many of the world's regions.

- Limitations will be caused by shortages of water for irrigation—agriculture will face increasing competition for water from urban, industrial, and other uses.
- Because populations are moving out of agriculture and into urban industrial modes of life, there will be too few subsistence farmers to feed ever-increasing populations.
- Of the total world population, the proportions of urban populations are increasing, and rural (agricultural) populations are decreasing, meaning that the role of subsistence agriculture in feeding populations must decrease and the role of commercial, surplus-producing agriculture must increase.



Module 2, Investigation 1: Briefing

Is there a future for subsistence agriculture?

Background

Will subsistence agriculture continue to feed the billions of people that currently depend upon it? Unlike the large-scale, surplus-producing, industrial farmers in the developed countries of North America and Europe, subsistence farmers produce only enough to feed themselves and their families. Subsistence agriculture, which is mainly found in the developing countries in Asia, Africa, and Latin America, feeds half of the world's population. More important is the fact that the population in the developing countries is increasing much faster than it is in the developed countries. Intensive subsistence rice farming supports nearly three billion people, mostly in Asia. (Much smaller numbers of people practice other forms of subsistence agriculture, such as shifting cultivation in humid tropical regions and nomadism in dry regions.) Subsistence ways of life, which are based on ancient practices far removed from modern technology and urban industrial livelihood patterns, are disappearing. This investigation will help you speculate about the role subsistence agriculture will play in feeding the populations of the developing world in the 21st century.

Objectives

In this investigation, you will

- describe and locate three major types of subsistence agriculture,
- develop expertise about Asian intensive subsistence agriculture,
- interpret NASA satellite imagery to identify challenges to the survival of intensive subsistence agriculture, and
- debate the future of intensive subsistence agriculture.

Part 1. Where is subsistence agriculture found?

Imagine that you are a geographer working for the United Nations Food and Agriculture Organization (FAO). You are a member of an FAO team assigned to investigate the role of intensive subsistence agriculture in the world. You will debate whether this type of agriculture will continue to support populations in the developing world in the 21st century.

Three main types of subsistence agriculture are

- a) pastoral nomadism,
- b) shifting cultivation, and
- c) intensive subsistence.

Describe these types by completing the table for Log Question 1. In addition to the information in this activity, you should use atlases and other print or electronic reference materials to complete the tables.

Your team should now use the remainder of this investigation to develop expertise about intensive subsistence agriculture.

Part 2. How is intensive subsistence agriculture practiced?

Intensive subsistence agriculture maximizes food production on relatively small fields that are carefully cultivated, fertilized, and irrigated. Intensive subsistence agriculture occupies less than 10 percent of the world's land area but supports about half of the world's population. Intensive subsistence agriculture dominates in regions with large, densely settled populations, such as India, China, and Southeast Asia (Figures 2 and 3).

Intensive subsistence agriculture can support large populations. Families must produce enough food to survive on very small parcels of land. To ensure as much food production as possible:

- no land is wasted,
- fertilizer (usually manure) is used,
- double cropping is common,
- the same fields are planted every year,
- livestock are usually not allowed to graze on land that could be used for crops, and
- little grain is planted for animal feed.

Rice is widely grown by subsistence farmers in much of Southeast Asia, Southeast China, and East India. Rice production involves several steps. Farmers use water buffalo or oxen to plow the field, or paddy. The paddy is then flooded (Figure 2). Dry seeds are then scattered through the field, or seedlings are transplanted from a nursery (Figure 3). The plants grow submerged in water for about three-fourths of the warm, wet growing season, and harvesting is done by



Module 2, Investigation 1: Briefing

Is there a future for subsistence agriculture?

hand. This wet rice cultivation must be done on flat land (like river valleys and delta regions). As the need for expanded production rises, many farmers terrace the hillsides of river valleys to produce more flat land.

Wet rice cultivation requires a constant supply of water through irrigation and drainage. Figure 4 is a Space Shuttle image of Bangkok, Thailand, showing the network of canals used for irrigation for agriculture and domestic water consumption.



Figure 2: Chinese rice farmer using a hand-operated pump to draw water from a canal

Source: <http://www.fao.org/NEWS/FOTOFIL/Ph9716-e.htm>, FAO photo by F. Botts



Figure 3: Indian women farmers transplanting rice

Although women produce more than half the food grown globally, in many countries their nutritional needs are met only after men and children have had enough.

Source: <http://www.fao.org/NEWS/FOTOFIL/PH9737-e.htm>, FAO photo by G. Bizzari



Figure 4: Space Shuttle photography of Bangkok, Thailand

In an infrared photograph, the vegetation appears reddish in hue. In this west-looking view, the city of almost four million people has a vast network of canals that are used for irrigation and drainage.

Source: <http://images.jsc.nasa.gov/images/pao/STS45/10064754.htm>



Module 2, Investigation 1: Briefing

Is there a future for subsistence agriculture?

Part 3: How is wet rice traditionally cultivated in China?

Farmers in some of the more remote parts of China (such as Hunan, Jiangxi, Anhui, inland parts of Fujian and Zhejiang, inland/mountain parts of Guangdong, Guangxi, Guizhou, and some areas of Sichuan) still practice traditional wet rice farming. They plant two crops of rice a year (double-cropping) where it is warm and wet. In the double-cropping cycle, farmers

- turn the soil with an iron-tipped wooden plow pulled by a water buffalo early in March and August;
- rake the plowed soil smooth, fertilize, and water the plot (they must keep the water in the rice field at the proper level as the plants grow);
- transplant rice seedlings from seedbeds into the prepared plot from the middle of March and August (the entire family works in the field taking seedlings by the bunch and pushing them into the soft, water-covered soil, as shown in Figure 3);
- weed the crop in April and September (weeding is done by hand, and everyone old enough for such work participates);

- weed and fertilize again in May and October;
- allow the rice to stand to “draw starch” to fill the hull of the kernels (they let water out of the fields when the kernels draw enough starch, and both soil and stalks dry under the Sun); and
- harvest in late June or early July and in November; they cut off rice plants a few inches above the ground with a sickle; then they separate the rice from the other parts of the crop (Figure 5), which are used for fuel.

When harvest work is done, farmers begin plowing for the next crop. They use the slack season of the rice crop for vegetable gardening. In the hot and damp period of late spring and summer, they grow eggplant and several varieties of squash and beans. After harvesting a crop of vegetables, they turn the soil and break up the clods with a digging hoe, and level it with an iron rake to prepare for a new crop. They weed vegetables constantly, water with the long handled wooden dipper two or three times a day, and fertilize often (Yang 1959).

[Answer Question 2 on Log.](#)



Figure 5: Women winnowing rice in Myanmar

Source: <http://www.fao.org/NEWS/FOTOFIL/PH9722-e.htm>, FAO photo by G. Bizzarri



Module 2, Investigation 1: Briefing

Is there a future for subsistence agriculture?

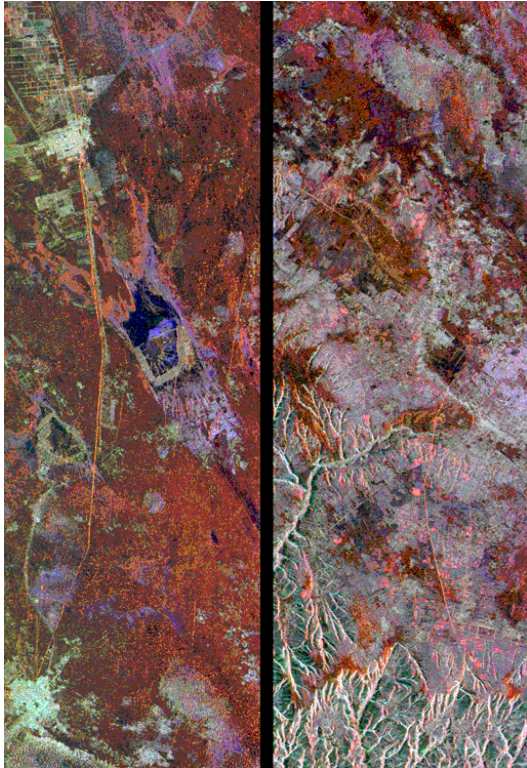


Figure 6: Intensive subsistence wheat agriculture around the Great Wall, north-central China

This radar image, taken on August 3, 1995, shows a segment of the Great Wall. Most of the image is taken up by rectangular patterns indicating agricultural development, primarily wheat fields. The Great Wall appears as a thin orange band, running from the top to the bottom of the left image. The wall is easily detected from space by radar because its steep, smooth sides provide a prominent surface for reflection of the radar beam.

Source: <http://www.jpl.nasa.gov/radar/sircxsar/gwall.html>



Figure 7: Mulberry fields and fish ponds in Jiangsu province in eastern China

Source: <http://www.fao.org/NEWS/FOTOFIL/PH9811-e.htm>,
FAO photo by H. Zhang

Part 4. What are other types of intensive subsistence agriculture?

In addition to wet rice cultivation, intensive subsistence agriculture also occurs in drier areas where irrigation is available to provide water for crops during dry seasons. The land is still fully planted with a variety of grains and other crops. These include wheat, barley, oats, corn, sorghum, millet, soybeans, cotton, hemp, and flax. For example, intensive subsistence wheat agriculture is found around the Great Wall of China in a desert region of north-central China, about 700 kilometers west of Beijing (Figure 6).

In many wet areas, aquaculture, or fish farming, is practiced, usually integrated with agriculture (Figures 7 and 8). Fish provide an important source of protein. In a world of land and water scarcity, fish ponds have an advantage over feedlots in producing low-cost animal protein. In contrast to meat production, which is concentrated in industrial countries, some 85 percent of fish



Figure 8: Indian workers harvest carp raised in an inland aquaculture pond

Source: <http://www.fao.org/NEWS/FOTOFIL/ph9711-e.htm>,
FAO photo by I. de Borhegyi



Module 2, Investigation 1: Briefing

Is there a future for subsistence agriculture?

farming is in developing countries. China, where fish farming began more than 3,000 years ago, accounted for 21 million tons of the 31 million tons of world aquaculture output in 1998. India was a distant second with 2 million tons. Other developing countries with large aquaculture production include Bangladesh, Indonesia, and Thailand (Brown 2000).

Complete Question 3 on the Log.

Part 5. What are the challenges to intensive subsistence agriculture in the 21st century?

This investigation began by posing the question of whether intensive subsistence agriculture will continue in the 21st century. The answer to this question may depend upon current and future challenges to this form of agriculture. Examine Figure 9 for clues to one important challenge to subsistence agriculture, and write your observations on the Log at Question 4.

To consider another challenge to intensive subsistence agriculture, study the image in Figure 10, which shows an area in the southern part of Borneo, in Indonesia, and record your observations in the Log at Question 5.

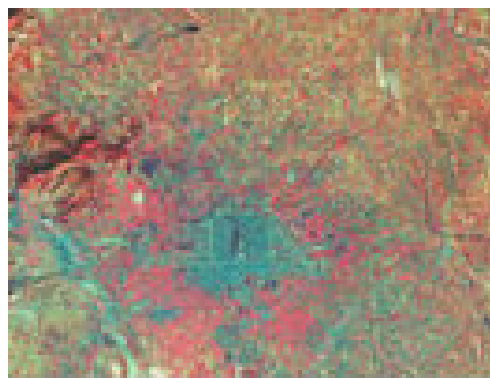
Figure 9: Urban expansion of Beijing, China, over 15 years, as seen by the growth of the area in light blue color, which is the signature of concrete in the infrared image

Source: http://see.gsfc.nasa.gov/edu/SEES/global/class/Chap_8/8_Js/8-03.jpg

Beijing, China, LANDSAT scene 123/32

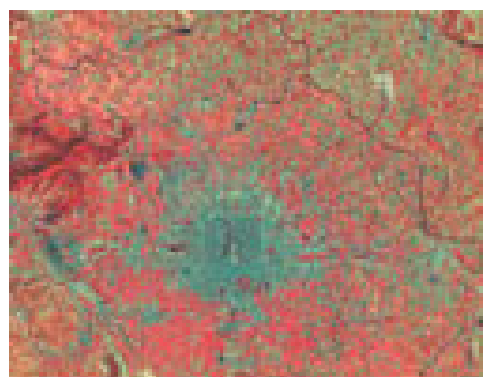
Data extract is 35 kilometers wide

26 Oct 1976



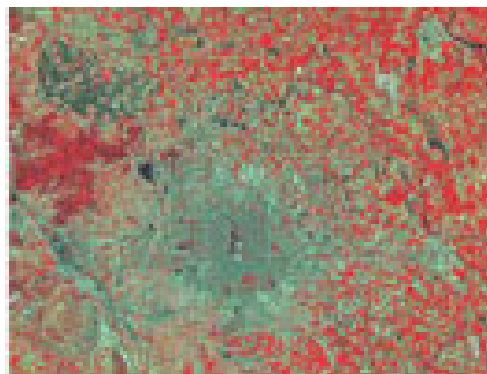
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16 May 1991



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Module 2, Investigation 1: Briefing

Is there a future for subsistence agriculture?

Now that you have completed a basic investigation of intensive subsistence agriculture, your team should:

- Brainstorm arguments *either for or against* the proposition that intensive subsistence agriculture will continue to play a significant role in feeding the populations of the developing world.
- List these arguments on your Log at Question 6.
- You can use these arguments in a debate on the proposition.

References

Brown, Lester R. 2000. Fish farming may soon overtake cattle ranching as a food source. *Worldwatch* Institute Alert 2000-9.

Conklin, H.C. Hanunoo agriculture, FAO Forestry Development Paper No. 12. In Getis, Getis, Fellmann. 1995. *Human geography. Landscapes of human activities*. Fourth Edition. Wm. C. Brown Publishers, Dubuque, Iowa, page 261.

Yang, C.K. *A Chinese village in early communist transition*. Cambridge, Massachusetts: Massachusetts Institute of Technology, 1959. In Getis, Getis, Fellmann. 1995. *Human geography. Landscapes of human activities*. Fourth Edition. Wm. C. Brown Publishers, Dubuque, Iowa, page 263.



Figure 10: Space Shuttle view of a portion of the Kalimantan region in southern Borneo, Indonesia, (3.5S, 113.5E) taken in September, 1991

Source: <http://images.jsc.nasa.gov/images/pao/STS48/10065058.htm>



Module 2, Investigation 1: Log

Is there a future for subsistence agriculture?

1. Use individual or group research to complete the table below.

Characteristic	Pastoral Nomadism	Shifting Cultivation	Intensive Subsistence
3 countries representative of type	1) 2) 3)	1) 2) 3)	1) 2) 3)
Climate			
Percentage of world land area covered			
Population density (high, medium, or low)			
Percentage of world population supported			
Output per unit area (high, medium, or low)			
Output per unit of human effort (high, medium, or low)			
Other			



Module 2, Investigation 1: Log

Is there a future for subsistence agriculture?

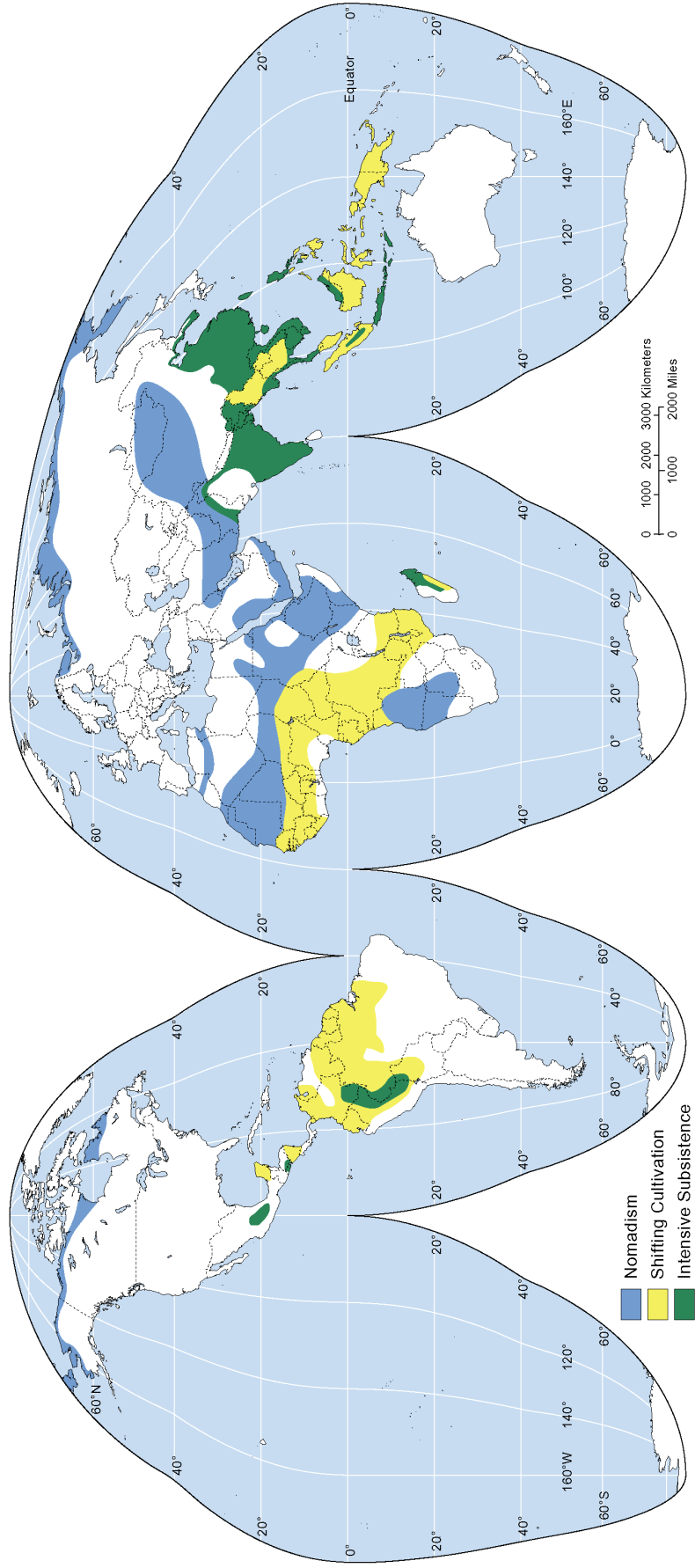


Figure 1: World agricultural practices map



Module 2, Investigation 1: Log

Is there a future for subsistence agriculture?

2. On the timeline below, write in the annual activities of traditional wet rice double-cropping in China. Write the steps for crop #1 on the left and for crop #2 on the right.

	January	
	February	
	March	
	April	
	May	
	June	
	July	
	August	
	September	
	October	
	November	
	December	

3. Identify six important features of intensive subsistence agriculture on your own as you read the Briefing.

- 1) _____
- 2) _____
- 3) _____
- 4) _____
- 5) _____
- 6) _____



Module 2, Investigation 1: Log

Is there a future for subsistence agriculture?

4. Using the information on Figure 9, provide a *quantitative* description of the changes over the 15-year period shown by the three images. How do these changes challenge subsistence agriculture?

5. What do you think is shown in Figure 10, and how might this be related to intensive subsistence agriculture?

6. List three arguments, *either for* or *against* the proposition that subsistence agriculture will continue to play a significant role in feeding the populations of the developing world in the 21st century.
